fujipoly®
an ISO9001:2008 registered company

Connecting you to the world

ZEBRA® ELASTOMERIC CONNECTORS

Creating unprecedented products with unprecedented performance.

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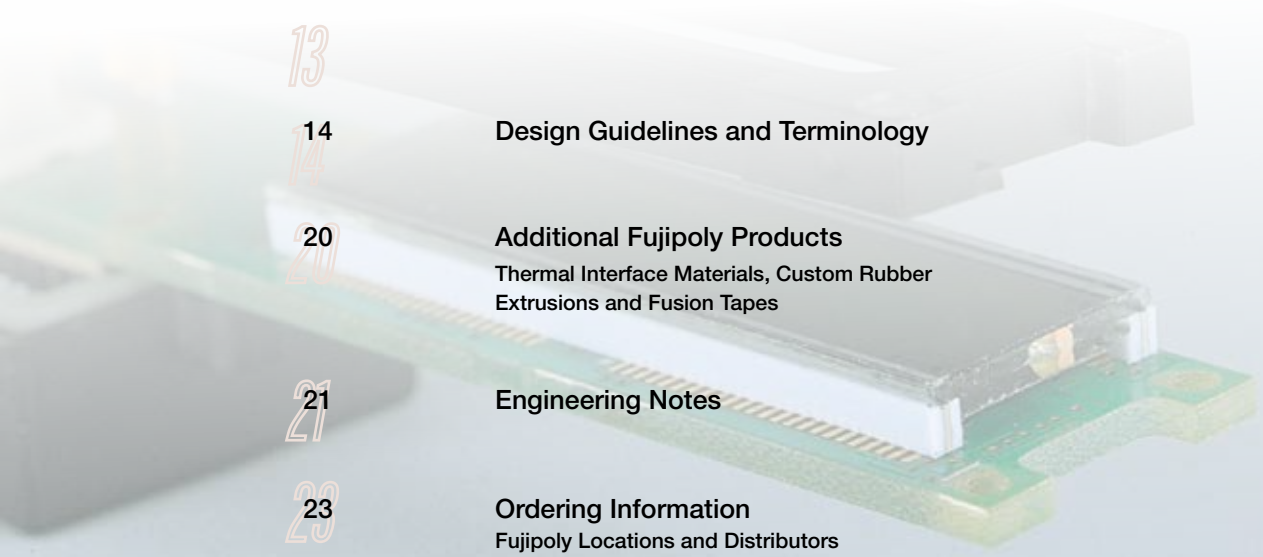


FUJIPOLY

SILICONE ELECTRONIC PACKAGING COMPONENTS

A NETWORK of DEPENDABLE PRODUCTS to INCREASE YOUR PRODUCTS' DEPENDABILITY

A worldwide network to serve your electronic packaging needs. Fujipoly's multi-plant system was established for, and continues to grow toward, excellence in meeting customers' needs matched with excellence in product performance.

We manage a globally responsive, diverse group of facilities. Technologies have been both developed and acquired. Locations have been established based on a borderless business strategy to meet the growing trend of internationalization.

Manufacturing and distribution centers located in Europe, North America and Asia keep us close to our customers' needs while giving them convenient access to our increasing technologies.

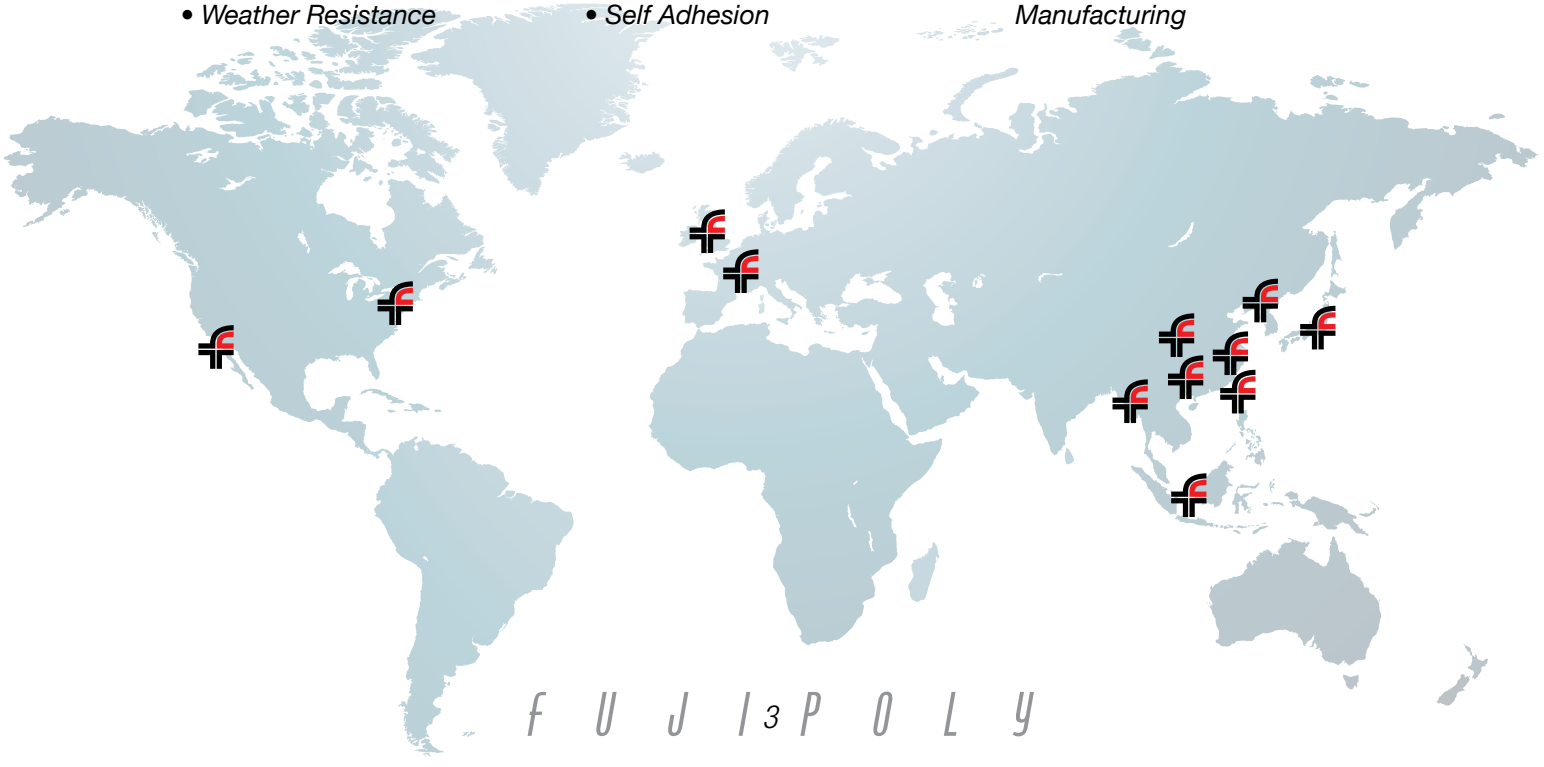
Less than 5% of silicone potential has been researched to date and even more applications than we can now imagine are possible.

The inherent advantages of silicone already seem limitless. There are very few commercial or industrial products which do not contain some form of it as a molded, extruded or die-cut shape.

The composition of formulations is almost infinite, each offering strong advantages in one characteristic or another, many with great superiority over other materials.

Fujipoly's proprietary research and specific treatments are focused on obtaining the highest overall performances for the field of electronic packaging. Some of these areas are:

- *Heat Resistance*
- *Flame Retardance*
- *Low Compression Set*
- *Oil & Solvent Resistance*
- *Weather Resistance*
- *Thermal Conductivity*
- *Electrical Conductivity*
- *Electrical Insulation*
- *Cold Resistance*
- *Self Adhesion*
- *Variety of Shapes and Sizes Possible*
- *Aging Resistance*
- *Ease of Custom Manufacturing*



ZEBRA® Elastomeric Connectors

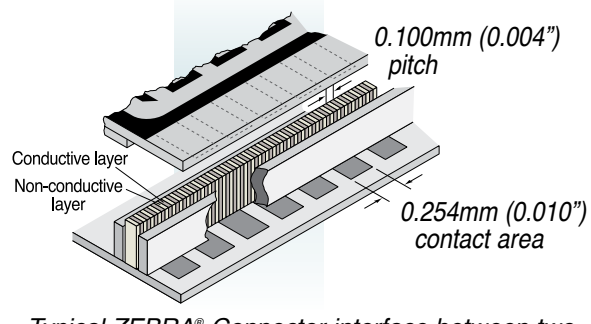
ZEBRA® Elastomeric Electronic Connectors are a comprehensive group of high performance interconnect devices with applications throughout the entire field of electronics.

With the expansion of micro-electronics and miniaturization of all products, the same high reliability must be maintained.

ZEBRA® Elastomeric Connectors are an obvious choice and one which offers a variety of alternatives based on the primary design objectives. Some of the more important considerations are:

- ***High Density, increased number of I/O's***
- ***Low resistance, high current capacity***
- ***Low insertion force, low compression force***
- ***Redundant contact engagement***
- ***High electrical and mechanical reliability***
- ***Chemical stability, degradation resistance***
- ***Cost-effectiveness, ease of assembly***

ZEBRA® Elastomeric Connectors have alternating conductive and non-conductive layers. See diagram below. The conductive layers are oriented vertically in the thickness direction, making contact from top to bottom.

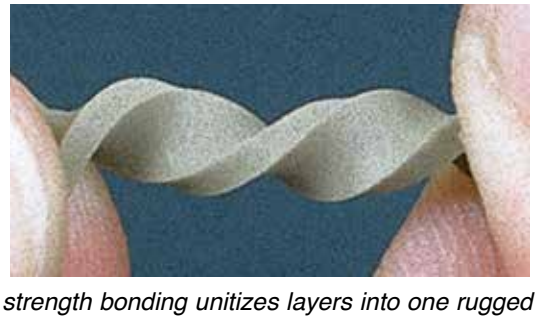


Typical ZEBRA® Connector interface between two contact areas; such as, PCB to LCD, or PCB to PCB.

