DIFFERENTIAL CONNECTOR

FCN-260(D) Series
microGiGaCN™ Stacking Connector

FEATURES
• High speed matched impedance (100Ω) differential signal connector
• Low cross talk
• 2-step sequential mating of contacts
• Self alignment feature
• Hot plugable
• RoHS compliant

SPECIFICATIONS

<table>
<thead>
<tr>
<th>Item</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature range</td>
<td>-55˚C to +105˚C</td>
</tr>
<tr>
<td>Current rating</td>
<td>AC 0.5A (signal) AC 1A (ground)</td>
</tr>
<tr>
<td>Voltage rating</td>
<td>AC 30 V</td>
</tr>
<tr>
<td>Contact resistance</td>
<td>80m ohms max. (signal) 40m ohms min. (ground)</td>
</tr>
<tr>
<td>Insulation resistance</td>
<td>1000Mohms minimum</td>
</tr>
<tr>
<td>Dielectric withstand voltage</td>
<td>AC 500V for 1 minute</td>
</tr>
<tr>
<td>Durability</td>
<td>100 cycles</td>
</tr>
<tr>
<td>Insertion force</td>
<td>50 N maximum (24 pair)</td>
</tr>
<tr>
<td>Withdrawl force</td>
<td>5 N minimum (24 pair)</td>
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</table>

MATERIALS

<table>
<thead>
<tr>
<th>Item</th>
<th>Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulator</td>
<td>LCP Resin (UL94V-0)</td>
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<tr>
<td>Conductor</td>
<td>Copper Alloy</td>
</tr>
<tr>
<td>Plating</td>
<td>Contact: Au Plating (PAGOS) Au over Pd-Ni plating</td>
</tr>
</tbody>
</table>

Fujitsu’s FCN-260(D) Differential Signal Connector

As network speeds increase, designers are moving to differential interconnects for network switches and hubs, as well as for connections between components in high-speed computer clusters, video systems, test equipment, and real-time medical equipment (MRI, etc.). Conventional connectors do not support the speed and signal integrity requirements of these applications. By implementing a connector specifically for high-speed, high-density, board-to-board differential applications, designers can take advantage of a differential interconnect instead of more costly fiber optic or coax alternatives.

Differential signals use two conductors to carry signals that are compliments of one another. This arrangement reduces noise effects because any noise introduced by interference or crosstalk appears in both signals (common-mode noise) and is ignored by differential
receivers. With noise voltages less of a problem, differential signals can use a small voltage swing that switches between LOW and HIGH values extremely quickly--hence the appeal of differential signals for high-speed networking and clustering.

Differential connector characteristics can exceed the requirements of upcoming 1-Gbit applications and extend to next-generation applications at speeds upwards of 4.4 Gbps. As a result, system and board vendors who adopt such a connector can look forward to legacy usage that spans multiple product generations.

The signal transmission path of connectors has not always been a critical issue when choosing an interconnect method because the connector's electrical signal path is short compared to cables or printed circuit board assemblies. In applications utilizing high-frequency signals, however, connectors can have a significant effect on signal integrity. Connectors for high-speed applications must be designed to achieve optimal performance through the minimization of crosstalk and susceptibility to noise influences.

**Differential signal applications**

The shift from mainframe environments to networked client/server enterprises has made networks a critical bottleneck for improving system performance. Emerging technologies such as high-speed server farms, video conferencing, and greater use of graphical interfaces is pushing networks toward performance of 1 Gbit/sec and higher. The IEEE 802 committee is releasing 1.028-Gbit Ethernet standards to meet this requirement.

One of the key challenges for switch, hub, video equipment, and server manufacturers is to find a board-to-board connector system that allows signals to transfer at gigabit speeds over an affordable interconnect system that furnishes specific matched-impedance characteristics. Applications such as servers are now moving to extremely high-speed interfaces (often based on Fibre Channel) between computer backplanes and disk subsystems that require advance interconnects between boards. Similarly, networking hubs incorporate many boards that must be interconnected via short-run cables. These internal cables often have to transfer data at speeds significantly higher than those of the actual network, so even today's 10/100-Mbit networks need high-speed internal interconnects with excellent signal integrity. In addition, any system that uses an external fiber optic connector probably requires an internal, board-to-board connector system that works at the highest possible speeds.

Fiber optic and coax interconnect systems obviously meet the internal performance requirements, but the cost is high. Differential interconnects meet both the performance and cost goals but until recently, no connectors were available that provided high-density connections at gigabit speeds. In addition, connector test methodologies from the past cannot give reliable and repeatable results of the differential connector's performance in high-speed systems. Therefore, new test methodologies must be developed based on the unique characteristics of these emerging high-speed applications.

**High-speed differential interconnect characterization**

In the past, connector manufacturers "de-embedded" the connector from the test PCB's to show just the electrical characteristics of the connector and did not include any parasitic effects associated with solder joints on a through hole contact lead, or the effects of the contact post (compliant or non-compliant pin) in a plated through hole. While this test methodology was acceptable for slower system speeds, today's differential interconnects demand much more focused attention on system and board effects.

