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LRM Typical Markets:
• Military & Commercial Avionics
• Military Vehicles
• Missiles/Ordnance
• Missile Defense

• C4ISR
• Space (Satellites)
• Radar
Amphenol® Line Replaceable Module (LRM) High Performance Board Level Interconnects

**INTRODUCTION - LRM STYLES & DESIGN FLEXIBILITY**

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.

**MODULAR AVIONICS ARCHITECTURAL POSSIBILITIES**

With its flexibility in design, Amphenol LRM interconnects are capable of meeting the wide variety of user requirements for a board mount connector.

- Thousands of combinations of inserts are possible - tailored to meet user needs
- LRM interconnects can be designed in 1, 2, 3 (and more) bay configurations with many shell designs available
- LRM digital (brush) inserts can be combined with inserts for power, fiber optics, RF, high speed and high amperage RADSOK® contacts

**Staggered Grid LRM**

High contact density in SEM-E and custom form factors

**GEN-X Grid LRM**

Higher contact density and improved electrical performance

**High Speed LRM**

Inserts with 3.125 Gb/s and 6.25 Gb/s data rate capability, with flex termination. Can be added to existing LRM configurations.

**LRM INTERCONNECTS FEATURE AMPHENOL’S BRUSH CONTACT TECHNOLOGY**

- With its low mating force, stable electrical performance and extended service life, the B³ Brush contact is the standard contact for the LRM.
- Digital (Brush) inserts can be combined with each other or with inserts for power, RF, fiber optic and high speed contacts.

**NOTE:** This catalog section supersedes Amphenol's older individual catalog on LRM products, 12-037.
Amphenol® Line Replaceable Module (LRM) Interconnects

LRM PRODUCT EVOLUTION

Amphenol has been committed to keeping pace 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 later with the development of the line replaceable module (LRM), Amphenol has led the way in the avionics packaging industry for high quality rectangular products. This page and the following page give an overview of 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, /169, /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.
- Digital insert pattern grid: 6 rows, 0.075” spacing along rows, 0.075” between rows with 0.025” offset.

**LRM Connectors with Staggered Grid**
- Advanced design to provide higher contact density for high speed integrated circuitry in SEM-E and custom form factors.
- Digital insert pattern grid is in 8 rows: 0.100 inch spacing along the row with 0.050 inch between rows, rows offset 0.050 inch. Typical standard arrangements would have 80 or 108 or 152 or 180 digital brush contacts.
- Options include various shell designs options to accommodate a wide range of PC board/heat sink combinations
- Surface mount termination on module connectors, PCB or compliant termination on backplane connectors
- Amphenol ESD protection (in module connector) - 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: Impervious to fretting corrosion, Micro-arching
- ESD Protection

* See the Brush Contact Technology section, and the Low Mating Force MIL-DTL-55302 section of this catalog.

Amphenol LRM Evolution continues on next page.
Amphenol® Line Replaceable Module (LRM) Interconnects

LRM PRODUCT EVOLUTION, CONTINUED

Certainly not standing still, and continuing to expand product offering, Amphenol now provides LRMs with higher contact densities, special purpose configurations and high speed inserts.

LRM Connectors with GEN-X Grid
- Higher contact density and improved electrical performance
- All the features of staggered LRM, including ESD protection (module connector)
- 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 board packages up to 0.425 in. These accommodate standard B3 tails in staggered pattern, but with increased spacing in the center, to accommodate airflow through heatsinks

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; size 8 coax for DC-32 GHz
  - SMPM coax contacts*

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

LRM with High Amperage RADSOK® Contacts
- The RADSOK® contact technology enables high current flow with minimal voltage loss and low insertion force

Board Level Interconnects of 2010 and Beyond -
More and more the customer has demanded a high level of flexibility, with designs that incorporate higher speeds and special features going beyond the standard LRM.
Configurations such as:
- High speed GigaStak® LRM connectors - capable of data rates up to 6.25 Gb/s, and DigiStak® LRM connectors capable of data rates up to 3.125 Gb/s
- High speed shielded contacts - coax, triax, twinax, differential twinax, and quadax contacts available in inserts of the LRM
- Combinations of power contacts, standard brush, high power, differential pair brush, and fiber optic termini
- Incorporation of Flex Circuits for more versatility of PC board terminations
- Custom shells with multiple bay configurations, special keying components or special guide/ground pins
- Compliant pin contacts for press-fit termination to circuit boards.