All styles offer redundant contact depending on the pitch of the conductive layers, some as small as 0.05 mm centerline (see drawing above).

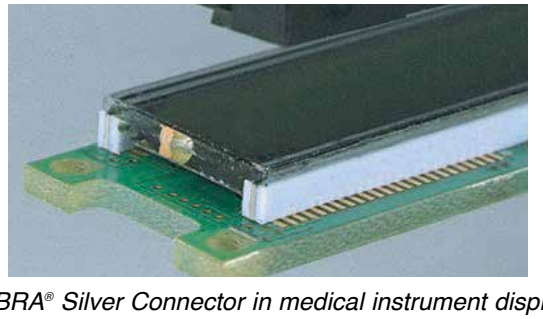
APPLICATIONS:

- *LCD and EL displays*
- *Board-to-board*
- *Chip-to-board*
- *Memory cards*
- *Flex circuit-to-board*
- *Burn-in sockets*
- *Miniature and low profile interconnect - general electronics*

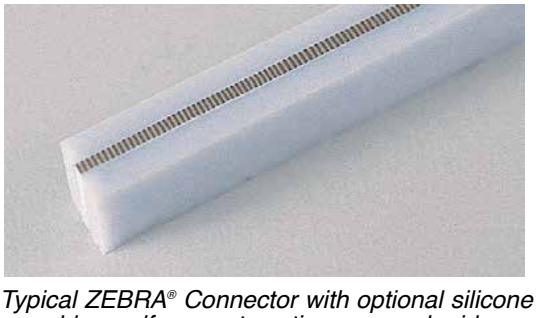


High strength bonding unitizes layers into one rugged body.

Each of the styles is also available with outer support sections along the entire length on one or both sides (except Series 8000). The support is available in sponge or solid silicone rubber, and creates a larger width area. This eliminates the need for a holder while still allowing a very low compression force during deflection. For optional ordering information, see instructions on page 6 under "Self -Supported Connectors".



ZEBRA® Silver Connector in medical instrument display.



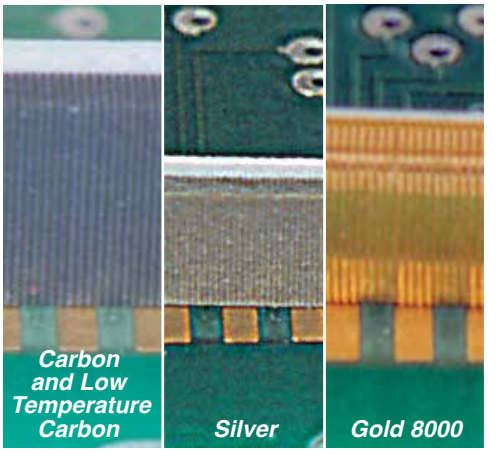
Typical ZEBRA® Connector with optional silicone rubber self-support sections on each side.

All dimensions in millimeters and inches

ZEBRA® CONNECTOR TECHNICAL DATA

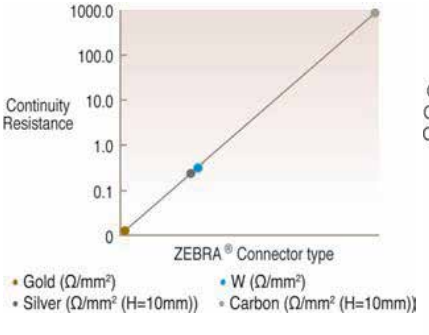
The five ZEBRA® Elastomeric Connector designs below are detailed in their dimensional and performance characteristics. Follow the general guidelines to determine the design characteristics most suitable for your application. See following pages for detailed characteristics.

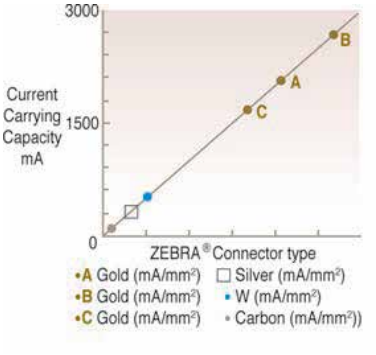
The photo enlargements at right demonstrate the multiple contact points per circuit conductor pad for typical ZEBRA® connector designs.



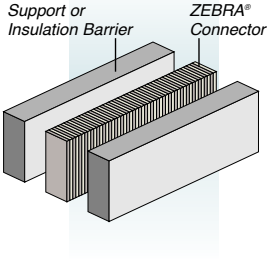
Name	Application Guidelines	Typical Products
Carbon	Economical general use with contact pitches at 140, 240 or 500 per inch	LCD's for aerospace, aircraft, military, meters, instruments, cameras Electroluminescent displays, component-to-board, burn-in sockets, PCB to PCB, chip on glass, LCD's, chip on foil, COF's
Silver	300mA current carrying capacity, rugged long-life aging with contact pitches at 240 per inch	
Gold 8000	Zero insertion force, tight pitch, low compression force, very low resistance, very high current carrying capacity; contact pitches at 100, 133, 166 per inch	

TYPICAL PERFORMANCE CHARACTERISTICS:





SIDE SUPPORT or INSULATION BARRIER:



Drawing at left shows side support or insulation on one or both sides, or one of each.

Various materials are available from the minimum insulating barrier of 0.05mm to support layers of up to 1.5mm. Support layers can be soft silicone rubber, or medium and soft silicone sponge. Recommended height is twice the width for minimum force deflection.

See page 6 for details. Consult customer service for ordering specifications.

Part Number Nomenclature:

To specify a connector to your exact requirements, substitute the metric measurements for width, length and height according to instructions below; example part# Ag(2.0 IB1 x 20 x 2.0)-U; ***Note: For Carbon Zebra, make sure to advise pitch desired.***

ZEBRA® Ag (2.0 – IB1 x 20 x 2.0)

- *Height*
- *Length*
- *Insulation Barrier or Solid Support (if required)*
  - *CA, Ag only*
    - *IB1 0.05mm Insulation barrier 1 side only*
    - *IB2 0.05mm Insulation barrier 2 sides*
    - *SS1 Solid Support 1 side only (specify ZEBRA® thickness; i.e., SS1-1.5)*
    - *SS2 Solid Support 2 sides (specify ZEBRA® thickness; i.e., SS2-1.5)*
    - *SPG Sponge Support 2 sides (see standards page 6)*
  - *Au only: Wire Pitch (Insulation Barrier component not needed for Au)*
    - *Au-A 0.25mm (0.010") wire pitch*
    - *Au-B 0.19mm (0.0075") wire pitch*
    - *Au-C 0.15mm (0.006") wire pitch*
- *Width*
- *ZEBRA® series: • CA for Carbon • Ag for Silver • Au for Gold*

All dimensions in millimeters and inches

Elastomeric Connectors

ZEBRA® CARBON CONNECTORS

FUJIPOLY ZEBRA® connectors (see figure 1) have alternating layers of conductive carbon-filled and non-conductive silicone rubber. They make reliable connections by being deflected between contacting surfaces. ZEBRA® connectors are used for connecting any LCD from small displays for watches to large area displays for instruments. Table A shows the different types of ZEBRA® connectors available. Table C shows performance characteristics.

Figure 1 shows the three dimensions of the ZEBRA® connector. When ordering, the three dimensions should be specified within the limits shown in table B.

For best overall performance, ZEBRA® connectors must be ordered and used with a ratio of H/W equal to or greater than 1.5.

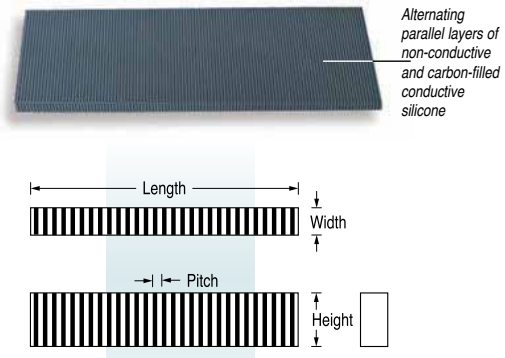


Figure 1

Series	LCD Contact Spacing Center-to-Center Minimum	Pitch: Sum of the Thickness of an Adjacent Conductive and Non-conductive Layer Nominal	Pitch: Sum of the Thickness of an Adjacent Conductive and Non-conductive Layer Maximum	Conductive Layers per inch Minimum	Individual Conductive and Insulating Layer Thickness Minimum	Individual Conductive and Insulating Layer Thickness Maximum	Available Lengths Maximum
1002 (CZ410/CZ710)	0.015 in. 0.38 mm	0.004 in. 0.10 mm	0.006 in. 0.15 mm	240	0.001 in 0.025 mm	0.004 in. 0.10 mm	9.0 in. 230 mm
2004 (CZ418)	0.020 in. 0.50 mm	0.007 in. 0.18mm	0.010 in. 0.25 mm	140	0.002 in. 0.050 mm	0.006 in. 0.15 mm	9.0 in. 230 mm
2005 (CZ405/CZ705)	0.010 in. 0.25 mm	0.002 in. 0.050 mm	0.004 in. 0.10 mm	500	0.0004 in. 0.010 mm	0.0024 in. 0.060 mm	9.0 in. 230 mm

TABLE A

Measurement	Tolerance (inches/mm)
Length=L	0.157 in. to 2.40 in. — ± 0.008 in. ····/···· 4.00 mm to 61.00 mm — ± 0.20 mm 2.410 in. to 6.00 in. — ± 0.015 in. ····/···· 61.2 mm to 152.4 mm — ± 0.38 mm 6.010 in. to 7.87 in. — ± 0.020 in. ····/···· 152.6 mm to 200.0 mm — ± 0.50 mm 7.880 in. to 9.00 in. — ± 0.039 in. ····/···· 200.1 mm to 230.0 mm — ± 1.00 mm
Height=H	0.020 in. to 0.750 in. ± 0.005 in. ····/···· 0.50 mm to 19mm ± 0.127 mm above 0.750 in/19.0 mm consult factory
Width=W	0.015 in. to 0.039 in. — ± 0.002 in. ····/···· 0.38 mm to 1.0 mm — ± 0.050 mm 0.040 in. to 0.079 in. — ± 0.003 in. ····/···· 1.01 mm to 2.0 mm — ± 0.076 mm 0.080 in. to 0.118 in. — ± 0.005 in. ····/···· 2.01 mm to 3.0 mm — ± 0.127 mm above 0.118 in./3.00 mm consult factory.

