Integrated Flex, Rigid Flex, and Rigid PCB Assemblies

IPC-6012/6013 Specializing in Class III, Types 1–4 · Design, Prototyping, and Production

OCTOBER 2019
Flex, Rigid Flex, and Rigid PCB assemblies with signature interconnect technology available only from Glenair

Turnkey connectorized flex, rigid flex, and rigid PCB assemblies incorporating Glenair's broad range of innovative small form-factor circular and rectangular PC-tail connector solutions. All terminations backpotted for compliance with conformal coating processes.

GLENAIR SIGNATURE PC-TAIL CONNECTOR TYPES AVAILABLE IN TURNKEY FLEX ASSEMBLIES

- Series MWD Micro-D and innovative pogo-pin AlphaLink
- Series 88 SuperFly
- Series 79 Micro-Crimp
- SuperSeal RJ45 and USB
- Series SW SuperFly
- Series 88 SuperFly
- Series 79 Micro-Crimp
- SuperSeal RJ45 and USB

CONVENIENT PACKAGING AND INTEGRATION

Flex circuit assemblies are ideal for space-constrained electronic packages and enclosures, or for interconnect systems that are required to flex in 3 axes during normal use. Flex circuitry offers complete freedom to design boards and wiring for even the most densely-packed electronic enclosures. In mission-critical applications, the ability to reduce or even eliminate discrete wiring and boards in favor of flex circuitry helps designers make the most efficient use of available space.
**SPECIFICATION STANDARDS**

The following tables describe, in brief, Glenair flex and rigid flex manufacturing formats and specifications. Glenair recommends commercial customers understand and adhere to IPC-6012/6013 specification standards which are fully supported by Glenair. Military customers may alternatively cite specifications MIL-PRF-31032.

* Information below is based on the most common materials and physical property requirements. Please consult the factory for alternatives.

### Flex Assemblies
- **Design Formats**: PADS / PADS PRO / Pro E / Creo / SolidWorks / Autodesk Inventor / CAM 350 / Altium / Valor / POLAR / XPedition
- **Manufacturing Formats**: DXF / Gerber / ODB++ / IPC 2581
- **Layer Count**: Max typ up to 8
- **Termination**: Thru hole • Reverse bare • Floating fingers / Sculpted circuits • ZIF Termination
- **Conductor Width/Space**: Lines: .003” • Spacing: .003” (dependent on copper weight)
- **Bend Radius (military)**: Single Metal Layer: 4-6X overall flex thickness • Double Metal Layers: 6-10X overall flex thickness
- **Materials / Tg**: Substrate: DuPont™ Kapton® polyimide flex adhesive and adhesiveless -60°C to 125°C Cover layer: DuPont™ Kapton® Steffner: FR4 or DuPont™ Kapton® (metal stiffeners available upon request)
- **Surface Finish**: ENIG • HASL • Immersion Tin and Silver • Soft and Hard Gold
- **Specs and Quality Management**: IPC-6013 Class I, II, III, types 1-3 • ISO 9001, AS 9100

### Rigid Flex Assemblies
- **Design Formats**: PADS / PADS PRO / Pro E / Creo / SolidWorks / Autodesk Inventor / CAM 350 / Altium / Valor / POLAR / XPedition
- **Manufacturing Formats**: DXF / Gerber / ODB++ • IPC 2581
- **Max Panel Thickness**: 27 +
- **Via Technology**: Blind, buried • Thru hole • Filled (conductive and non-conductive)
- **Conductor Width/Space**: Lines: .023” • Spacing: .003” (dependent on copper weight)
- **Materials / Tg**: Substrate: Nelco 4000, Rogers, Megtron, Polyimide, and more
- **Surface Finish**: ENIG • HASL • Immersion Tin and Silver • Soft and Hard Gold
- **Specs and Quality Management**: IPC-6013 Class I, II, III, types 1-4 • ISO 9001, AS 9100, J-STD-001 Space

**GROUND PLANE S AND SHIELDS**

Managing EMI emissions and signal line impedance are critical aspects of flex circuit design. Effective use of ground / shield planes, appropriate connector interfaces, and matched-impedance flex circuits delivers optimal high-speed signal integrity.