Amphenol Backplane Capabilities
Amphenol backplanes incorporate a wide range of our interconnects.

* See Other Rectangular Interconnects Section, page 126 for more information on SMPM contacts.
Amphenol Leads in Board Level Product Technology

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
- M1A2 Tank
- F-117
- AH-64 APACHE
- ASRAAM
- EA18G
- EA6B
- MEADS
- G/ATOR
- EQ-36
- B52

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 photo top right shows the 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.

Engineers working at the signal integrity modeling and simulation software suite at Amphenol Aerospace Operations. (See page 28 for more information on Amphenol’s testing of Hi-Speed LRM connectors).

Above and below are production areas for LRM interconnects and heatsinks. Note the orange balls on the machines - these are used as a quick checking device for processes.

Close-up photo showing vertical machining of heatsink housings done at Amphenol.

* VME64x products are covered on page 43.
Amphenol Aerospace is highly integrated to design, manufacture, assemble and ship an extensive variety of line replaceable module and backplane connectors. We 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. For more information on heatsinks, see the Other Board Level and Rectangular Interconnects Section, pages 112 & 113.

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 Printed Circuits (APC)** 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 the rectangular interconnect products offered by AAO division. Go online at [www.amphenol-aerospace.com](http://www.amphenol-aerospace.com) to see the wide range of cylindrical and other interconnect products offered by AAO. And see the Other Rectangular Products section at the end of this catalog for other Amphenol divisions offerings of rectangular interconnects.

** For more information on backplane assemblies: page 117 and online at [www.amphenol-abs.com](http://www.amphenol-abs.com).

*** For more information on flex circuit products: page 121 and online at [www.amphenolapc.com](http://www.amphenolapc.com).
The following is the LRM Module Connector identification and naming convention. The illustration is a double bay module with a staggered grid pattern.
The following diagram shows an exploded view of an LRM staggered grid backplane connector in a two bay configuration.
STAGGERED GRID DESCRIPTION
The LRM standard staggered grid pattern employs surface mount leads on .025 inch centerlines (pitch). Insert patterns of digital brush contacts are in 80, 108, 152 and 180 contact counts. See typical arrangement drawings on pages 19 and 20.

STAGGERED AIRFLOW-THRU GRID DESCRIPTION
The staggered grid airflow-thru inserts were designed to accommodate wider board packaging and airflow-thru heatsinks. Insert patterns of digital brush contacts are same as the staggered grid pattern (80, 108, 152 and 180 contact counts). See typical arrangement drawings on page 21.
Staggered Grid LRM & Staggered Grid Airflow-thru

CONTACT PATTERNS/COMPARISON

Staggered Grid (Standard)

- Staggered Grid for Standard Board Packages
- Contact Amphenol Aerospace for more information at 800-678-0141 • www.amphenol-aerospace.com

Staggered Grid Airflow-Thru

- Staggered Grid Air-flow for Wider Board Packages

| Contact Amphenol Aerospace for more information at 800-678-0141 • www.amphenol-aerospace.com |
Staggered Grid LRM interconnects can be one, two or three bay configurations, and special additional bay arrangements. The typical arrangements shown here are depicted in one bay drawings. Amphenol’s design flexibility also allows for combinations of contact types. These arrangements represent the versatility that can be arrived at by arranging digital (brush) inserts with inserts for power, RF, fiber optic and high speed contacts in various combinations within a typical bay.