TABLE B

ZEBRA® Connectors	Temperature Range Minimum	Temperature Range Maximum	Current Carrying Capacity 0.040" x 0.040" pad	Resistance Between Layers
Carbon	-40°F -40°C	212°F 100°C	0.005 amps	10^{12} ohms

TABLE C

All dimensions in millimeters and inches

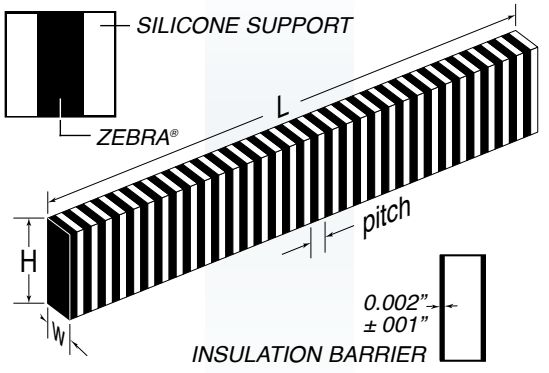


Figure 2 Recommended Height (H) should be 1.5 x Width (W) dimension for minimum force deflection. Maximum Skewness 2% of Height.

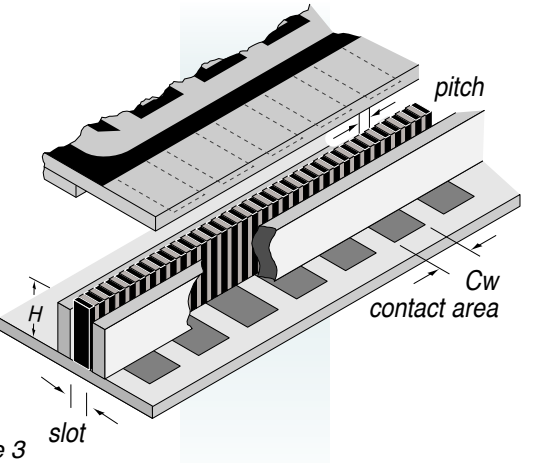


Figure 3

ZEBRA® CONNECTOR DIMENSIONS

Figure 2 shows the three dimensions of the ZEBRA® connector. When ordering, the three dimensions should be specified within the limits shown in Table B. For best overall performance, ZEBRA® connectors must be ordered and used with a ratio of H/W equal to or greater than 1.5. Details show silicone support (left) and insulation barrier (right). Each is available on one or both sides. Configurations may also include support on one side and insulation on the other.

ZEBRA® CONNECTOR INSULATING BARRIER

Description	Insulating Barrier
Color (one only)	White
Hardness, Durometer A	30
Dielectric Strength volts/mil.	500
Resistance, ohms	10^{12}
Insulating Barrier Width (B) in.*	0.002 ± 0.001
(B) mm	0.050 ± 0.025

TABLE D *The tolerance of W_1 is equal to the sum of the tolerances of W.

NOMINAL RESISTANCE CALCULATION

To calculate the resistance of the ZEBRA® connector use the following formulas:

Where: Cw = Contact pad width in inches
H = ZEBRA® connector height in inches
W = ZEBRA® connector width in inches

Metric:

$$R = \frac{60 \times H}{E_W \times W}$$

Inches:

$$R = \frac{2.37 \times H}{E_W \times W}$$

Where:

R = Resistance (Ω)
E_W = Electrode Pad width (mm or inches)
W = Connector width (mm or inches)
H = Connector height (mm or inches)

NOMINAL FORCE DEFLECTION - PLAIN ZEBRA® OR INSULATION BARRIER TYPE

ZEBRA® connectors should be deflected 5% to 25% of H. To calculate F-Force for deflection, use the following formula:

Where:

F = Force (N)

$$D = \frac{H - H_1 \times 100\ (\%)}{H}$$

H = Height of connector (mm or inches)
H_1 = Deflected height of connector (mm or inches)
W = Width of connector (mm or inches)
W_1 = Width of ZEBRA portion (mm or inches)
L = Length of connector (mm or inches)

Metric:

$$F(N) = 9 \times D \times W \times L \times 9.8 \times 10^{-3}$$

Inches:

$$F(N) = 5806 \times D \times W \times L \times 9.8 \times 10^{-3}$$

NOMINAL FORCE DEFLECTION - SILICONE SUPPORT TYPE

Metric:

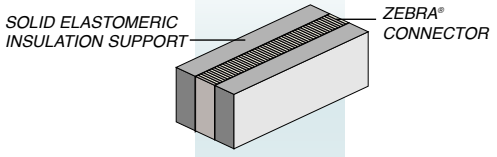
$$F(N) = [(9 \times D \times W_1 \times L) + \{2.2 \times D \times (W-W_1) \times L\}] \times 9.8 \times 10^{-3}$$

Inches:

$$F(N) = [(5806 \times D \times W_1 \times L) + \{1419 \times D \times (W-W_1) \times L\}] \times 9.8 \times 10^{-3}$$

ZEBRA® SOLID SELF-SUPPORTED CONNECTORS

The Solid Self-Supporting ZEBRA® connector utilizes a standard ZEBRA® connector element supported by a soft, non-conductive silicone rubber on one or two sides. The silicone rubber creates a larger width that eliminates the need for a holder, and yet the force required for deflection is very low. The standard Solid Self-Supporting ZEBRA® connector has a 0.020"/0.50mm wide ZEBRA® connector element and is available in 8 different widths to accommodate LCD's with a glass lip overhang of 0.050"/1.27 mm minimum.



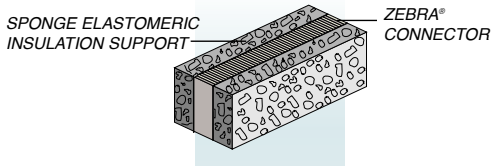
ZEBRA® Element	LCD Contact Spacing in/mm	Standard Connector Widths	
2004 (CZ418)	0.020/0.50	0.050 in./ 1.27 mm	0.090 in./ 2.3 mm
1002 (CZ410/CZ710)	0.010/0.25	0.060 in./ 1.50 mm	0.100 in./ 2.5 mm
2005 (CZ405/CZ705)	0.006/0.15	0.070 in./ 1.8 mm	0.120 in./ 3.00 mm
		0.080 in./ 2.0 mm	0.140 in./ 3.50 mm

Measurement	Tolerance (inches/mm)
Length=L	0.157 in. to 2.40 in. — ± 0.008 in. / 4.00 mm to 61.00 mm — ± 0.20 mm 2.410 in. to 6.00 in. — ± 0.015 in. / 61.2 mm to 152.4 mm — ± 0.38 mm 6.010 in. to 7.87 in. — ± 0.020 in. / 152.6 mm to 200.0 mm — ± 0.50 mm 7.880 in. to 9.00 in. — ± 0.039 in. / 200.1 mm to 230.0 mm — ± 1.00 mm
Height=H	0.039 in. to 0.750 in. ± 0.005 in. / 1.0 mm to 19mm ± 0.127 mm above 0.750 in/19.0 mm consult factory
Width=W	0.050 in. to 0.079 in. — ±0.006 in. / 1.27 mm to 2.00 mm — ± 0.15 mm 0.080 in. to 0.100 in. — ±0.007 in. / 2.03 mm to 2.54 mm — ± 0.18 mm 0.101 in. to 0.140 in. — ±0.008 in. / 2.55 mm to 3.50 mm — ± 0.20 mm above 0.140 in./3.50 mm and for custom widths consult factory.

ZEBRA® Connectors	Temperature Range Minimum	Maximum	Current Carrying Capacity 0.040" x 0.040" pad	Resistance Between Layers
All series	-40°F -40°C	212°F 100°C	0.005 amps	10^{12} ohms

ZEBRA® SPONGE SELF-SUPPORTED CONNECTORS

The Self Supporting Sponge ZEBRA® connector utilizes standard ZEBRA® connector elements supported by a silicone sponge rubber on one or two sides. The silicone sponge creates a larger width that can eliminate the need for a holder, and yet the force required for deflection is very low. The standard Self Supporting Sponge ZEBRA® connector is available in a host of widths to accommodate LCD's with a glass lip overhang of 0.060"/1.5 mm minimum. The Self Supporting Sponge ZEBRA® connector is used to connect LCD's to printed circuit boards and eliminates bowing of the printed circuit board due to the low force required to make contact.