The requirements for testing today's high-speed differential interconnects are demanding with good reason. Connectors and other traditionally "electrically small" components are no longer small when considering presently available signaling technologies with 100ps risetimes and multi-gigabit data rates. Among these requirements are very well-designed test boards needed for accurate
measurement and characterization. This data is used to develop SPICE or other models and to provide detailed data to the design community. Typical high-frequency test boards designed by Fujitsu include:

- well-controlled impedance, matched-length test traces (with "real-world" widths and spacings)
- calibration/reference lines that mimic the test traces
- connector region entities (pads, pins, vias) that reflect actual system board implementations
- low discontinuity test connectors (these give access to the measurement equipment) of sufficient bandwidth to meet the testing needs (e.g. SMA, 55MB, etc.)

Differential pairs must be well-matched in order to minimize skew and maintain the proper impedance. Calibration lines of lengths "L" (where L is the length of the test traces between the article under test and the test connectors) and 2L provide the opportunity to calibrate out the board effects (if necessary) as well as to make "reference" measurements to test the goodness of an interconnect. These reference measurements are especially important when determining transmission fidelity. Fujitsu Takamisawa attempts to use standard, commonly available FR-4 type board materials (better performers than some believe) whenever possible; however, there are times when so-called "low loss" board materials may be required, such as for long paths running at gigabit speeds.

In addition to very good test articles, test equipment must be selected that will provide for the measurements required at the bandwidths needed. Measurements may be completed for differential interconnects running at 100 Mbps, 625 Mbps, 1 Gbps, 2.5 Gbps or beyond depending on the system being designed. Fujitsu Takamisawa typically measures for single-ended and differential impedance (using a "TDR"), transmission fidelity, crosstalk, and eye pattern performance among other measures of quality.
Figure 1

Basic Concept for Differential Transfer
Sectional View (Connection area)

Virtual ground plane
Differential pair contact
Ground/Power contact

0.75 mm
1.5 mm
1.27 mm

Patent pending

Figure 2

PCB Routing - Test Card

Measurement pair
Drive pairs

S1+
S1-
S2+
S2-
S3+
S3-

SMA connector footprints

Edge coupled differential pairs

PCB Routing - Test Card

Measurement pair
Drive pairs

S1+
S1-
S2+
S2-
S3+
S3-

SMA connector footprint

6” test pattern
Edge coupled differential pairs
Adapter card socket foot print card
3” test pattern

Specifications subject to change
Dimensions are in millimeters (inches)
www.fcai.fujitsu.com
TDR Results (Impedance Tr 50ps)

(Test Card + Stacking Connector)  (Area of connector)

92.3 to 109.8 Ohms
TDR data includes connector footprint and test board

Single Pair Cross talk @ 50 ps T rise

Aggressor Differential Signal Components
(Tr=46.4 ps, 3 inches PCB calibration line)

Adjacent Connector Pair
Near End Cross talk
(6.0 mV /500mV=1.2%)

Adjacent Connector Pair
Far End Cross talk
(3.5 mV /500mV=0.7%)

Data includes test SMA connector and test boards

Cross talk data includes connector footprint and test board
Eye Pattern@625 Mbps

Measurement Input: 250mV

800ps (50% bit time)

1584ps

6 inches test card
Jitter: 16ps(Pk-Pk)
Height: 241mV
Pseudo-Random Bit Stream (PRBS) excitation from HP8133A-02 3GHz Pulse Generator

Eye Pattern@1.25 Gbps

Measurement Input: 250mV

400ps (50% bit time)

784ps

6 inches test card
Jitter: 16ps(Pk-Pk)
Height: 227mV
Pseudo-Random Bit Stream (PRBS) excitation from HP8133A-02 3GHz Pulse Generator

Specifications subject to change
Dimensions are in millimeters (inches)
www.fcai.fujitsu.com
**microGiGaCN™ FCN-260 (D) Series**

**Eye Pattern@2.5 Gbps**

*Measurement Input: 250mV*

- **6 inches test card**
  - Jitter: 32ps(Pk-Pk)
  - Height: 193 mV
  - Pseudo-Random Bit Stream (PRBS) excitation from HP8133A-02 3GHz Pulse Generator

- **Test Card + Stacking Connector**
  - Jitter: 36ps(Pk-Pk)
  - Height: 203 mV
  - All data includes connector footprint and test board

- **368ps**
- **200ps (50% bit time)**

**Eye Pattern @ 3.125 Gbps**

*Measurement Input: 250mV*

- **6 inches test card**
  - Jitter: 46ps(Pk-Pk)
  - Height: 181mV
  - Pseudo-random Bit Stream (PRBS) excitation from HP8133A-02 3 GHz Pulse Generator

- **Test Card + Stacking Connector**
  - Jitter: 47ps(Pk-Pk)
  - Height: 183 mV
  - All data includes connector footprint and test board