Consult Amphenol Aerospace for assistance in designing the LRM that best meets your specific application needs. See page 41 for an aid in selection and ordering.

**Example of a backplane connector in a 2 bay arrangement with inserts of staggered brush contacts and coax (size 12) contacts.**

- 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
TYPICAL ARRANGEMENTS

144 brush contacts plus 4 fiber optic termini

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

80 brush contacts plus 6 coax contacts

108 brush contacts plus an insert for 2 fiber optic MT ferrules*

6 cavities for fiber optic MT ferrules*

Example of a 3 bay module connector with an insert for MT fiber optic ferrules and inserts for brush LVDs and digital contacts.

Example of a 2 bay staggered grid module connector.

Example of a staggered grid module and backplane with 108 brush contacts and an insert for 7 size 20 crimp contacts for high voltage applications.

8 brush LVDS differential pairs plus an insert for 2 fiber optic MT ferrules*

16 LVD pairs

* MT ferrules are not supplied by Amphenol Aerospace. See page 28 for more information on LRMs with MT ferrules.

Contact Amphenol Aerospace for more information at 800-678-0141 • www.amphenol-aerospace.com
Staggered Grid Airflow-thru LRM

ARRANGEMENTS, CUSTOM SHELLS

The typical Airflow-thru arrangements are with brush contacts. The arrangements shown at left for staggered grid Airflow-thru are typical of what has been developed for customer requirements.

LRMs with airflow-thru inserts can be custom designed in combination with power contacts, such as the example below.

Amphenol designs and builds custom shell configurations such as the module face plate and its mating backplane connector.

This custom Airflow-thru module contains RADSOK® high amperage socket contacts in sizes 8 and 12.
See more description of RADSOK® contacts, page 124.

Underside of Backplane, showing size 8 & 12 RADSOK® contacts with compliant termination.

Closeup of insert with compliant pin termination power contacts.

Contact Amphenol Aerospace for more information at 800-678-0141 • www.amphenol-aerospace.com
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 41 for an aid in selection and ordering, and call Amphenol at 607-563-5011 for technical support.

An example of a typical Amphenol Module part number is: 10-507XXX-X( )

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>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.125 ±.005</td>
</tr>
<tr>
<td>2</td>
<td>.100 ±.005</td>
</tr>
<tr>
<td>3</td>
<td>.075 ±.005</td>
</tr>
<tr>
<td>4</td>
<td>.062 ±.005</td>
</tr>
</tbody>
</table>

( ) ...........Board Package Thickness Suffix for Modules

<table>
<thead>
<tr>
<th>Suffix</th>
<th>Description Standard Staggered</th>
<th>Description Airflow-thru Staggered*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Surface Mount / .090 – .130 Package</td>
<td>Surface Mount / .265 – .305 Package</td>
</tr>
<tr>
<td>2</td>
<td>Surface Mount / .130 – .190 Package</td>
<td>Surface Mount / .305 – .365 Package</td>
</tr>
<tr>
<td>3</td>
<td>Surface Mount / .190 – .250 Package</td>
<td>Surface Mount / .365 – .425 Package</td>
</tr>
<tr>
<td>4</td>
<td>Surface Mount / .060 – .100 Package</td>
<td>Surface Mount / .235 – .275 Package</td>
</tr>
<tr>
<td>5</td>
<td>Surface Mount / .100 – .160 Package</td>
<td>Surface Mount / .275 – .335 Package</td>
</tr>
</tbody>
</table>

* .175 is added for increased center spacing in the airflow-thru staggered style

An example of a typical Amphenol Backplane part number is: 10-507XXX-X( )