ZEBRA® Element	LCD Contact Spacing in/mm	Standard Connector Widths
2004 (CZ418)	0.020/0.50	.060 in./ 1.5 mm .087 in./ 2.0 mm .118 in./ 3.0 mm
1002 (CZ410)	0.010/0.25	.063 in./ 1.6 mm .091 in./ 2.3 mm .126 in./ 3.2 mm
2005 (CZ405)	0.006/0.15	.067 in./ 1.7 mm .100 in./ 2.5 mm .138 in./ 3.5 mm
		.070 in./ 1.8 mm .102 in./ 2.6 mm .150 in./ 3.8 mm
		.075 in./ 1.9 mm .106 in./ 2.7 mm .157 in./ 4.0 mm
		.079 in./ 2.0 mm .110 in./ 2.8 mm

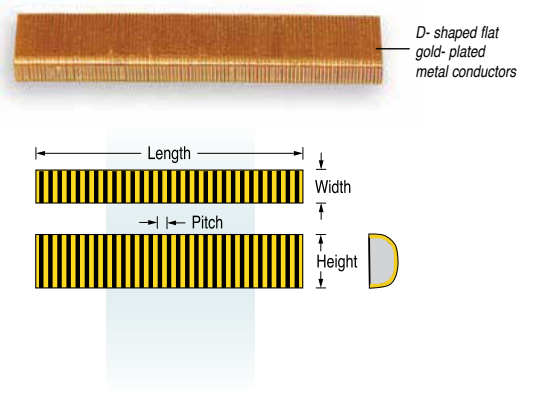
Measurement	Tolerance (inches/mm)
Length=L	0.157 in. to 2.40 in. — ± 0.008 in. / 4.00 mm to 61.00 mm — ± 0.20 mm 2.410 in. to 6.00 in. — ± 0.015 in. / 61.2 mm to 152.4 mm — ± 0.38 mm 6.010 in. to 7.87 in. — ± 0.020 in. / 152.6 mm to 200.0 mm — ± 0.50 mm
Height=H	0.039 in. to 0.750 in. ± 0.005 in. / 1.0 mm to 19mm ± 0.127 mm above 0.750 in/19.0 mm consult factory
Width=W	0.060 in. to 0.157 in. — ±0.004 in. / 1.52 mm to 4.0 mm — ± 0.1 mm above 0.157 in./4.00 mm consult factory.

ZEBRA® Connectors	Temperature Range Minimum	Maximum	Current Carrying Capacity 0.040" x 0.040" pad	Resistance Between Layers
All series	-55°F -50°C	260°F 125°C	0.005 amps	10^{12} ohms

All dimensions in millimeters and inches

ZEBRA® GOLD 8000 CONNECTORS

The FUJIPOLY ZEBRA® Series 8000 elastomeric connector elements are D-shaped, low durometer silicone elastomer cores around which flat metallic gold-plated conductors are vulcanized in a row parallel to each other. The tips of the metallic conductors are turned upward so that point contact can be effected; in addition, contact is made to the flat area when the connector element is positioned between two printed circuit boards. The point contact will penetrate surface oxides or contaminants which might be present on the surface of the contact pads, thus assuring reliable electrical connection on two planes. Also available are standard board-to-board assemblies which include connector and holder.



DIMENSIONAL SPECIFICATIONS

Connector Dimensions*	Minimum		Maximum	
Length=L	0.200" ± 0.005"	5.08mm ± 0.127mm	6.000" ± 0.030"	152.4mm ± 0.762mm
Height=H	0.100" ± 0.005"	2.54mm ± 0.127mm	0.500" ± 0.015"	12.70mm ± 0.381mm
Width=W	0.060" ± 0.005"	1.52mm ± 0.127mm	0.125" ± 0.010"	3.18mm ± 0.254mm

Note: *For good design practice and low deflection force requirements, the height "H" should be twice the width "W". For other sizes consult factory.*

MATERIALS

Connector Component	Materials Used
Conductive Elements	Gold-plated copper wire. gold 0.00025mm (0.00001"), nickel 0.0013mm (0.00005").
Wire Size and Spacing (Series 8000 A,B and C)	**A.** 0.05mm x 0.127mm (0.002" x 0.005") flat wire on 0.25mm (0.010") center-to-center spacing. (Min. 100 wires/ inch.) **B.** 0.05mm x 0.10mm (0.002" x 0.004") flat wire on 0.19mm (0.0075") center-to-center spacing. (Min. 133 wires/inch.) **C.** 0.025mm x 0.076mm (0.001" x 0.003") flat wire on 0.15mm (0.006") center-to-center spacing. (Min. 166 wires/inch.)
Connector body	Non-conductive tan color silicone rubber. UL-94-HB rating, 500 volts/mil dielectric strength.
Film	0.025mm (0.001") thick polyamide dielectric strength of film ASTM-D-149, 2000 volts/mil.

PERFORMANCE CHARACTERISTICS

Parameter	Conditions and Performance
Contact Resistance	Less than 25 milliohms on 0.025" wide contact pads; 0.100 amperes DC, Kelvin- type four probe test method
Insulation Resistance	Minimum 10^{12} ohms between adjacent conductive elements.
Current Carrying Capacity	Series 8000 A and B, 500 mA per wire max.; Series 8000 C, 250 mA per wire max.
Capacitance	Maximum 0.100 picofarads per adjacent pad at 1 MHz and 0.100" high ("H").
Inductance	Maximum 7 nanohenries per adjacent pad at 1 MHz and 0.100" high ("H").
Repeated Actuations	500 actuations without appreciable change in contact resistance (deflection of 15%).
Deflection	8% to 20%. Recommended deflection 10 to 15% of original height.
Deflection Force/Inch	4lbs. per linear inch for 15% deflection for a 0.062" ("W") x 0.285 ("H") connector.
Operating Temperature Range	-20° C min., 125° C max.
Salt Spray Test	MIL-STD-202E, method 101D, condition B. 5% salt solution 95° F, 48 hours. There was no evidence of blistering or peeling of the contact material.
Temperature Cycling	MIL-STD-202E, method 102A, condition D, -55° C, 25° C, 125° C. There was no change in the physical properties of the specimens.
Humidity (Steady State)	MIL-STD-202E, method 103B, condition C modified. 95% RH room temperature. There was no appreciable change in contact resistance after 500 hours exposure.
Corrosive Environment	1,000 hours exposure at 1 ppm H_2S and 1 ppm O_2, 60° C AND 75% RH. Slight change in contact resistance; no evidence of contact peeling or blistering.

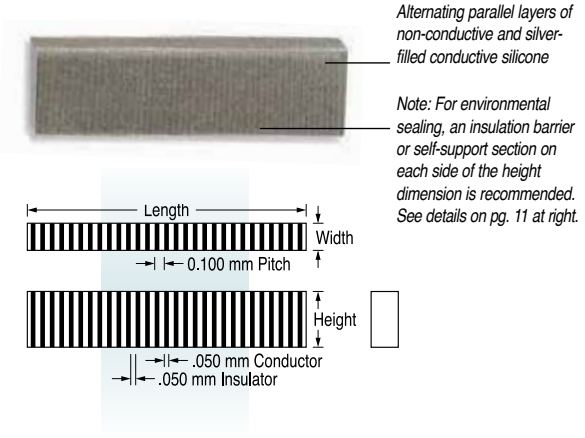
All dimensions in millimeters and inches

ZEBRA® HIGH PERFORMANCE SILVER CONNECTORS

FUJIPOLY low resistance ZEBRA® elastomeric connectors are constructed of alternating parallel layers of electrically conductive and non-conductive silicone elastomer. The electrically conductive layer is filled with silver-metal particles.

The composite alternating layers provide reliable electrical connection when placed between two aligned conducting surfaces.

The low resistance ZEBRA® provides a redundant connection with a minimum of two conductive layers recommended per PC contact pad. The connector is available with insulating barrier or silicone supports (See page 6). The connectors are used for connecting electroluminescent (EL) and plasma type displays to PC boards or for connecting hybrid circuits to PC boards, among other applications.



Low resistance ZEBRA® connectors are positioned between two aligned surfaces and are mechanically clamped together with a lid or another PC board. The connectors may be free standing or positioned in a retainer depending on packaging profiles and design.

Series	Contact Spacing Center-to-Center Minimum	Pitch: Sum of the Thickness of an Adjacent Conductive and Non-conductive Layer Nominal	Maximum	Conductive Layers per inch Minimum	Individual Conductive and Insulating Layer Thickness Minimum	Maximum	Available Lengths
5002 (SZ100)	0.015 in. 0.38 mm	0.004 in. 0.100 mm	0.006 in. 0.152 mm	240	0.001 in. 0.025 mm	0.003 in. 0.075 mm	5.00 in. 127 mm

TABLE A (For requirements over 4" consult factory)

Measurement	Tolerance (inches/mm)
Length=L	0.250 ± 0.005 in. to 5.000 ± 0.025 in. ····· 6.35 ± 0.12mm to 127.00 ± 0.64mm
Height=H	0.040 ± 0.003 in. to 0.500 ± 0.007 in. ····· 1.00 ± 0.08mm to 12.70 ± 0.18mm
Width=W	0.020 ± 0.003 in. to 0.100 ± 0.005 in. ····· 0.50 ± 0.08mm to 2.54 ± 0.13mm

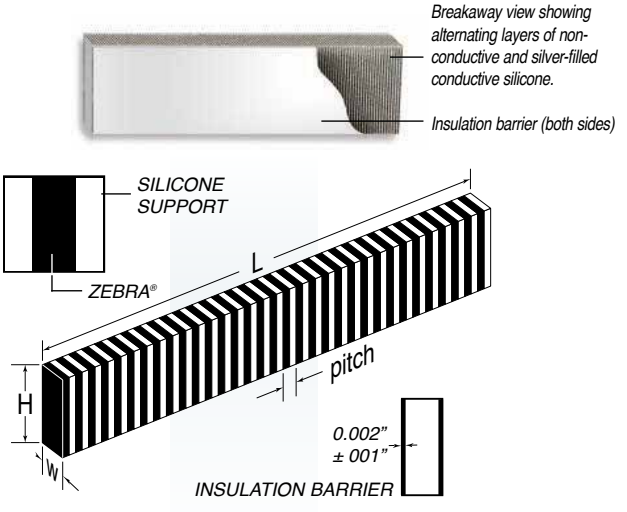
TABLE B

ZEBRA® Connectors	Temperature Range Minimum	Maximum	Current Carrying Capacity 0.040" x 0.040" pad	Resistance Between Layers
Silver ZEBRA®	-40°F -40°C	185°F 85°C	0.3 amps	10^{12} ohms

TABLE C

All dimensions in millimeters and inches

SELF-SUPPORT AND INSULATION BARRIER



Details show silicone support (left) and insulation barrier (right). Each is available on one or both sides. Configurations may also include support on one side and insulation on the other.

