

WHITEPAPER

NANOMINIATURE CONNECTORS: HIGH RELIABILITY WHEN MAXIMUM SIZE AND WEIGHT SAVINGS ARE CRITICAL

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D-style connectors have been a staple of military/aerospace industry for over half a century. As electronic miniaturization packed more and more capabilities into smaller packages, smaller connectors are enabling new technology in new locations on a variety of end products. Reducing both size and weight in tandem are critical factors in military/aerospace applications. The subminiature-D connector gave way to the microminiature-D in the early 1970's. Today, nanominiature-D connectors offer even more dramatic space and weight savings in applications where maximum space and weight savings are crucial design factors.

Typical applications include space, smart munitions, missile defense, aircraft communications, and unmanned aerial vehicles (UAVs). The common thread is the space-limited, weight-sensitive requirement of such applications operating in harsh environments. TE Connectivity (TE)'s nanominiature connectors combine their appealing size and weight with desired performance attributes such as high reliability, low contact resistance and wide operating temperature range, making them among the smallest and toughest connectors available to designers.

A nanominiature connector can offer a volume ten times smaller than a microminiature-D with the same number of positions. Figure 1 compares a 51-position microminiature-D to a nanominiature-D of the same number of contacts. The nano's 0.025-inch centerline allows very high contact density. Polarization is through dual lobes rather than traditional D-shaped keystone. Along with the dramatic size reduction are the weight savings: the nanominiature connector weighs only about 10% of the comparable micro-D connector.

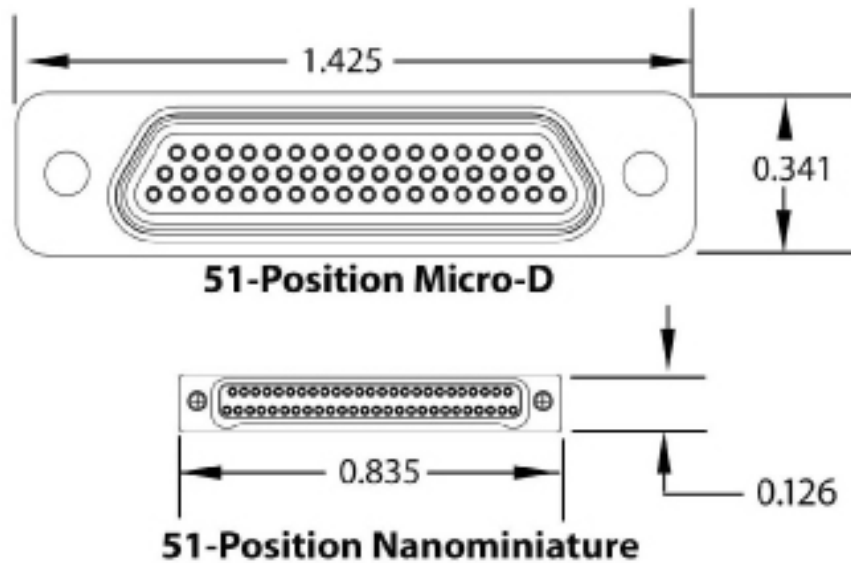


FIGURE 1. NANOMINIATURE CONNECTORS OFFER EXTREME WEIGHT

To maintain reliable, low-resistance contact mating in high-vibration, rugged environments, two approaches to contact design, shown in Figure 2, are used to achieve the required normal forces. One approach is to use stamped-and-formed pin contacts to achieve three to six points of contact between the pin and socket. The second approach, used by TE in our Nanonics connectors and more precisely in the DUALLOBE nanominiature connectors, uses a solid pin and a dimple on the inner surface of the socket contact.

The dimple presses the pin against the opposite side of the socket wall, achieving at least 170° of gold-on-gold contact. The use of a solid pin and socket design provides a more robust crimp joint which in turn leads to lower contact resistance than the stamped and formed contact. This solid design also provides a stronger contact which has better resistance to shock and vibration along with increased durability to provide a minimum of 500 mating cycles, versus 200 cycles typical of other legacy nanominiature connectors.



Solid Pin and Dimpled Socket



Stamped and Formed Spring Pin

FIGURE 2. NANOMINIATURE CONTACT SYSTEMS (SOURCE: TE CONNECTIVITY)

Nanominiature connectors support gigabit data rates. While not originally designed to support such high rates, they typically need to be electrically modeled to determine the optimum pinout for a specific application. Nanominiature contacts have a continuous

current rating of 1 A. Standard voltage ratings for military specified nanominiature connectors are 250 V at sea level and 100 V at 70,000 feet, while TE's DUALOBE nanominiature connectors offer 500 V at sea level and 150 V at high altitude.