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

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

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

<table>
<thead>
<tr>
<th>Suffix</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.021 ±.002 Dia. PCB Tail</td>
</tr>
<tr>
<td>2</td>
<td>.016 ±.002 Dia. PCB Tail</td>
</tr>
<tr>
<td>5</td>
<td>Compliant</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Suffix</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.150 ±.020 (PCB)</td>
</tr>
<tr>
<td>2</td>
<td>.200 ±.020 (PCB)</td>
</tr>
<tr>
<td>3</td>
<td>.250 ±.020 (PCB)</td>
</tr>
<tr>
<td>4</td>
<td>.300 ±.020 (PCB)</td>
</tr>
<tr>
<td>5</td>
<td>.350 ±.020 (PCB)</td>
</tr>
<tr>
<td>6</td>
<td>.400 ±.020 (PCB)</td>
</tr>
<tr>
<td>7</td>
<td>.450 ±.020 (PCB)</td>
</tr>
<tr>
<td>8</td>
<td>.500 ±.020 (PCB)</td>
</tr>
<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>
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 minimum at 100V d.c.</td>
</tr>
<tr>
<td>Electrostatic Discharge Protection (module only)</td>
<td>± 25,000 minimum air and direct discharge (see pg. XX 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 pound 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

#### ENVIRONMENTAL PERFORMANCE

<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 B534 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 (Compliant termination)</td>
<td>Contact barrel: 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. Contact tail: beryllium copper per ASTM B-534 alloy 17510 HT; finish is gold per ASTM B-488 over nickel per AMS-QQ-N-290. Contact sleeve: 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>Contact body: brass similar to UNS C33500; finish is gold over nickel; termination end is 60/40 or 63/37 tin lead dip. Contact sleeve: 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 electrolytically nickel per SAE AMS 2404.</td>
</tr>
<tr>
<td>ESD shields</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>
Staggered Grid LRM vs GEN-X Grid

**GEN-X PROVIDES HIGHER CONTACT DENSITY**

### Staggered Grid Module Termination

#### Two Surface Mount Planes

1.  
2.  

### GEN-X Module Termination

#### Four Surface Mount Planes

- **HEATSINK**
- **MAIN RIGID PCB**
- **FLEX CIRCUITRY**
- **INTERFACE RIGID PCB**

**Staggered Grid Contact Density**

- GEN-X Contact Density

**Staggered Grid Contact Density**

**GEN-X Contact Density**

**Staggered Grid Module Termination**

**GEN-X Module Termination**
Staggered Grid LRM vs GEN-X Grid

**GEN-X PROVIDES HIGHER CONTACT DENSITY**

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 Grid LRM has 0.0375 tail to tail centerline spacing

GEN-X is Designed to Terminate to Rigid-Flex PCB Attachment
The LRM GEN-X pattern employs surface mount leads on a .0375 inch center line (module connector), yet provides higher contact density than the Staggered grid pattern. GEN-X provides all the same features as the staggered grid LRM:

- GEN-X digital (brush) inserts are available in 118 and 236 pin contact counts.
- Digital contacts can also be combined with inserts for fiber optics, RF, poser and high speed contacts.
- Various combinations of inserts can be provided in 1, 2 or 3 bay shell configurations.
- Typical insert arrangements shown here are depicted in one bay drawing.

Consult Amphenol Aerospace for assistance in designing the LRM that best meets your specific application needs. See page 41 for an aid in selection and ordering of LRM and LRU interconnects.

118 brush contacts

236 brush contacts

140 brush contacts plus an insert for 2 fiber optic MT ferrules*

212 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

* MT ferrules are not supplied by Amphenol Aerospace. See page 28 for more information on LRM's with MT ferrules.
LRM Interconnect Options

LRMS WITH FIBER OPTIC TERMINI

High speed fiber optic transmission is available within LRM connectors for use in advanced avionics systems. Optical performance of fiber optic termini within in LRM connectors are the same as termini used in circular connectors.*

Insertion losses range from .3dB to <1.5dB depending upon launch conditions, fiber NA, fiber size and the type of termination.

Inserts for MIL-T-29504/1, /2, /14 and /15 can be incorporated. Terminals for LRMs can be supplied - consult Amphenol Aerospace for ordering information. The termini are determined by insert and shell style of the connector.