***Note:** Recommended Height (H) should be twice Width (W) dimension for minimum force deflection. Maximum Skewness 2% of Height.*

DESIGN RECOMMENDATIONS

Recommended deflection range is 5-25% of free height. Minimum deflection will vary with packaging applications and should consider overall height, PC board warpage, finish, etc. (Contact Fujipoly Product Application Engineering for assistance.) Design recommendations for solid ZEBRA® over 0.400" deflect 0.050" maximum. Silicone supported over 0.400" deflect 0.060" typical.

TEST CONDITIONS:

The use of an insulating barrier or silicone self-support material on one or both sides of the connector is recommended. The silicone support is utilized to reduce clamp force and provide an element of environmental protection for a cost-effective connection.

Item	Standard	Test Method
High Temperature	MIL-202D-108A	85° C 1500 hr
Low Temperature	—	-40° C 500 hr
Moisture	MIL-202D-103B	40° C 95% RH x 500 hr (250mA/pad)
Thermal cycle	MIL-202E-107G	65°C/25°C/150°C/ 25°C, 5 cycles

NOMINAL RESISTANCE CALCULATION

For the purpose of calculating the resistance of silver ZEBRA® connectors and testing them for compliance please use the following formula:

Where: R = Resistance in Ohms
W_1 = Width of ZEBRA® portion (inches or mm)
E_W = Electrode pad width (inches or mm)
H = ZEBRA® height (inches or mm)

Metric (mm)

$$R = \frac{H \times 0.01}{E_W \times W_1} + 0.10$$

English (inches)

$$R = \frac{H \times 0.0004}{E_W \times W_1} + 0.10$$

Example: if ZEBRA® is 0.100"/2.54 mm H and 0.030"/0.762mm W, then the maximum resistance on a 0.050"/1.27 mm wide pad will be:

Metric

$$R = \frac{2.54 \times 0.01}{0.762 \times 1.27} + 0.10 = 0.127 \text{ ohms}$$

English:

$$R = \frac{0.100 \times 0.0004}{0.030 \times 0.050} + 0.10 = 0.127 \text{ ohms}$$

NOMINAL FORCE DEFLECTION - PLAIN ZEBRA® OR INSULATION BARRIER TYPE

ZEBRA® connectors should be deflected 5% to 25% of H. To calculate F-Force for deflection, use the following formula:

Where:

F = Force (N)

$$D = \frac{H - H_1}{H} \times 100\ (\%)$$

H = Height of connector (mm or inches)
H_1 = Deflected height of connector (mm or inches)
W = Width of connector (mm or inches)
W_1 = Width of ZEBRA portion (mm or inches)
L = Length of connector (mm or inches)

Metric:

$$F(N) = 10.0 \times D \times W \times L \times 9.8 \times 10^{-3}$$

Inches:

$$F(N) = 6452 \times D \times W \times L \times 9.8 \times 10^{-3}$$

NOMINAL FORCE DEFLECTION - SILICONE SUPPORT TYPE

Metric:

$$F(N) = [(10.0 \times D \times W_1 \times L) + \{2.2 \times D \times (W-W_1) \times L\}] \times 9.8 \times 10^{-3}$$

Inches:

$$F(N) = [(6452 \times D \times W_1 \times L) + \{1149 \times D \times (W-W_1) \times L\}] \times 9.8 \times 10^{-3}$$

All dimensions in millimeters and inches

ZEBRA® Dummy Elastomeric Connectors

Non-conductive silicone strips made in the same exacting tolerances as the conductive ZEBRA® connectors.

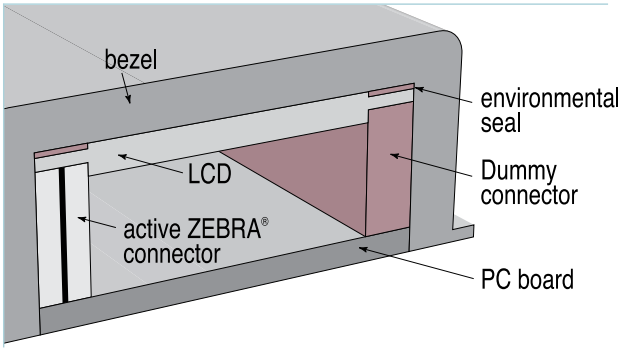
Used in locations adjacent to the active connector to balance the overall leveling and positioning of the display; also to control shock and vibration, and for use as an environmental seal between bezels and LC displays.

Can be installed in the same plane as the connector, and also between the bezel and the display in a variety of easy installation methods.

Consistent dimensional tolerance control assures accurate electronic packaging.

APPLICATIONS:

- *LCD and EL display balancing*
- *Bezel gasket, environmental seal*
- *Shock, vibration damping*



Typical Dummy ZEBRA® installation as an environmental seal and as Dummy connector.

Two types are available which match the mechanical functions of the active ZEBRA® connectors: extruded and closed cell sponge. A range of compression characteristics are available based on the material durometer selections shown below.

Type	Application Guidelines	Dimensions (mm)
Extruded	19 Durometer - translucent 25 Durometer - pink, blue	**maximum:** Length 457.0 Width 152.0 Thickness 0.38min., then in increments of 0.127 up to 1.78
Sponge	20 Durometer - pink	**maximum:** Thickness 0.38min., then in increments of 0.127 up to 1.78

Custom configurations are also available. For further information, contact Customer Service.

Part Number Nomenclature:

To specify a Dummy connector to your exact requirements, substitute the metric measurements for width, length and height according to the instructions below.

ZEBRA® DC 1.5 x 20 x 1.78 - EXT - 19

- *Durometer • 10, 19, 20, 25*
- *EXT for extruded • SPG for closed cell sponge*
- *Width*
- *Length*
- *Thickness*
- *ZEBRA® series • DC for Dummy connector*

All dimensions in millimeters and inches

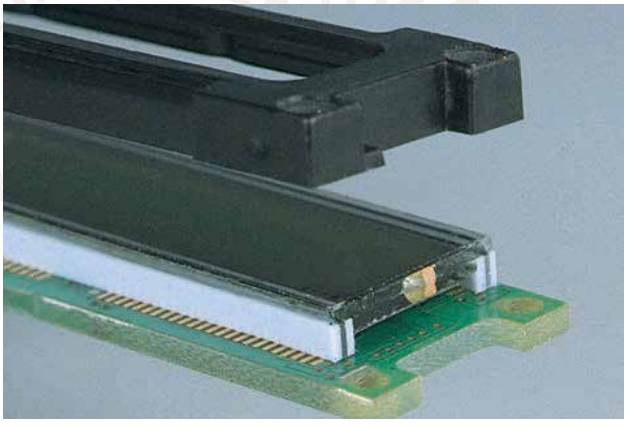
INDEX

Fujipoly electronic packaging components provide the finest performance available. To assure expected long-term results, refer to the following simple guidelines for each product area.

GLOSSARY OF CONNECTOR TERMINOLOGY

ASPECT RATIO (AR)	*Ratio of ZEBRA® connector height to width. (Aspect ratio of 1.5 and higher is recommended to minimize the amount of force required to deflect the ZEBRA® connector.)*
BEZEL	*Positioning device designed to surround the LCD edges while applying force to the ZEBRA® connector. Usually the decorative portion of the connector package. Plastic or metal cover placed over the LCD.*
BRIDGE	*Rib section on a ZEBRA® connector holder serving to reinforce the holder as well as minimize the length of individual ZEBRA® connection spans.*
COMPRESSION SET	*Amount by which a compressed ZEBRA® connector will not recover to its original height when compression is removed within the prescribed deflection limits. (typical maximum of 25%)*
CONNECTOR PITCH	*Center-to-center measurement of conductive layers.*
CONTACT DENSITY	*Number of conductive layers per inch.*
DEFLECTION	*Difference in original height versus compressed height of connector.*
GAP	*Space on a PC board or LCD which does not contain contact pads.*
HOLDER / RETAINER	*Positioning device used to contain the ZEBRA® connector to assure proper alignment between two mating surfaces.*
LCD PITCH AND/OR PC BOARD PITCH	*Centerline-to-centerline distance between contact pads.*
LIP WIDTH	*Distance from outside edge of front glass to edge of back glass.*
PAD WIDTH	*Distance measured edge-to-edge of contact pad (CW).*
PAD LENGTH	*Distance measured end-to-end of contact pad (CL).*
PAD MATERIALS	*LCD contact pads are normally indium tin oxide. PC board contact pads may be gold, carbon-coated or solder-coated. Plating methods can result in significant variations in contact pad thickness, but should be kept as flat as possible.*
REGISTRATION	*Vertical alignment of contact pads between two mating surfaces.*
SEPARATION	*Distance between two mating surfaces.*
STRESS RELAXATION	*The function which relates to the loss of back stress of the compressed connector over time. Expressed as a percent of original stress.*
TOLERANCE STACK-UP	*Minimum and maximum dimensions of separation between LCD contacts and PC board contacts as determined by consideration of tolerance variations in flatness and parallelism of components.*

ZEBRA® Design Guidelines - Connectors

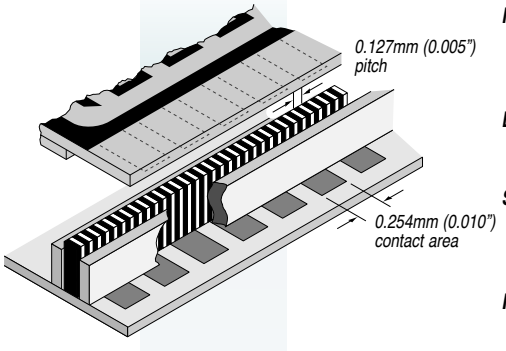


Micro-electronics interconnect packaging applications by their very nature leave a minimum of space in which to assemble mating components. High reliability and very small interconnections, with an ever-increasing number of I/O's, are a must if design objectives are to be met. ZEBRA® connectors can be found in most product types of this nature, and continue to gain wider acceptance as product packages decrease in size. Since each style consists of integral conductors, insulators and self-support structures, there is generally no added componentry required for installation – thus a very important by-product of hardware and installation cost-effectiveness can be realized.

