X3T9.2/89-106

RN

Robinson Nugent

Electronic Connectors

August 9, 1989

Mr. John Lohmeyer
NCR Corporation
3718 N. Rick Road
Wichita, KS 76226

Dear John:

After reviewing mailing number 4 of the X3T9.2 membership, I came across the request for a ribbon contact design versus a pin and socket approach to SCSI II. From my discussions with you prior to this mailing, it was my understanding that the connector design was a closed book for the pin and socket design.

After reading your response to AST Research, it seems that there might be a slight possibility that the X3 Secretariat could option to revise the connector portion of the specification; therefore, I am sending my plea to do so. Attached please find such documentation as you requested.

Best regards,

Ben Mattox
Product Manager

BM:ljn

ATTACHMENT

ROBINSON NUGENT, INC.
800 East Eighth Street • P.O. Box 1208
New Albany, IN 47150-1208

Phone (812) 945-0211
Telex 810-540-4082
FAX 812-945-0804

Other Locations: Dallas, Texas • Kings Mountain, North Carolina • Paris, France • Delemont, Switzerland • Stuttgart, W. Germany • London, England • Tokyo, Japan

RN

Robinson Nugent

Electronic Connectors

August 9, 1989

X3 Secretariat CEBEMA
311 First Street, N.W.
Suite 500
Washington, DC 20001

RE: X3.131-198 (SCSI II Specification)

Dear X3 Secretariat:

The SCSI II specification is calling out a 50 position pin and socket tuning fork contact design. The X3T9.2 committee decided upon this specification based on multiple sourcing of product. This letter is intended to request that you consider an alternative design that is also multiple sourced at this time. It is a half pitch connector system that is available through Robinson Nugent, Inc. and KEL Corporation and incorporates a redundant ribbon contact design. Most engineering groups on the OEM level prefer the ribbon contact to the pin and socket tuning fork design and now that it is not a single sourced product, any objection to the product should not be valid. Please reference attached request from AST Research regarding contact design and support documentation comparing the two designs in detail.

Primary advantages of the ribbon contact design over the tuning fork design are as follows:

- Lower contact resistance
- Higher wear resistance
- Higher normal force
- Greater contact protection
- Lower insertion/withdrawal forces

Please consider my request to further investigate the possibility for the redundant ribbon contact design when reviewing the SCSI II draft which should be forthcoming to you. If you have any questions, please don't hesitate calling me direct at 812/945-0211.

Thank you for your consideration.

Best regards,

Ben Mattox
Product Manager

BM:ljn

ATTACHMENTS

CC: John Lohmeyer/NCR Corp.

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RN PAK-50

50mil Interconnect System

Robinson Nugent

ROBINSON NUGENT PARTNERS IN QUALITY

RN PAK-50™ INTERCONNECT SYSTEM - THE PERFECT MATCH
A Reliable Solution for 50mil Connector Packaging Requirements

Ben Mattox

Robinson Nugent, Inc.
800 E. Eight Street
New Albany, IN 47150

ABSTRACT

Until now the standard pitch for PC board connectors has been 100 mil (2.54mm), but as systems become smaller and the corresponding mounting density of PC boards increases, it becomes necessary to increase the density and thus reduce the size of connectors. As always, Robinson Nugent is sensitive to the needs of the market and has produced the **RN PAK-50™** Series of 50 mil (1.27mm) connectors. The **RN PAK-50™** Connector Series reduces the existing 100 mil spacing standard by half, effectively doubling mounting density. Smaller PC boards and smaller connectors will ultimately lead to overall cost reductions in systems of the future. The **RN PAK-50™** Connector Series represents a Robinson Nugent solution to the high density packaging requirements of today's electronic marketplace.

The **RN PAK-50™** redundant ribbon contact is unique in that it is a straight-beamed vertical design with two points of contact. This type of contact construction combined with the employed surface treatment technology, facilitates high pin counts with low insertion/withdrawal forces. In addition to low insertion/withdrawal forces, the **RN PAK-50™** Series is also able to maintain a high reliability contact interface.