**STANDARD DESIGN OPTIONS FOR INTEGRATED (CONNECTORIZED) FLEX/RIGID FLEX ASSEMBLIES**

Properly designed flex and rigid flex assemblies offer significant space and weight savings compared to wire harnesses. Many design options are available, including integrated stiffeners, shielding, factory forming, selective bonding, termination, layer count and so on.

1. Right-angle surface mount Noncompliance plug connector
2. Hatch shield and solid copper shield flex
3. Series 801 Mighty Mouse receptacle with PC tails
4. Micro-D 37-pin connector
5. Silver paste shield flex
6. Resistor, inductor, and capacitor
7. Series 88 SuperFly™ rear panel mount PCB receptacle
8. Black EMI film (suitable for commercial applications)

808999 Series II type hermetic PC tail receptacle connector
9. ZIF (Zero Insertion Force) termination
10. 6-layer rigid flex circuit board with BGA
11. Overmolded termination

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Dimensions in Inches (millimeters) are subject to change without notice.
FAST TURNAROUND
3-D Modeling and Rapid Prototyping
SolidWorks modeling · 3-D printed prototyping

MODELING AND 3-D PRINT RAPID PROTOTYPING

- 3-D representation of flex assemblies using SolidWorks
- 3-D printed “paper doll” outline mockups for fit checks with copper clad DuPont Kapton to simulate actual flexibility
- Incorporation of customer-supplied wiring diagram and chassis information in laser-cut mechanical samples

Example SolidWorks and 3-D printed paper doll prototype mockups produced by Glenair’s Integrated Flex Assembly team—typical turnaround 2–3 days upon receipt of request, unless extraordinary requirements are requested (e.g., loose leaf, cross-hatch shielding on 3+ layers)

Here, a custom 3-D printed model is mated to a plug connector to check form and fit before actual part production

Complimentary quick-turn mockups produced by by Glenair: 28-layer rigid flex (close-up and full-length), and 12-layer multibranch rigid flex

HD Stacker board-to-board connector/flex mockup

SOLIDWORKS 3-D PROTOTYPING: “VIRTUAL” CONNECTOR MODIFICATIONS

- Customer-supplied STEP file of box with panel cutouts
- Glenair-supplied 3-D model of connector flange modifications

In this example, customer supplied a STEP file of a box enclosure with panel cutouts. The Glenair engineering team used SolidWorks to design a specially-modified connector flange, allowing the customer to take advantage of our signature size-and weight-saving circular connector, the Series 80 Mighty Mouse.

3-D MODELING FOR CONNECTORIZED INTEGRATED SYSTEMS

- Turnkey connector manufacture and interconnect cable / flex harnessing
- Electronic box builds supported by software-based design and prototyping
- Turnkey integration of harness technologies, boxes, and mechanisms

This integrated system enclosure, complete with printed circuitry, I/O connectors, and power modules was designed and modeled in SolidWorks prior to actual manufacture.

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FLEX AND RIGID FLEX DESIGN OPTIONS

- Factory forming facilitates assembly and helps the flex circuit adhere tightly to available space and routing.
- Stiffeners incorporated into flex: a practical approach for adding discrete mount points or component integration.
- Grounding can be achieved by directly grounding the connector shell to flex circuitry as shown in the above example.
- EMI/RFI Shielding is accomplished with solid or patterned shield planes, stitched vias, and/or with shielded I/O interconnects.
- High-Power may be routed through flex circuitry with wider traces.
- Hybrid flex, rigid flex, and embedded PCB technology facilitates electronic component size and weight reduction, and double-sided mounting of components.
- Flex and rigid flex combination assemblies provide hard mounting points and dynamic flexing and routing.