AS EASY AS 1...2...3: *Using ZEBRA® elastomeric electronic connectors requires only a brief orientation in order to assure that the components provide the finest performance possible. The basic design steps consist of:*

1. ***Layout of your package***
2. ***Select the proper connector and size***
3. ***Design the bezel or retainer***

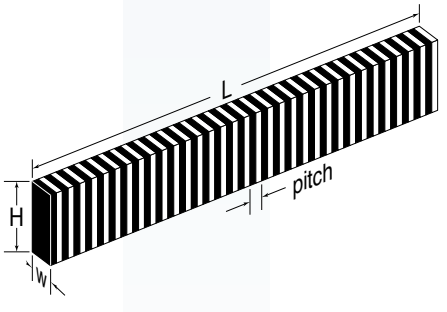
DESIGN FEATURES AND CHARACTERISTICS



ZEBRA® connectors are composed of alternating layers of conductive and non-conductive silicone rubber. Contact density of the ZEBRA® connector is greater than the contact pad density of either the LCD or PC board, making it an ideal design choice. When placed between the LCD and PC board at least one conductive layer will connect matched contact pads and at least one insulating layer will isolate adjacent circuits.

SOLDERLESS CONNECTIONS	*Pressure type contact eliminates lead straightening, hole drilling and soldering.*
NON-ABRASIVE CONTACTS	*(Zero insertion force) Contact to the LCD is made by deflecting the ZEBRA® connector between the LCD and PC board. ZEBRA® connectors are non-abrasive and will not damage indium oxide contact pads on the LCD. Repeated assembly and disassembly of package components will not affect performance.*
ENVIRONMENTAL RELIABILITY	*The LCD, when mounted with a ZEBRA® rubber connector, creates a gas tight seal at the contact interface. Assures contact in chemically corrosive atmospheres while at the same time protecting the glass display from shock and vibrations.*
SMALL GLASS OVERHANG	*With a ZEBRA® connector, LCD terminal overhangs can be as narrow as 0.030"/8mm permitting more efficient use of glass size related to character height. (Metal pins normally require a 0.150"/3.9mm glass overhang, reducing character height by as much as 0.240"/6.1mm for a dual in-line LCD.)*
HIGH DENSITY CONTACT	*ZEBRA® connectors are available in a variety of contact densities. The most dense allows contact pad spacing as close as 0.010"/0.25mm center-to-center. This spacing can be compared to 0.050"/1.3mm minimum for pins, allowing for increased capacity of LCD formats.*
TEMPERATURE RANGE	*-55˚ TO +260˚ F/-50˚ C TO +125˚ C (-60˚ TO +125˚ C available on request)*
CURRENT CARRYING CAPACITY	*40 amps per square inch of contact pad. (0.050A for .035 x .035 pad)*
CONNECTION RESISTANCE	*Typically 500 to 2,500 ohms.*
INSULATION RESISTANCE	*Typically 10^{12} ohms.*
DEFLECTION FORCE REQUIRED	*1.5 pounds per linear inch for a 0.020" wide ZEBRA®.*
LIFE	*100,000 hours minimum.*
CONDUCTIVE LAYERS	*up to 500 per inch.*

PHYSICAL AND ELECTRICAL MEASUREMENTS - NOMINAL



DIMENSIONS *- The above figure shows the dimensions of the ZEBRA® connector. For best overall performance ZEBRA® connectors should be designed with an aspect ratio of H/W equal to or greater than 1.5.*

MECHANICAL - FORCE DEFLECTION *- Recommended deflection is 5% to 25% of the height (H) dimension. To calculate F (force in pounds) for deflection the following formula may be used:*

For Carbon ZEBRA®s

Metric:
$F = 9 \times D \times W \times L \times 9.8 \times 10^{3}$

Inches:
$F = 5806 \times D \times W \times L \times 9.8 \times 10^{3}$

For Silver ZEBRA®s

Metric:
$F = 10.0 \times D \times W \times L \times 9.8 \times 10^{3}$

Inches:
$F = 6452 \times D \times W \times L \times 9.8 \times 10^{3}$

Where:
F = Force (N)

$D = \frac{H - H_1}{H}$

H = Height of connector (mm or inches)

H_1 = Deflected height of connector (mm or inches)
W = Width of connector (mm or inches)
L = Length of connector (mm or inches)

RESISTANCE *- To calculate the resistance of ZEBRA® connectors, choose one of the following formulas:*

For Carbon ZEBRA®s

Inches:
$R = \frac{2.37 \times H}{E_W \times W} = \text{ohms}$

Where E_W = Electrode pad width (in)
W = Connector width (in)
H = Connector height (in)

Metric:
$R = \frac{60 \times H}{C_W \times W} = \text{ohms}$

Where E_W = Electrode pad width (cm)
W = Connector width (cm)
H = Connector height (cm)

For Silver ZEBRA®s

Inches:
$R = \frac{H \times 0.0004}{W \times E_W} + 0.10 = \text{ohms}$

Where W = Width of ZEBRA® (in)
E_W = Electrode pad width (in)
H = Height of ZEBRA® (in)

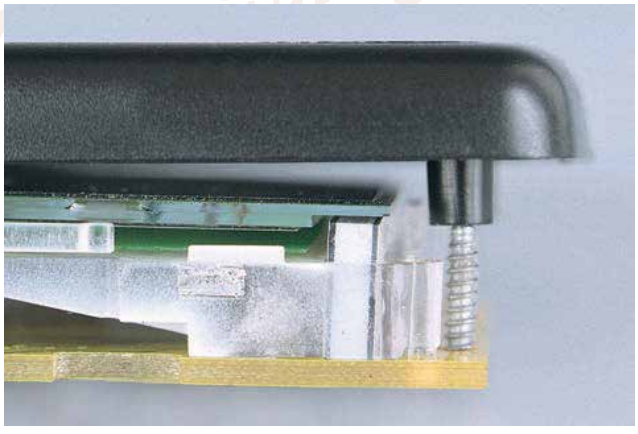
Metric:
$R = \frac{H \times 0.01}{W \times E_W} + 0.10 = \text{ohms}$

Where W = Width of ZEBRA® (mm)
E_W = Electrode pad width (mm)
H = Height of ZEBRA® (mm)

ENVIRONMENTAL SEALING

The ZEBRA® connector will provide a gas tight seal. Adverse effects of temperature, shock and vibration, atmospheric corrosion as well as harsh chemical environments will not affect LCD or PC board contacts, when sealed through use of a ZEBRA® connector.

ZEBRA® Design Guidelines - Connectors



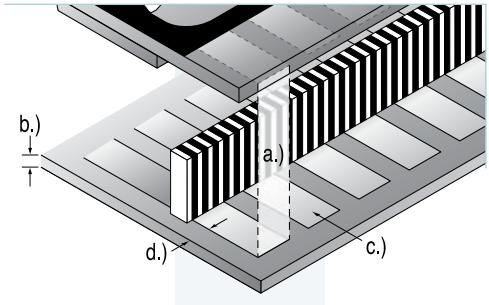
1. LAYOUT OF YOUR PACKAGE:

Shown at left is a typical LCD-to-printed circuit board interconnect using ZEBRA® elastomeric connectors in a cellular telephone handset. The components are stacked and consist of only three items to be addressed:

- ***Liquid Crystal Display (LCD)***
- ***ZEBRA® connector***
- ***Printed Circuit Board (PCB)***

It is essential that contact mating characteristics be kept as similar to the other components as possible. Any factors restricting positive contact interface should be compensated for in the design. Some of these are as follows:

1.1 PRINTED CIRCUIT BOARD DESIGN CONSIDERATIONS



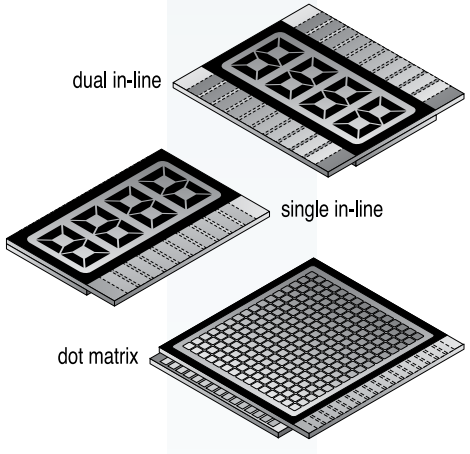
a.) ***Registration of contact pads*** *between the LCD and PC board is critical in effecting contact. Contact pads of both should ideally be of the same size and equally matched in tolerances for width and pitch.*

b.) ***Consider carefully PC board thickness*** *and the related flatness tolerances. Proper design should involve the control of "waviness" tolerances and board stiffness. Both elements are essential in the appropriate design and selection of the ZEBRA® connector. Connector deflection and width are important considerations in determining the size of the ZEBRA® connector to be used in order to maintain proper deflection without "bowing" the PC board.*

c.) ***Contact pad material*** *on the PC board, as well as the LCD, should be smooth and regular with thickness tolerances established.*

d.) ***Consider the area on the PC board*** *to be dedicated to the LCD and the presence of neighboring components. Location of the LCD above or on the PC board should permit free clearance on all four sides of the PC board profile of at least 0.250"/6.2mm for packaging and/or fastening.*