INTRODUCTION

In the early 1960's, 125 and 156 mil card edge type connectors dominated the connector marketplace. In 1970, two row, two-piece connectors on 100 mil spacing began to take the lead. In the mid 1970's two-piece 3 row and 4 row connectors on 100 mil spacing with high pin counts began to pervade.

With the onslaught of smaller, feature rich, more complex electronic systems connector manufacturers have been faced with the challenge of developing higher density, higher pin count connectors. Today's high density electronic systems demand a much more efficient use of connector space. The reaction has been to design 50 mil pitch connectors to save space and maximize board density. The 50 mil pitch micro-miniaturized connector system provides the same number of contacts in a much smaller space.

The end result for designers and packagers is less board space with no decrease in I/O or even more I/O without increasing PC-board real estate. This in turn, contributes to significant cost reductions for packaging designers and system users.

PROPOSED TECHNOLOGIES

This micro-miniature connector solution (.050" center connector technology) has taken two forms:

Cross Sections

Figure 1. Pin/Socket Tuning Fork Contact Design

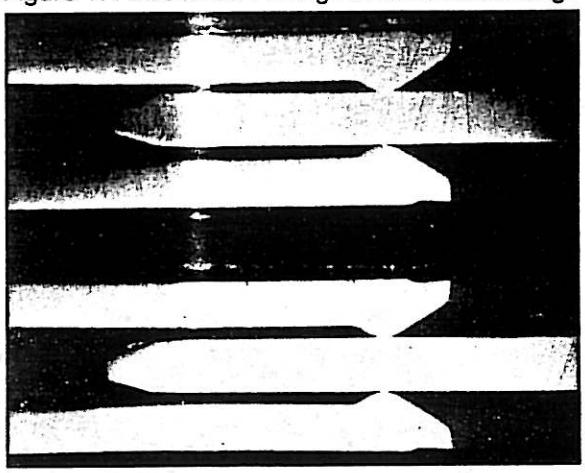
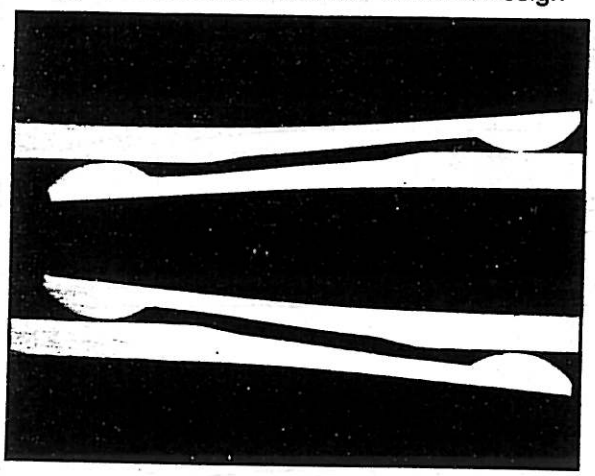


Figure 2. Redundant Ribbon Contact Design



TUNING FORK DESIGN CONCERNS

Specific concerns have arisen with high density pin socket technology utilizing a tuning fork contact design:

- No pin protection/pin deformation -
  With a pin and socket tuning fork contact design on .050" centers, one of the primary concerns is the lack of pin protection on the male header pin and the potential pin deformation that may result. Another concern with the tuning fork female contact is that it has a tendency to take a set readily upon mating. This will result in discontinuity and/or intermittence at the contact interface.
- Insertion/withdrawal forces -
  Insertion and withdrawal forces are very high and become unacceptable with higher pin counts, especially under multiple cycling applications.
- Rough faces/surfaces from stamping dies -
  Many times, the processing of tuning fork contacts results in rough contact surfaces. This causes minimal contact wear resistance, resulting in high insertion and withdrawal forces, high contact resistance and lower normal forces over the life of the connector. Figure 3 illustrates this concern.