MULTIBRANCH FLEX AND RIGID FLEX CONNECTORIZED ASSEMBLIES

- Micro-D subminiature multibranch flex assembly—a Glenair specialty.
- Multibranch RJ45 / Ethernet / USB Flex assembly.
- High density .025” contact center nano miniature multibranch flex assembly.

POINT-TO-POINT CONNECTORIZED FLEX AND RIGID FLEX JUMPER DESIGN OPTIONS

- Environmentally sealed rectangular I/O interface flexi circuit.
- Military aerospace grade I/O connector to commercial grade board level termination.
- Master-Latch quick disconnect Micro-D I/O flexi circuit.
- Military aerospace grade circular I/O connectors to matched impedance high-speed mil-aero board terminations.

SPECIAL-PURPOSE FLEX, RIGID-FLEX DESIGNS, AND PHOTONICFLEX CAPABILITIES

- Production run of individual PCBs in panelized form.
- Space-grade Series 28 HiPer-D to Series 80 Mighty Mouse I/O jumper.
- High-shock matched-impedance Mighty Mouse assembly with flex circuit.
- Stacked Micro-D I/O connectors with flex jumper to rigid PCB assembly.
- EMI/RFI filtered power transmission flex circuit assembly.
- PhotonicFlex circuitry for lightweight, small form-factor management of fiber optic media and MT ribbon terminations.
TURNKEY
Flex, Rigid Flex, and Rigid PCB Assemblies
Interconnect I/O and termination design guide

First step in securing a time and delivery quote from Glenair is to communicate basic information regarding the flex assembly, including quantity requirements, number of layers, overall size, special features such as factory forming, stiffeners and so on. Accordingly, here is a five step flex design guide, beginning with I/O interconnect selection.

Note: all Glenair PCB I/O connectors are potted/sealed and certified parylene compatible.

**STEP 1:** SELECT FLEX/RIGID FLEX ASSEMBLY I/O CONNECTOR(S)

- **HiPer-D 24308** is a high-performance, precision machined, shielded alternative to commercial-grade D-subminiatures
- Series 79 Micro-Crimp is Glenair’s high-density .075” contact center crimp- and shielded-contact, mil-aero grade rectangular
- Series 89 Micro-D is Glenair's high-density .075” contact center crimp & shielded-contact, mil-aero grade rectangular
- Series MWDM (MIL-DTL-38513) high-density micro miniature .050” contact spacing mil-aero grade Micro-D sub
- Series MWDM (MIL-DTL-38513) ultra-high density .025” contact spacing mil-aero grade miniaturization
- HiPer-D Combo straight and 90°
- HiPer-D 24308 straight and 90°
- Ultra high density .075” contact center mil-aero solution for size and weight reduction
- Single-row vertical PCB plugs / receptacles
- Dual-row right angle PCB plugs / receptacles
- Ultra high density, precision machined, high-speed datalink version 1.0X and panel plugs and receptacles
- High-speed datalink and rack-and-panel versions
- High-temp thermoplastic insulator
- Direct termination
- Surface mount
- Through hole
- Straddle mount
- ZIF (zero insertion force)
- AlphaLink® board-level pogo-pin connectors and flex jumpers
- Low-profile, solder-free, board-to-board stackable connectors
- Ultra high density .075” contact center mil-aero solution for size and weight reduction
- Polarity pins and keyed guide pin hardware
- Used to determine ROM pricing

**STEP 2:** DEFINE STYLE OF PCB / FLEX TERMINATIONS

- Thru-hole
- Surface mount
- Pogo pin / spring-loaded contacts
- Direct termination
- Encapsulating pot
- Straddle mount
- ZIF (zero insertion force)

**STEP 3:** DEFINE MECHANICAL SCHEMATIC

- Customer-supplied 3-D file to determine “keep out areas”
- “Napkin sketch” with rough idea of routing
- Customer-supplied 2-D DXF format to determine ROM pricing