1.2 LCD DESIGN CONSIDERATIONS



a.) ***Select LCD configuration****, e.g., Single In-Line (SIL); Dual In-Line (DIL); or contacts on both planes. Example: Dot Matrix.*

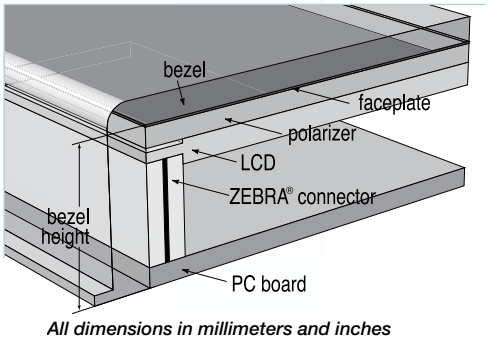
b.) ***Select an LCD*** *which in its design has contact pads on the reverse side of the viewing area (facing PC board). For those instances where contact pads cannot be stationed facing the PC board, a custom elastomer may be required.*

c.) ***Pitch*** *of LCD contact pads.*

d.) ***Length, width, and thickness*** *of combined front glass and back glass of LCD.*

e.) ***Determine lip width*** *(distance from outside edge of front glass to edge of back glass). This dimension should be at least 0.060"/1.5mm and preferably 0.100"/2.5mm. Ideally, contact pads should extend to the outer edge of the lip on the glass.*

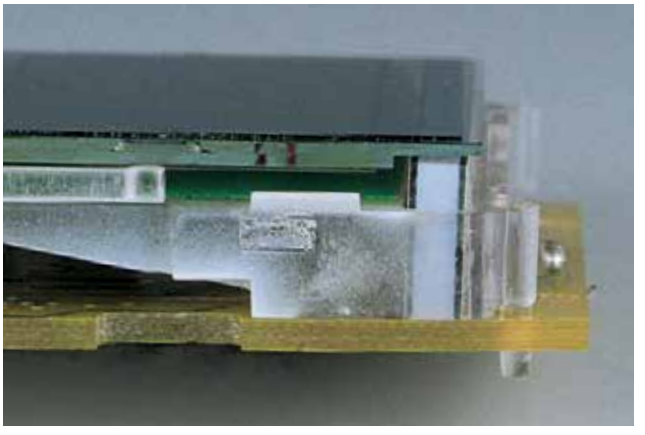
1.3 CALCULATING THE SEPARATION FACTORS



All dimensions in millimeters and inches

Consideration must be given to tolerance control *on the elements that comprise the connector package. There are separate flatness and parallelism tolerances for the LCD glass, polarizers, reflectors and PC board. Materials used for the contact pads of the LCD and contact pads of the PC board also have thickness variations which must be considered. Flatness of the PC board and parallelism between the components are also factors. These tolerance values are vital criteria in determining separation variations between the LCD and PC board. The sum of the tolerances of these elements plus nominal separation determine the height (H) of the connector which will meet your design application.*

Design Guidelines - Connectors

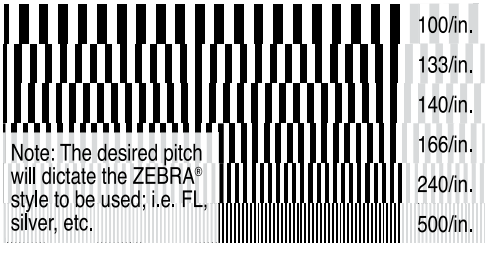


2. SELECT THE CONNECTOR AND SIZE

ZEBRA® elastomeric connectors offer a wide variety of application possibilities, in many cases where no other type of interconnect device is possible. They require a minimum of installation hardware considerations, allowing for very small packaging structures to support low profile display and microelectronic interfacing.

When properly dimensioned, long-life performance can be assured and gas-tight connections without additional precautions can be realized.

2.1 CONNECTOR PITCH AND LENGTH

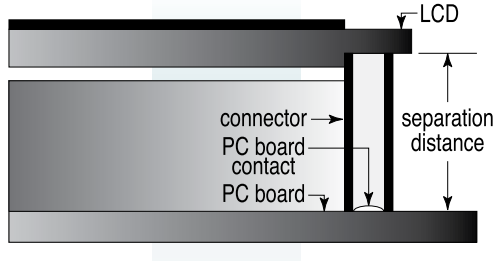


a.) ***Select a** ZEBRA® **connector that will assure that at least one conductive layer** connects between contact pads, for example, of an LCD and PC board to be interconnected, and at least one insulating layer is between adjacent contact pads.*

b.) ***ZEBRA® connectors can accommodate** applications with contact spacing of .010"/.254 mm center-to-center or greater.*

c.) ***The overall length** should extend a minimum of 0.020" beyond the edge of the contact at each end of the connector.*

2.2 CONNECTOR HEIGHT



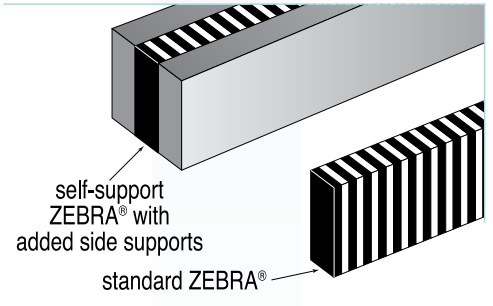
a.) ***ZEBRA® connector height** is determined by the separation distance between LCD and PC board contact pads, including tolerance variations. ZEBRA® connectors can be supplied with a height of up to 1"/25mm.*

b.) ***ZEBRA® connector height** is the most critical dimension in determining the functional performance of the connected components. Calculate the tolerance stack-up of the PC board, LCD, polarizer, and ZEBRA®. Multiply the maximum separation distance by 1.10 (adding 10% to separation distance) to establish uncompressed ZEBRA® connector height.*

c.) ***The following example** shows calculations used in determining uncompressed ZEBRA® connector height.*

***Example:** Separation distance in this application equals 0.200"/5.08mm with tolerance of +/- 0.005"/0.13mm representing the tolerance stack-up from one end of the LCD and PC board separation to the other end. The minimum separation in our application equals 0.195"/4.9mm; the maximum separation equals 0.205"/5.2mm. Multiply the maximum separation of 0.205"/5.2mm by 1.10 to develop the uncompressed ZEBRA® connector height. The resulting 0.225"/5.7mm uncompressed height of ZEBRA® connector is the correct ZEBRA® connector height to assure adequate contact and achieve the minimal 0.195"/4.9mm separation for assembled height of the LCD, PC board package, and to insure contacts in areas where the minimum separation of 0.195"/4.9mm prevails. To achieve the 0.200"/5.08mm assembled height, it is necessary to deflect the 0.225"/5.7mm free height ZEBRA® connector by 10%. The design result falls within the 5%-25% deflection range recommended for effective ZEBRA® connector contact.*

2.3 CONNECTOR WIDTH

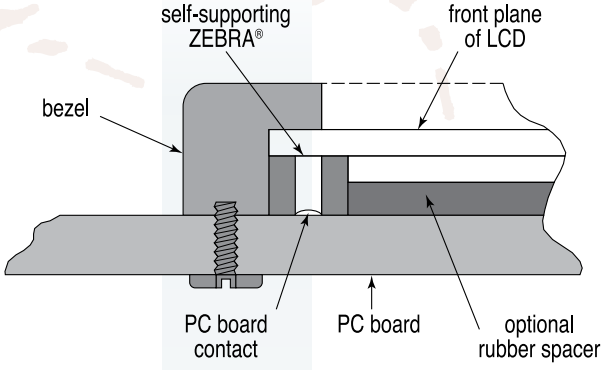


a.) ***Force deflection** considerations of the ZEBRA® connector (Refer to Force Deflection formula) result in a recommendation of 0.025"/0.6mm as the width for connectors of lengths between 0.25"/6mm and 2.5"/63.5mm. Continuous connector spans of 2.6"/66mm to 8"/203mm require a minimum 0.035"/0.9mm wide connector to allow easy assembly of the ZEBRA® connector into the slot of a holder. Ideally, the ZEBRA® connector length should be limited to 2.5"/63.5mm due to possible insertion difficulties of the connector in the slot of the holder.*

b.) ***ZEBRA® connectors with a width of 0.025"/0.6mm to 0.035"/0.9mm** require the use of a holder. (See design of ZEBRA® connector holder.) Fujipoly offers standard self-supporting ZEBRA® connectors eliminating the need for fabricating a holder for heights up to 0.200"/5.08mm.*

All dimensions in millimeters and inches

Design Guidelines - Connectors



3. DESIGNING THE CONNECTOR HOLDER

Once the ZEBRA® style and design have been decided upon, two last considerations should be resolved; namely:

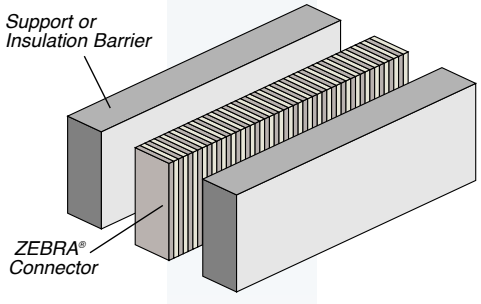
-Support of the ZEBRA® connector in its operating position

-Application of pressure onto connector height dimension to cause deflection and proper contact to the conductive contact pads.