Figure 3

- Static versus dynamic contact interface -
  The pin and socket tuning fork contact design utilizes a static header pin mating to a tuning fork contact. With the tighter confinement and smaller contacts on .050" centers, there is less room for error. A slightly oversized header pin or a slightly offset tuning fork contact could result in a poor connection. If both contacts are dynamic (moving/working with each other), the contact interface will have a tendency to maintain more reliable integrity.
- Insulator warpage with higher density/higher pin counts -
  When header pins are press fit into a plastic housing, there is a tendency for the plastic housing/insulator to bow or warp. The potential for warpage increases as the number of contacts and their density increases.
- Contact wiping action -
  The tuning fork contact incorporates minimal wiping action by design. The longer wipe a contact interface has, the more opportunity the contacts have in wiping debris, corrosion, etc. from the surface of the contact. The longer the wiping action, combined with adequate normal forces, the more reliable the interconnect system will be.

RN PAK-50™
REDUNDANT RIBBON SOLUTION

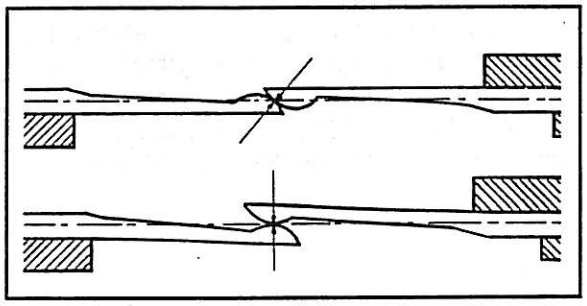
The **RN PAK-50™** redundant ribbon dynamic contact interface addresses and resolves the concerns and inadequacies of the pin and socket tuning fork contact design on .050" centers.

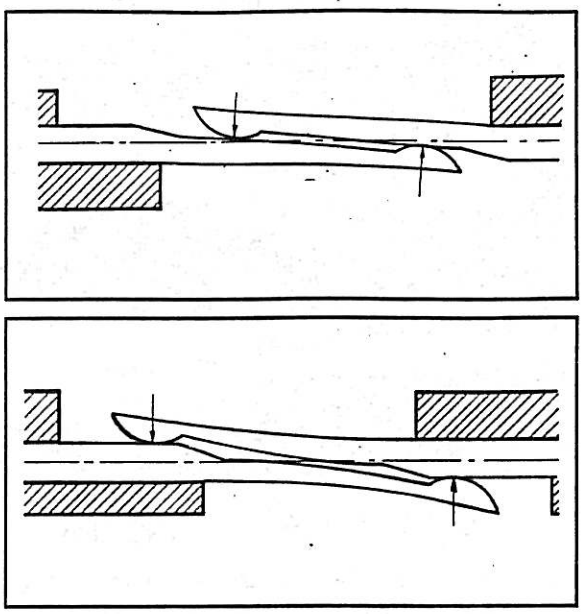
The smooth, tapered surfaces of the **RN PAK-50™** redundant ribbon contacts allow for lower insertion and withdrawal forces, yet are able to yield higher normal forces, lower contact resistance, and high wear resistance. This is due in part to the nature of the dynamic contact design and the actual processing/stamping of the contacts. Both contact surfaces move together when mated. This results in contact surfaces working together versus against each other.

The contacts are partially recessed in the insulator housing on both the male and female connector. This shrouding protects the contact surfaces from damage or misalignment and minimizes any potential pin deformation. The long, smoothly tapered redundant ribbon contact also affords a longer wiping action to facilitate a cleaner, more reliable contact interface. The potential insulator warpage is also minimized as a result of the redundant ribbon contact design.

The **RN PAK-50™** redundant ribbon contact interface incorporates a 3 stage mating. In the first stage, the smoothly curved tips of each contact meet with one another and gently slide over each other's smoothly processed arced surface. In the second stage, the curved tip of each contact wipes against the smooth gradually tapered beam of the other contact. In the third stage, the mating point of the tip reaches the trunk of the other contact.

Figure 4. Three Stage Mating Diagram.