LRM interconnects can have hybrid arrangements of fiber optics with Brush contacts, as well as other contact types.

Staggered Grid Patterns with MIL-T-29504 Fiber Optic Termini

(These drawings are also shown with other staggered grid patterns on pages 19 and 20).

Examples of LRM connectors with fiber optic multi-mode termini in combination with brush contacts.

GEN-X Patterns with MIL-T-29504 Fiber Optic Termini

(This drawing is also shown with other GEN-X patterns on page 20).

Examples of LRM connectors with fiber optic multi-mode termini in combination with brush contacts.

*For more information on Amphenol fiber optic circular connectors, see Amphenol Circular Interconnects Catalog 12-C3, Fiber Optic section.

Contact Amphenol Aerospace for more information at 800-678-0141 • www.amphenol-aerospace.com
LRM Interconnect Options

LRMS WITH INSERTS FOR MT FERRULE FIBER OPTICS

Through Amphenol’s LRM design flexibility, inserts are available to house high speed MT ferrules which can have 12 or 24 fiber lines per ferrule. MT ferrules are not supplied by Amphenol; they must be purchased separately.

Termini for rectangular LRM connectors are determined by insert and shell style of the connector.

Staggered Grid Patterns with MT Ferrule Fiber Optics

(These drawings are also shown with other staggered grid patterns on pages 19 and 20).

- Insert with cavities for 6 fiber optic MT ferrules
- Insert with 8 brush differential pairs plus an insert for 2 fiber optic MT ferrules
- Insert for 108 brush contacts plus an insert for 2 fiber optic MT ferrules

GEN-X Patterns with MT Ferrule Fiber Optics

(These drawings are also shown with other GEN-X patterns on page 26).

- 140 brush contacts plus an insert for 2 fiber optic MT ferrules

Amphenol can supply optical backplane assemblies; see more information in the Other Board Level and Rectangular Interconnects Section on page 117.

Example of an LRM module connector with MT fiber optic inserts in combination with inserts for brush LVDs and digital contacts.

LRM Module Insert Assembly with MT Termini

LRM Backplane Insert Assembly with MT Termini
LRM Interconnect Options

RF MODULES, LRMS WITH HIGH SPEED CONTACTS

LRM inserts have been designed to accommodate the following RF 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
- SMPM RF contacts*
- 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 19 and 20).

108 brush contacts plus an insert for 8 SMPM* style RF contacts

80 brush contacts plus an insert for 10 SMPM* style RF contacts

80 brush contacts plus an insert for 6 RF contacts

108 brush contacts plus inserts for 4 shielded contacts and 4 fiber optic termini

152 brush contacts plus an insert for 2 SMPM* style RF contacts

152 brush contacts plus an insert for 4 sz. 16 shielded 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 26).

212 brush contacts plus an insert for 2 sz. 16 shielded contacts

170 brush contacts plus an insert for 6 sz. 16 shielded contacts

Staggered Grid Patterns with LVDS Differential Pairs
(These drawings are also shown with other staggered grid patterns on page 20).

8 brush differential pairs plus an insert for 2 fiber optic MT ferrules

16 LVDS differential pairs

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

* See more information on SMPM RF contacts in Other Rectangular Interconnects Section, page 126. SMPM RF contacts can be supplied by Amphenol SV Microwave. Phone: 561-840-1800
Website: www.svmicrowave.com

Contact Amphenol Aerospace for more information at 800-678-0141 • www.amphenol-aerospace.com
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 19).

108 brush contacts plus 270 VDC power input

80 brush contacts plus 270 VDC power input

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.