The most common alternatives are among the following:

- ***A Self-Supporting ZEBRA® connector***
- ***A Custom Holder - for your specific configuration***
- ***Clamping or fastening devices***

3.1 STANDARD SUPPORTED SIZES

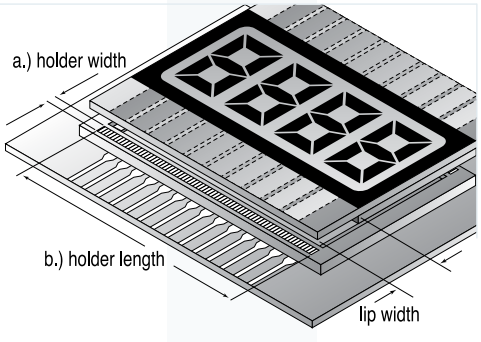


The supported connector typically contains a thin elastomeric 0.020"/.51mm wide strip attached to either one or both sides. It is a sponge or solid silicone rubber support medium which allows a lower compression force over a wide range while also providing a greater width-to-height ratio. Thus, the free-standing stance is more stable, especially as compression is introduced.

Carbon and Silver Filled Standard Dimensions (in./mm)

	min.	***max.***
width	*0.050/1.27*	*0.157/3.44*
height	*0.050/1.27*	*1.000/25.4*
length	*0.250/6.35*	*9.000/229.0 carbon; 5.000/127.0 silver*

3.2 DIMENSIONING A STANDARD OR CUSTOM CONNECTOR HOLDER



a.) ***Holder/Retainer width:*** *Determine LCD lip width as well as clearance on the PC board allowed to accommodate the LCD.*

b.) ***Holder length:*** *Holder should extend a minimum of 0.1"/2.5mm beyond the edges of the front of the glass of the LCD and/or the PC board pad lengths in order to provide support, and proper positioning and placement of aligning pins of the holder. Where wall thickness of the holder must be thin and length of contact area is in excess of 2.5"/63.5mm, it may be necessary to provide a bridge or separator in the holder slot at 2.5"/63.5mm intervals, or the wall thickness of the frame on either side of the slot must be adequate to inhibit inward "bowing". Design considerations should preclude such bridges or separators from interfering with the contacts designed to be between LCD and PC board.*

The difference between slot width and ZEBRA® width should be approximately 0.005"/0.13mm to allow for easy insertion and removal.

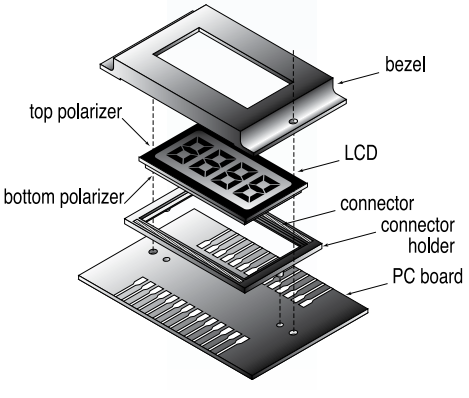
c.) ***The following design considerations should be evaluated:***

Plastic Holders: *Reinforced plastic is preferable because it affords superior physical and electrical design properties. Temperature range of LCD should be consistent with temperature specifications of plastic selected. Chamfer the slot in the holder as shown in the illustration. Add 0.005"/0.13mm to the width of the slot for insertion of the ZEBRA® connector. Allow a minimum of 0.050"/1.3mm wall thickness or greater as height approaches 0.150"/3.8mm/ Locating pins should be molded to bottom of ZEBRA® connector holder to provide registration between LCD and the PC board contacts. See Figure #1.*

Metal Holders: *In designing metal holders, specify an insulating barrier or supports on the sides of the ZEBRA® connector to assure electrical insulation to eliminate shorting, etc.*

Locating pins: *Should be provided on the ZEBRA® connector holder to provide registration between LCD and PC board contacts. Check with the LCD manufacturer regarding the glass seal in designing either plastic or metal holders. Provide room in the ZEBRA® connector holder for the seal. Provision should be made to accommodate loose polarizers and reflectors if such elements are included in the design.*

3.3 DESIGNING THE BEZEL



In determining design requirements for the bezel, specific design elements should be considered:

a.) ***Using separation distance factors****, determine required height of the bezel. Length and width of the LCD plus holder tolerances will establish length and width dimensions.*

b.) ***Must the LCD be protected?*** *If so, the bezel should incorporate a cover element.*

c.) ***Is sealing required*** *to prevent dust and/or moisture intrusion? Under what environmental conditions will the LCD be expected to function?*

d.) ***What is the LCD viewing area?*** *Be sure that bezel edges do not interfere.*

e.) ***Is masking required*** *for any portion of the LCD viewing area?*

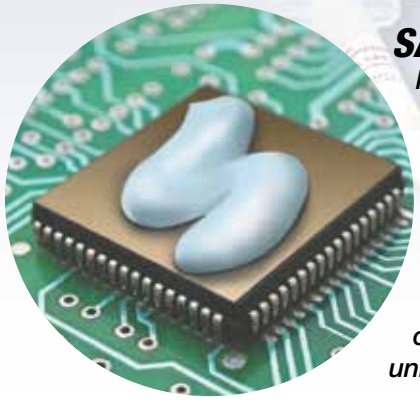
f.) ***Can the housing or case of the end product be used to provide the necessary pressure*** *and protection required for the LCD/PC board connection? If so, a bezel may not be necessary.*

g.) ***Will there be a need for clamps or fasteners?*** *Consult Fujipoly as a design reference source for bezel configurations.*

All dimensions in millimeters and inches

ADDITIONAL PRODUCT LINES

Fujipoly is a world-leader in the development and production of silicone-based electronic packaging solutions. In addition to Elastomeric Connectors, Fujipoly offers advanced Thermal Interface Materials, Custom Rubber Extrusions and Fusion Tapes. Fujipoly is the go-to source when performance, value and reliability are the keys to the success of your product.



SARCON® Thermal Interface Materials

More power and light weight. In the past, these two characteristics in electronics were mutually exclusive. Now, micro-electronics are just that, and in addition, need thermal management components to further complement these objectives. SARCON® is an advanced silicone rubber with high thermal conductivity and superior flame-retardancy. By combining the inherent silicone rubber properties of heat resistance, electrical insulation and long-term aging into one compound, this universally applicable material can be made in an unlimited number of thermal management configurations.

Custom Rubber Extrusions

Complex shapes of silicone rubber consisting of different properties such as conductive and non-conductive segments, or color coding. Specifically custom designed to eliminate multiple extruded components by combining different elements into one unitized design.

Fusible Tapes

Self-fusing silicone rubber general purpose class H electrical tape is ideal for insulating or conductive applications where a quick, reliable weather-resistant electrical or hydraulic leak seal is required. The highly elastic material wraps around problem areas, immediately conforming to the applied surface with a tight fitting adhesion. Originally developed for military applications, and now available for general commercial use.

Notes

Notes

ORDERING Information

FUJIPOLY® LOCATIONS

Fuji Polymer Industries Co., Ltd.

Eternal Kitayama Bld 3F
1-3-18 Nishiki,Naka-ku,Nagoya-shi, Aichi 4600003 JAPAN
Phone +81-052-218-5480 Fax +81-052-218-5515
Web site http://www.fujipoly.co.jp/
E-mail sales@fujipoly.co.jp
ISO9001 (Aichi Plant)

Fujipoly America Corporation

900 Milik Street P.O. Box 119 Carteret,NJ 07008, USA
Phone +1-732-969-0100 Fax +1-732-969-3311
Web site http://www.fujipoly.com/
E-mail info@fujipoly.com
ISO9001-2008

Fujipoly Customer Engineering Resource Center

94 Bonaventura Drive, San Jose, CA, 95134
Phone +1-408-708-5980
E-mail fpcerc@fujipoly.com

Fujipoly Europe Ltd.

Avant Business Centre, Unit 8,Third Avenue, Bletchley Millton Keynes, MK1 1DR UK
Phone +44-1908-277800 Fax +44-1908-277900

Fujipoly Europe Ltd. German Liaison Office

Gaertnerstr. 60,80992,Muenchen,Germany
Phone +49-89-14900240 Fax +49-89-14900211
E-mail sales@fujipoly.eu

Fujipoly (Thailand) Co.,Ltd.

55/8 Moo 13 Navanakorn
Industrial Estate Phase 4 Phaholyothin Road,
Klong Nueng,Klong Luang Phathumthanee 12120,Thailand
Phone +66-2-529-2732 Fax +66-2-529-2223

Fujipoly Singapore PTE Ltd.

1001 Jalan Bukit Merah #02-17/20 Singapore 159455
Phone +65-6272-3766 Fax +65-6272-3577
E-mail info@fujipoly.com.sg
ISO9001

Fujipoly Hong Kong Ltd.

Workshop(F&J),Block1,4/F.,Kwai Tak Industrial Centre,15-33,
Kwai Tak Street,Kwai Chung,N.T.,HongKong.
Phone +852-2428-3770 Fax +852-2489-9637

Fujipoly Trading (Shenzhen) Co.,Ltd.

Room 2703, Shun Hing square,
Shennan East Road, Luohu district,
Shenzhen 518022, China
Phone +86-755-8237-5494 Fax +86-755-8237-5491

Fujipoly China (Dongguan) Electronics Co., Ltd.

Gaobao Road, The First Industrial Park, Tutang Estate,
Changping Town, Dongguan City, Guang Dong 523581 China
Phone +86-769-8398-9660 Fax +86-769-8398-9662
E-mail info@fujipoly.com.hk
ISO9001 ISO14001

Fuji Polymer Industries Co., Ltd. Taipei Liaison Office

Room B, 7F., No. 59, Tiansiang Rd.,Jhongshan District,
Taipei City 10452, Taiwan
Phone +886-2-2586-5771 Fax +886-2-2586-5745
E-mail fujipolytw@fujipoly.com.tw

Fuji Polymer Industries Co.,Ltd. Korea Liaison Office

Rm404,Daewoo Trump World 2-A #48,Yeouido Dong,
Youngdeungpo Gu,
Seoul,150-934,Korea
Phone +82-2-785-2801 Fax +82-2-785-2802
E-mail info@fujipoly.co.kr

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