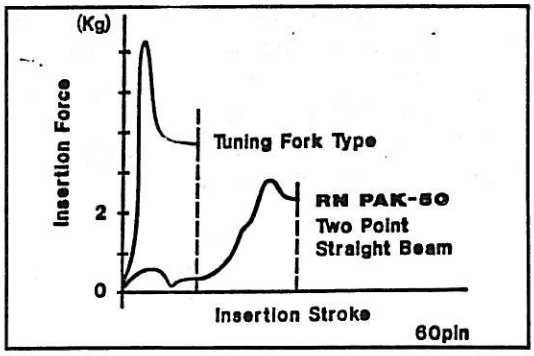




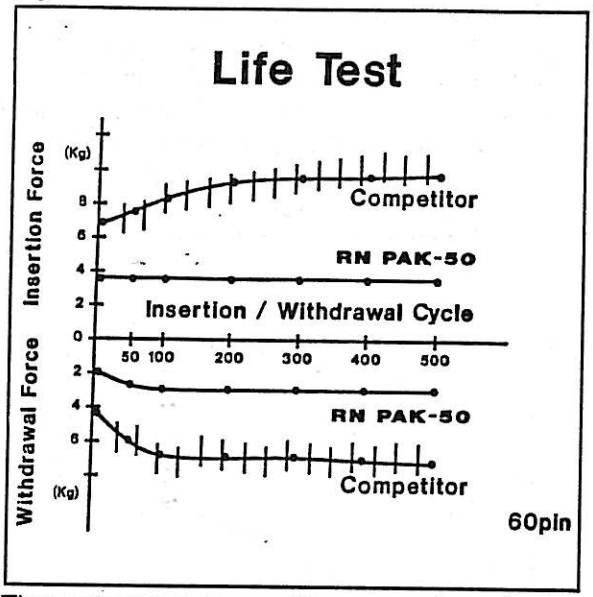
The mating point of the **RN PAK-50™** redundant ribbon contact moves during the mating process. Connector wear is distributed along the curved tip; therefore, connector life is increased. This results in an interconnect system that is highly durable and resistant to wear. Connector performance is not significantly changed after multiple insertion and withdrawal cycles. The dynamic mating mechanism is the key to the wide applicability of the **RN PAK-50™** interconnect system for many packaging requirements.

Initial comparisons of insertion force measurements between the tuning fork contact design and the **RN PAK-50™** redundant ribbon contact design show that the **RN PAK-50™** demonstrates significantly lower forces.

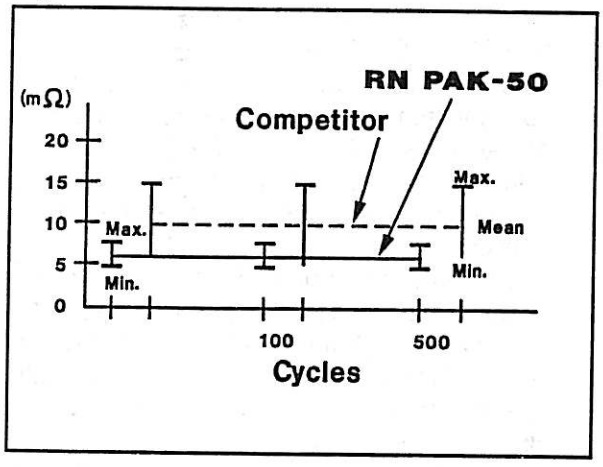
Figure 5



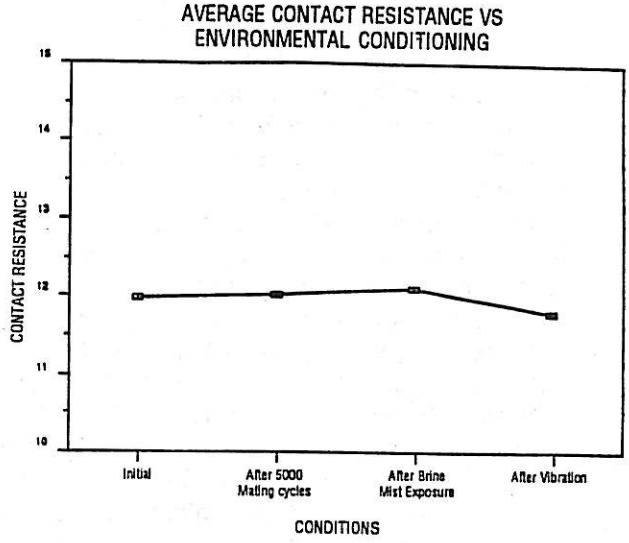
As the connector pairs are multiply mated, the insertion/withdrawal forces of the competitor's tuning fork contact increase. This is an indication of poor wear characteristics. The insertion/ withdrawal forces of the **RN PAK-50™** redundant contact remain stable and constant.
Figure 6