	TE's DUALOBE nanominiature connectors	MIL-DTL-32139 specified connectors
Temperature Rating	-200°C to +200°C	-65°C to +125°C
Durability	500 Mating Cycles	200 Mating Cycles
Dielectric Withstanding Voltage	500V @ Sea Level 150V @ 70,000 Feet	250V @ Sea Level 100V @ 70,000 Feet
Footprint Mated (Size 25)	0.5085" ~ 12 % smaller	0.575"

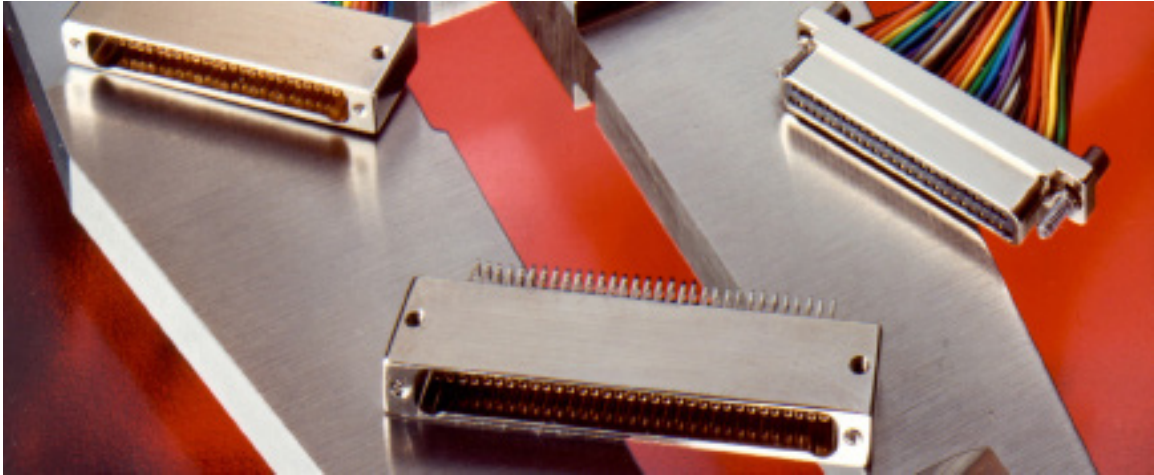
Wide Temperature Range: From Space to Downhole

Nanominiature connectors are available with temperature ranges as wide as -200°C to +200°C. This wide range makes the connectors attractive in a variety of applications. For space, the low-temperature rating, combined with low outgassing materials and significant weight and space savings, helps reduce payloads at liftoff and provide long-term reliable operation. The performance and reliability at cryogenic temperatures, along with the low outgassing material properties, has led to an increased usage in space applications. Such applications include nitrogen-cooled optics, low- and high-earth orbiting satellites, telescopes, deep space probes, orbiters, and rovers. At the opposite extreme, the high-temperature rating makes nanominiature connectors popular for downhole applications in petroleum exploration. Here, temperatures can exceed +175°C.

More Choice for Flexible Application

Nanominiature connectors are available in single-row configurations with 5 to 51 contacts and double-row configurations with 9 to 65 contacts. They come with machined aluminum shells (with a variety of plating), stainless steel shells for extra sturdiness or plastic shells for added weight savings. The connectors are factory-terminated by crimping contacts to the wires. Connectors can be supplied with flying leads, as jumper assemblies, or as custom harnesses with multiple connectors. Due to the small size of the contacts, wire sizes are 30 AWG and smaller. The wires typically use PTFE or ETFE thin-wall insulation, which have extended operating temperatures, excellent mechanical and environmental properties, and compact dimensions well matched to the connectors.

On the pc board side, they mount in through-hole, surface-mount, and edge-board options.



Despite their small size, nanominiature connectors are designed for rugged applications, with the capability of withstanding significant levels of shock and vibration, salt spray, oil and solvent immersion, and other environmental and mechanical hazards. In addition, connector materials

exhibit low thermal outgassing required for space applications. The bottom line is that nanominiature connectors are very robust. With the wide range of options, they are available for a wide range of applications where weight and space savings are achieved without compromising performance.



FIGURE 4. NANOMINIATURE CONNECTORS (LEFT AND LOWER RIGHT) OFFER EXTREME REDUCTIONS IN SIZE AND WEIGHT COMPARED TO MICROD CONNECTORS. (SOURCE: TE CONNECTIVITY)

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