**STEP 4:** DEFINE ELECTRICALS

- To approximate layer count, we need a wiring diagram “schematic” complete with signal types, currents, and shielding requirements
- Used to determine ROM pricing

**STEP 5:** DEFINE VALIDATION TEST REQUIREMENTS

Glenair offers complete circuit design and generation of PCB/Flex fabrication data packages including component level documentation. Most flex customers specify a certain level of validation testing as a required part of the documentation package. Tests may include DWV/IR, continuity, impedance (eye pattern), and others.
**INTEGRATED PCB / FLEX**

**Design Service Information Form**

Please fill in as much as possible. We understand that information will need to be modified/adjusted later during the design process.

<table>
<thead>
<tr>
<th>Customer Name</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Address</td>
<td></td>
</tr>
<tr>
<td>Engineer / Point of Contact Name, email, Phone Number</td>
<td></td>
</tr>
</tbody>
</table>

**GENERAL QUESTIONS**

<table>
<thead>
<tr>
<th>PCB P/N</th>
<th>Assembly P/N</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Revision (1, 2... A, B...)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Title</td>
<td></td>
<td></td>
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<tr>
<td>DCN Number (when applicable)</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Class 2</th>
<th>Class 3</th>
<th>RoHS Compliant</th>
<th>Yes</th>
<th>No</th>
<th></th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>Where Used, and Program Name</th>
<th></th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>Schematic Completed and Reviewed?</th>
<th>Yes</th>
<th>No</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Schematic Provided</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Provide Part Geometries?</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Provide Part Datasheets?</td>
<td>Yes</td>
<td>No</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Design Rules from Customer</th>
<th>Yes</th>
<th>No</th>
<th></th>
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<tbody>
<tr>
<td>Will Require Gerber Files</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Silkscreen and Etch Required?</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Glenair H/W in place of Existing H/W?</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

**DESIGN / CONSTRUCTION**

<table>
<thead>
<tr>
<th>Design Type (Rigid, Flex, Rigid Flex, etc.)</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Final Board Thickness (e.g. .062&quot; ±.006&quot;)</td>
<td></td>
</tr>
<tr>
<td>Proposed Layer Count (may change)</td>
<td></td>
</tr>
<tr>
<td>Will This Design Utilize Stiffeners?</td>
<td>Yes</td>
</tr>
<tr>
<td>Proposed Finished Copper Weight (start foil +.001&quot; after plating):</td>
<td></td>
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</tbody>
</table>

**DESIGN / CONSTRUCTION (continued)**

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<thead>
<tr>
<th>Board Outline Supplied in DXF and/or IDIF Format?</th>
<th>Yes</th>
<th>No</th>
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</thead>
<tbody>
<tr>
<td>Dimensions Provided</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Connector Location Provided?</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Tooling Hole Locations Provided?</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Tooling Holes Plated?</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Stiffener/Bend Locations Provided?</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Height Restrictions/Keepouts Defined?</td>
<td>Yes</td>
<td>No</td>
<td></td>
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<tr>
<td>Maximum and Minimum Lengths</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Conformal Coating?</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Testing Requirements</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Is Glenair H/W currently used?</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

**TECHNOLOGY (HIGH SPEED, RF, EMI, SHIELDING, ETC.)**

Any High Current Lines (please define)

<table>
<thead>
<tr>
<th>Controlled Impedance?</th>
<th>Yes</th>
<th>No</th>
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<tbody>
<tr>
<td>Controlled Impedance Value and ± Tolerance</td>
<td></td>
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<td></td>
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<tr>
<td>Matched Pairs/Lengths?</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Controlled Impedance Calculation Provided?</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Routing Constraints Received?</td>
<td>Yes</td>
<td>No</td>
<td></td>
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</tbody>
</table>