The contact resistance of the connector pairs after 500 cycles can be seen in Figure 7 below. The competitor's tuning fork interface yields approximately twice the contact resistance as the **RN PAK-50™** redundant ribbon contact interface. The competitor's tuning fork connector also yields approximately twice the variance between maximum and minimum contact resistances.
Figure 7



To further qualify the high wear characteristics of the **RN PAK-50™** redundant ribbon contact design, three groups of connector pairs were tested. The devices under test were first assessed for insertion/extraction durability, followed by environmental and vibration resistance tests. At each stage the devices under test were visually inspected for external or structural defects and their contact resistance was measured. The graphs that follow depict the actual test averages. As can be seen from Figure 8, contact resistance fluctuations for all **RN PAK-50™** connectors were well within the specified 25 milliohm limit.
Figure 8



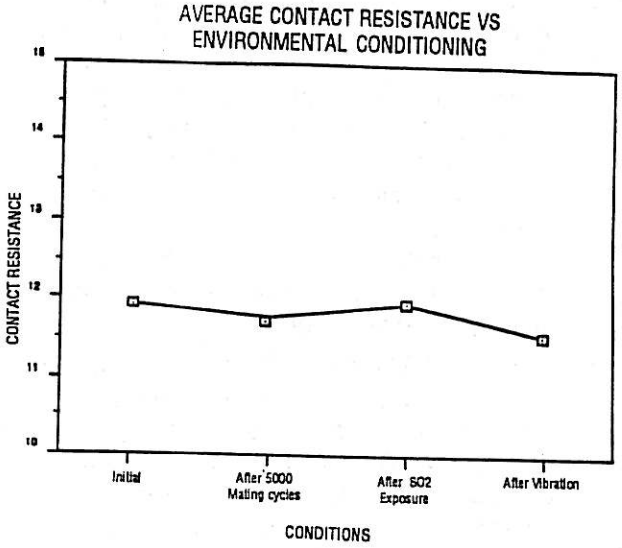
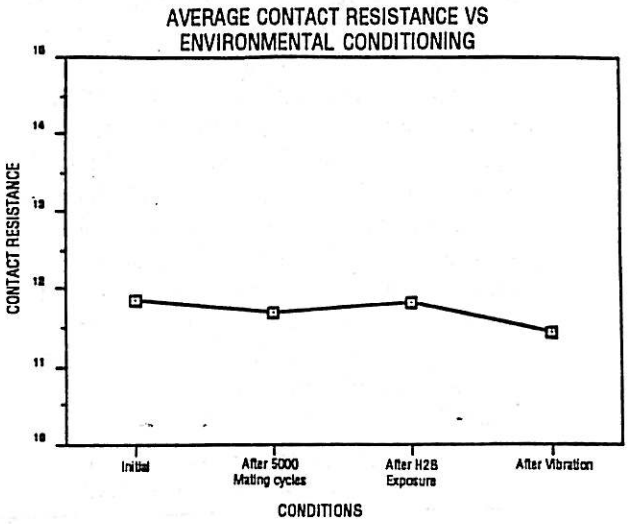