See more interconnects that incorporate RADSOK® contacts in the Other Board Level and Rectangular Interconnects Section, pages 124 & 125. Also, for more information on Amphenol RADSOK® connectors, see the Amphenol Industrial Operations catalog SL-391 on-line at www.amphenol-industrial.com.
NEW LRMS PROVIDE HIGHER SPEED DATA TRANSFERNE

Hi-Speed LRM Connectors

**New/Featured Product**

Amphenol’s LRM connectors meet today’s need for high speed interconnects for harsh environments. Constantly evolving and striving to meet the needs of higher data transfer rates within a board level product, Amphenol has developed LRM’s to meet this challenge. These LRMs are designed, or can be configured, to achieve data rates up to 6.25 Gb/s and include all the features of our rugged and reliable staggered grid LRM series:

- Brush contact interface
- ESD protection (Level 2 flight line classification)
- Connector float
- Guide pins and polarization keys
- Metal shells
- Modular design (hybrid configuration available)
- Accepts wide range of board packages
- Accomodations for custom modular offsets

In addition, the new GigaStak™, GigaStak-LG™ and DigiStak™ Series incorporate Amphenol’s cStack™ solderless termination technology (see page 35 for details).

**Versatility**

Unique flex and cStack terminations accommodate a variety of mounting configurations and a wide range of board packages. Connectors can terminate in a variety of ways:

- “traditional” 2 board/heatsink package
- to one or both sides of a single board
- as an offset board package

DigiStak module connectors allow mating to existing configurations of backplane connectors (users can upgrade solder termination module connectors to the solderless cStack termination).

The Hi-Speed Family of LRM Connectors and associated data rates includes:

- Gigastak™ - 6.25 Gb/s
- Gigastak LG™ - 3.125 Gb/s
- DigiStak™ & DigiStak-X™ - 3.125 Gb/s
- Standard Staggered Grid - 1.25 Gb/s

**Example of a Hi-Speed Hybrid Connector**

- GigaStak LG™ Inserts
- DigiStak™ Inserts
- Insert for RF or Power contacts

Contact Amphenol Aerospace for more information at 800-678-0141 • www.amphenol-aerospace.com
Amphenol has taken the proven and highly reliable LRM Brush connector and incorporated the cStack™ termination technology - giving the user hi-speed signal options up to 6.25 Gb/s and a solderless termination to their CCA. Through strategic placement of signal and ground contacts, each insert arrangement is optimized for the perfect balance of impedance control and cross-talk mitigation for a given data rate.

**GigaStak Features:**
- Hi-Speed connector designed for both single ended and differential signals
- Supports data rates of 6.25 Gb/s
- High density providing 30 differential signals per linear inch
- Designed for 100 ohm differential impedance
- Optimized cross-talk

**GigaStak Patterns**
- 24 Differential Pair*
- 36 Differential Pair*
- 48 Differential Pair*
- 60 Differential Pair

* Consult Amphenol for availability.

Validation testing has been performed through both simulation (CST Microwave Studio) and actual testing of production connectors. Test reports, touchstone files and hardware are available for review.
Hi-Speed LRM

**GIGASTAK-LG™**

*New/Featured Product*

The GigaStak-LG™ inserts provide hi-speed data transference, utilizes cStack solderless termination, and can be combined with low speed signal contacts, as shown in the hybrid connector photo below.

**GigaStak LG Features:**
- Hi-Speed connector designed for differential signals
- Supports data rates of 3.125 Gb/s
- Current Design has 8 differential pairs
- Provides 11 differential signals per linear inch
- Designed for 100 ohm differential impedance
- Optimized cross-talk

**GigaStak LG Patterns**

- 23 Differential Pairs
- 8 Differential Pairs and 108 Digital Contacts

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**GigaStak-LG™ Inserts with 8 Hi-Speed Differential Pairs**

Combined GigaStak-LG and DigiStak Insert (see next page for DigiStak description)
**New/Featured Product**

**DigiStak™ Hi-Speed LRM Inserts**

The DigiStak™ connector provides the standard staggered grid LRM pattern in a hi-speed connector that utilizes cStack solderless termination.