- **274ps**
- **160ps (50% bit time)**
- **273ps**
- **160ps (50% bit time)**
### STACKING SPECIFICATIONS

<table>
<thead>
<tr>
<th>Board interval (mm)</th>
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<th>10</th>
<th>12</th>
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<td><img src="image.png" alt="Diagram" /></td>
<td><img src="image.png" alt="Diagram" /></td>
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<tr>
<td>Part number</td>
<td>FCN-268F0xx-G/0D</td>
<td>FCN-268Mxxx-G/1D</td>
<td>FCN-268Mxxx-G/2D</td>
<td>FCN-268Mxxx-G/3D</td>
</tr>
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</table>

Note: This socket is used for all dimensions.
BOARD TO BOARD, SOCKET

DIMENSIONS

RECOMMENDED P.W.B. DIMENSION

PART NUMBERS AND DIMENSIONS
microGiGaCN™ FCN-260 (D) Series

RIGHT ANGLE, SOCKET

DIMENSIONS

RECOMMENDED P.W.B. DIMENSION

PART NUMBERS AND DIMENSIONS

<table>
<thead>
<tr>
<th>Number of Differential Pair Signals</th>
<th>Part Number</th>
<th>Dimensions: mm (in.)</th>
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<tr>
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<tr>
<td>24</td>
<td>FCN-268F024-G/BD</td>
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<td>FCN-268F036-G/BD</td>
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</table>
**BOARD TO BOARD, PLUG, STACKING HEIGHT 8 mm**

**DIMENSIONS**

![Diagram of board dimensions](image)

**RECOMMENDED P.W.B. DIMENSION**

![Diagram of recommended P.W.B. dimensions](image)

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<tr>
<td>36</td>
<td>72 signal 37 ground</td>
<td>FCN-268M036-G/0D</td>
<td>1-36</td>
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</table>

Specifications subject to change
Dimensions are in millimeters (inches)
www.fcai.fujitsu.com
BOARD TO BOARD, PLUG, STACKING HEIGHT 10mm

- DIMENSIONS

![Diagram of the FCN-260 (D) Series](image)

Unit: mm (in.)

- RECOMMENDED P.W.B. DIMENSION

![Recommended P.W.B. Dimension](image)

Unit: mm (in.)

- PART NUMBERS AND DIMENSIONS

<table>
<thead>
<tr>
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<td>72 signal 37 ground</td>
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<td>1-36</td>
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</table>

Specifications subject to change
Dimensions are in millimeters (inches)
microGiGaCN™ FCN-260 (D) Series

BOARD TO BOARD, PLUG, STACKING HEIGHT 12mm

Dimensions

Part Numbers and Dimensions

<table>
<thead>
<tr>
<th>Number of Differential Pair Signals</th>
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<tr>
<td>12</td>
<td>24 signal 13 ground</td>
<td>FCN-268M012-G/2D</td>
<td>m 1-12 n 1-13 A 19.89 (0.783) B 23.0 (.906) C 20.7 (.814) D 29.5 (1.161)</td>
</tr>
<tr>
<td>24</td>
<td>48 signal 25 ground</td>
<td>FCN-268M024-G/2D</td>
<td>m 1-24 n 1-25 A 37.89 (1.491) B 41.0 (1.614) C 38.7 (1.523) D 47.5 (1.870)</td>
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<tr>
<td>36</td>
<td>72 signal 37 ground</td>
<td>FCN-268M036-G/2D</td>
<td>m 1-36 n 1-37 A 55.89 (2.200) B 59.0 (2.322) C 56.7 (2.232) D 65.5 (2.578)</td>
</tr>
</tbody>
</table>

Specifications subject to change
Dimensions are in millimeters (inches) www.fcai.fujitsu.com
BOARD TO BOARD, PLUG, STACKING HEIGHT 14mm

**DIMENSIONS**

![Diagram of board to board plug with dimensions](image)

**RECOMMENDED P.W.B. DIMENSION**

![Diagram of recommended P.W.B. dimension](image)

**PART NUMBERS AND DIMENSIONS**

<table>
<thead>
<tr>
<th>Number of Differential Pair Signals</th>
<th>Number of Contacts</th>
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</thead>
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<tr>
<td></td>
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<td>m  n  A  B  C  D</td>
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Specifications subject to change

Dimensions are in millimeters (inches)
BOARD TO BOARD, PLUG, RIGHT ANGLE

■ DIMENSIONS

<table>
<thead>
<tr>
<th>BOARD TO BOARD, PLUG, RIGHT ANGLE</th>
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<tbody>
<tr>
<td><strong>DIMENSIONS</strong></td>
</tr>
<tr>
<td><img src="image" alt="Diagram of microGiGaCN™ FCN-260 (D) Series" /></td>
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**RECOMMENDED P.W.B. DIMENSION**

![Diagram of Recommended P.W.B. Dimension](image)

**PART NUMBERS AND DIMENSIONS**

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</table>

Specifications subject to change
Dimensions are in millimeters (inches)
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Web: www.fcal.fujitsu.com

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