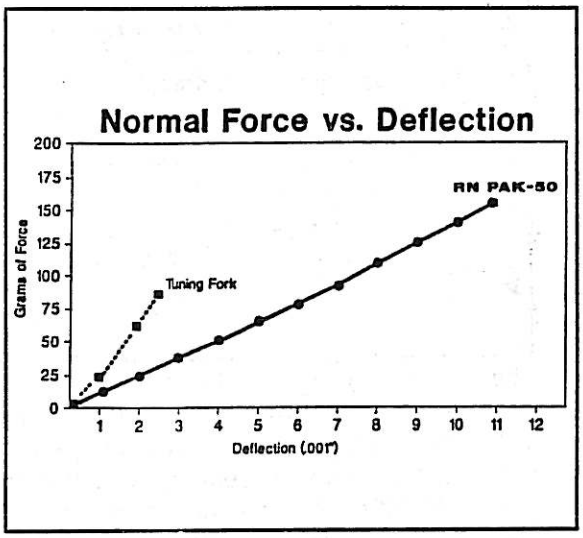
Figure 8 Continued



Adequate normal force is one of the most important criteria for determining the overall reliability of an interconnect system. In the past, a minimum of 50 grams of normal force on a gold-to-gold interface was considered acceptable. Today, many OEM's specify a minimum of 100 grams of normal force per contact beam on a gold-to-gold interface. Normal Force is a function of contact design and deflection. Deflection is a function of contact design; however, it can be affected by environmental conditions. If deflection is minimal as a result of the contact design, there becomes less room for error. Tolerances must be more tightly controlled and maintained. As seen in Figure 9 for the competitor's tuning fork contact, the maximum deflection is only 0.0026". At this deflection, the tuning fork design is only capable of yielding approximately 85-90 grams of normal force. If an oversized pin is mated with the tuning fork contact, if the contact takes a set, if stress relaxation is caused by heat, or if the connector is simply mis-mated, causing the contact beam to under deflect by 0.001", the integrity of the contact interface becomes questionable at best. The normal force exerted at 0.0016" is below 50 grams.

Since the **RN PAK-50™** interconnect system incorporates a dynamic contact interface, the male and female contacts simultaneously deflect. Maximum deflection of the **RN PAK-50™** contact beam is 0.011". This dynamic movement and increased deflection allow for much higher, more consistent normal forces. With a normal force of 155-160 grams at maximum deflection, more than a minimally reliable gold-to-gold contact interface is achieved. The contact interface is capable of tolerating a greater margin of error and maintaining a reliable connection. If for some reason, the contact beam is overstressed or underdeflected 0.002", 100 grams of normal force can still be maintained. Because of the redundant ribbon contact design, if one beam is damaged or broken, the other beam can still maintain the contact integrity.

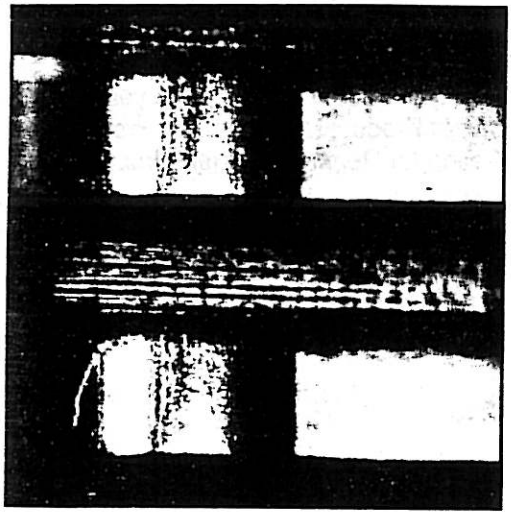
Figure 9. Normal Force



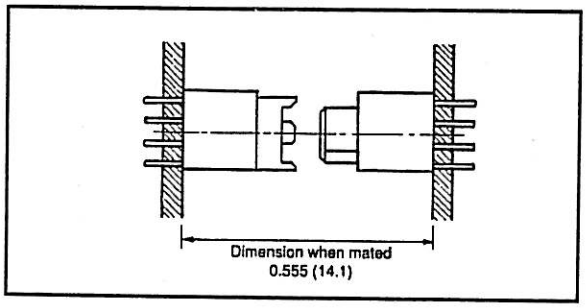
As discussed earlier, both the male and female contacts in the **RN PAK-50™** connector design are recessed and fully protected on three sides from damage. This minimizes the potential for pin deformation. This is not the case with the pin and socket tuning fork design.