**DigiStak Features:**
- Designed to improve data rates in existing staggered grid LRM inserts
- Supports data rates of 3.125 Gb/s
- Configurable for up to 20 differential pairs per linear inch
- Designed for 100 ohm differential impedance
- Optimized cross-talk

The DigiStak uses standard staggered grid insert pattern shown at right. (Pages 19 and 20 show the arrangements of staggered grid connectors which are also available in the DigiStak connector).

**DigiStak-X™ Hi-Speed LRM Inserts**

The DigiStak-X™ connector provides the GEN-X grid LRM pattern in a hi-speed connector that utilizes cStack solderless termination.

**DigiStak-X Features:**
- Designed to improve data rates in existing GEN-X LRM inserts
- Supports data rates of 3.125 Gb/s
- Configurable for up to 20 differential pairs per linear inch
- Designed for 100 ohm differential impedance
- Optimized cross-talk

The DigiStak-X uses GEN-X LRM grid pattern shown at right (Page 26 shows the arrangements of GEN-X grid connectors which are also available in the DigiStak-X connector).
cStack™ Termination
GigaStak™, GigaStak-LG™, DigiStak™ and DigiStak-X™ series incorporate Amphenol’s cStack™ termination which provides the following features and benefits:

- Flex circuit assemblies that provide high speed, impedance controlled performance with high signal integrity.
- Flex can be electrically and mechanically customized to fit system specifications.
- Allows solderless interconnection between flex and board, eliminating a principal reliability problem with traditional flex assemblies.
- Standard and customized hardware are available which allow fast, solderless interconnection with only screw attachment to boards. Hardware uses captive attachment screws, eliminating loose component pieces.

See more information on Flex Circuitry in the Other Rectangular Interconnects Section page 121 of this catalog.
Hi-Speed LRM (Line Replaceable Modules)

Options:
- Fire / Fiber Optic
- Staggered, GEN-X
- Hybrids - Fiber Optics / Hi-Speed / RF / Power
- Options / Accessories

High Density

- HDB3, HSB3
- Hi-Speed

Ruggedized

- Low Mating Force MIL-DTL-55302
- Docking Conn. / Accessories / Install.

Other

- Rectangular Interconnects

Amphenol’s Capabilities for Modeling and Testing Hi-Speed Contacts and Connectors

Signal Integrity
- Amphenol SI engineers apply their expertise at the system level and work hard-in-hand with design engineering

Modeling & Simulation
- Amphenol uses powerful modeling, simulation and analysis tools
- CST Microwave Studio
- Allows characterization of current designs
- Rapidly aids in development of new, high speed designs
- S-parameter and SPICE analysis

Test Capability
- System level (full thread) and “connector only”
- TDR with iConnect software
  - Capability for S-parameter to 15 GHz
  - Time domain/eye pattern to 10 Gb/s
- BERT to 6.5 Gb/s

Customer Support
- Amphenol SI engineers directly support customers on their specific applications providing S-parameter data and Touchstone files

Hi-Speed Simulation Software used at Amphenol Aerospace.

Test bench for LRM connectors. Computer screen shows a pass/fail mask test eye diagram.
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 APC (Amphenol Printed Circuits) 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. See page 121 in the Other Rectangular Products section for more information on Flex circuitry.

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 or flex circuits. These are called I/O (input-output) LRM modules and have staggered grid pattern.

Flex circuitry used to attach to PC boards - designed to fit specific board requirements
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 are not subjected to more than 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

ESD protection is standard on the Amphenol Ruggedized VME64x connectors (see page 43) and offers all the above features and benefits. There are many drop-in replacement ESD protected connectors for retrofitting existing programs which have a 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 Faraday 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.

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 KITS

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.

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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.

ATTENTION:

Probing brush contacts with anything other than a brush contact may damage or degrade the brush contact performance.
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.
**Aid in Selection and Ordering of LRM and LRU Interconnects from Amphenol**

A FORM THAT CAN BE COPIED AND FAXED TO 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: ________________________________

Function Requirements:
- 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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