**OUTPUT FILES / INSTRUCTIONS / DELIVERABLES**

<table>
<thead>
<tr>
<th>Require Export Control Notes?</th>
<th>Yes</th>
<th>No</th>
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<tbody>
<tr>
<td>Require Fabrication/Assembly PDFs?</td>
<td>Yes</td>
<td>No</td>
<td></td>
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<tr>
<td>Require Gerber Files?</td>
<td>Yes</td>
<td>No</td>
<td></td>
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<tr>
<td>Require Schematic Files PDF</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Require ODB++ File?</td>
<td>Yes</td>
<td>No</td>
<td></td>
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<tr>
<td>Require BOM?</td>
<td>Yes</td>
<td>No</td>
<td></td>
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**SPECIAL NOTES AND ADDITIONAL INSTRUCTIONS**

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Integrated Flex, Rigid Flex, and PCB Assembly Production Lab

GLENDALE, CALIFORNIA
IPC 6012/6013 Class I, II, III, types 1–4
ISO 9001, AS9100 Certified

Glenair Integrated PCB/Flex assembly production facilities are operated in accordance with commercial and military standards. Staff includes 200+ PCB and cable assemblers with Nadcap certification for special processes and ESD management.

- Automated Optical Inspection
- Flying Probe Electrical Test
- Deluxing Washer

- High-availability catalog components as well as custom design and manufacture
- No minimums
- We never obsolete parts

Glenair’s PCB/Flex interconnect team is housed together under one roof. From electrical design to computer-aided manufacturing and assembly, the team has a well-deserved reputation for on-time delivery of even the most complex PCB/Flex assemblies.
### Glenair Power
**Products Group**
20 Sterling Drive
Wallingford, CT
06492

**Telephone:** 203-741-1115
**Facsimile:** 203-741-0053
**sales@glenair.com**

### Glenair Microway Systems
7000 North Lawndale Avenue
Lincolnwood, IL
60712

**Telephone:** 847-679-8833
**Facsimile:** 847-679-8849

### Glenair GmbH
Schaberweg 28
61348 Bad Homburg
Germany

**Telephone:** 06172 / 68 16 0
**Facsimile:** 06172 / 68 16 90
**info@glenair.de**

### Glenair Italia S.p.A.
Via Del Lavoro, 7
40057 Quarto Inferiore –
Granarolo dell’Emilia
Bologna, Italy

**Telephone:** +39-051-782811
**Facsimile:** +39-051-782259
**info@glenair.it**

### Glenair Korea
B-1304 Gunpo IT Valley
148 Gosan-Ro, Gunpo-Si
Kyunggi-Do, Korea
435-733

**Telephone:** +82-31-8068-1090
**Facsimile:** +82-31-8068-1092
**sales@glenair.kr**

### Glenair UK Ltd
40 Lower Oakham Way
Oakham Business Park
Mansfield, Notts
NG18 5BY England

**Telephone:** +44-1623-638100
**Facsimile:** +44-1623-638111
**sales@glenair.co.uk**

### Glenair Nordic AB
Gustaf III : S Boulevard 46
SE-169 27 Solna
Sweden

**Telephone:** +46-8-50550000
**sales@glenair.se**

### Glenair Iberica
C/ La Vega, 16
45612 Velada
Spain

**Telephone:** +34-925-89-29-88
**Facsimile:** +34-925-89-29-87
**sales@glenair.es**

### Glenair France SARL
7, Avenue Parmentier
Immeuble Central Parc #2
31200 Toulouse
France

**Telephone:** +33-5-34-40-97-40
**Facsimile:** +33-5-61-47-86-10
**sales@glenair.fr**

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Contact the Glenair Integrated Flex Assemblies team at 818-247-6000 or email

**Ben Porcaro, BDM:** bporcaro@glenair.com
**Tom Pfingston, FAE:** tpfingston@glenair.com
**Vinita Kakkar, PM:** vkakkar@glenair.com