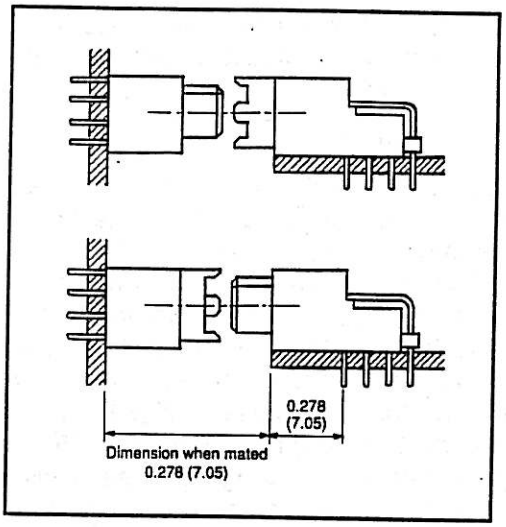
Also discussed previously, rough contact surfaces from stamping dies result in minimal contact wear resistance, higher insertion/withdrawal forces, higher contact resistance, and lower normal forces over the life of the connector. This concern is eliminated with the **RN PAK-50™** redundant ribbon contact. The contacts are processed in a more controlled environment, insuring a smoothly tapered contact beam. On most tuning fork contacts, the mating surface has been cut from the material stock. However, the mating surface of the **RN PAK-50™** contact is the rolled surface of the material stock and is not cut from the material

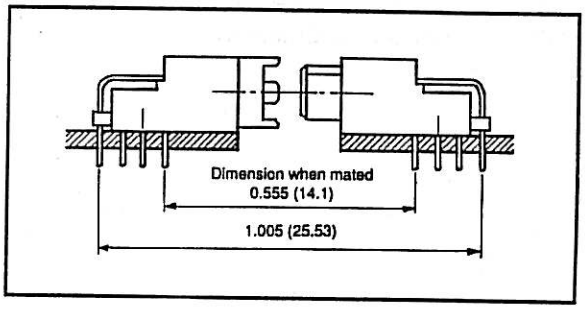
stock. A large amount of coining is used to form the **RN PAK-50™** contact into its final shape. Figure 10 clearly illustrates the superior processing of the **RN PAK-50™** redundant ribbon contact.
Figure 10



The **RN PAK-50™** two-piece interconnect system is available in configurations from 20 to 100 position connectors. Additional sizes up to 200 position product will become available by January 1989. Options include retention clips to secure connector to the board during wave solder, mounting flanges to allow for additionally desired mounting hardware, no flange connectors to further maximize board density and power ground pins to facilitate the discharge of static electricity. The **RN PAK-50™** two-piece interconnect system allows for three dimensional mating. It can accommodate parallel, vertical and horizontal connector mating applications as illustrated in Figure 11.
Figure 11







The **RN PAK-50™** interconnect system is also available in a family of insulation displacement flat cable connectors and laminated or discrete wire I/O connectors. The **RN PAK-50™** insulation displacement flat cable connectors are currently available in standard product sizes from 20-60 position. The **RN PAK-50™** IDC product utilizes .050" cable. This affords backward and forward compatibility in that two .100" connectors can be used in conjunction with one .050" connector on the same cable assembly. The female socket incorporates an intergrated one-touch latching mechanism that further simplifies the mating process and reduces accessory hardware. Three dimensional mating versatility is also available with the **RN PAK-50™** IDC product family.

The input/output connectors will become available in 20 and 50 position products by January 1989. The solid metal cover with its intergrated snap-on locking mechanism affords a fully EMI shielded connector system. Standard product supports 28

AWG laminated or discrete wire cables with custom product available to support 30 AWG cable requirements.

CONCLUSION

The **RN PAK-50™** interconnect system is the "Perfect Match" for high density packaging requirements. The redundant ribbon contact design resolves the reliability concerns of .050" Connector Technology by maximizing contact wear resistance and contact normal forces while minimizing contact resistances and insertion/ withdrawal forces. The **RN PAK-50™** high density contact design combined with .050" center connector technology affords the reliability and packaging requirements necessary to support the connector needs for the electronic systems of today and tomorrow.

BIOGRAPHY

Ben Mattox is product manager for flat cable insulation displacement connectors, discrete wire insulation displacement D-subminiature connectors, and the **RN PAK-50™** interconnect system at Robinson Nugent, Inc., New Albany, Indiana.

He received his B.S. Degree from Butler University in 1980. For the past 5 years he has worked in Product Management/ Product Marketing for Robinson Nugent, Inc.

Prior to employment with Robinson Nugent, Inc., he was involved in systems marketing with Xerox and Bell South Corporations.