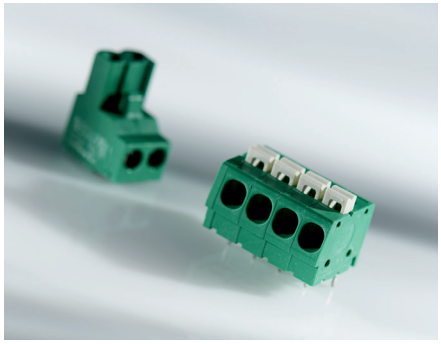
DYNAMIC SERIES

TE Connectivity's Dynamic Series as a high performance alternative to Euro Style Terminal Blocks

TE CONNECTIVITY'S DYNAMIC SERIES AS A HIGH PERFORMANCE ALTERNATIVE TO EURO STYLE TERMINAL BLOCKS

Factories are becoming increasingly "smart"- that is, they are becoming more automated, efficient and reactive to needs on the assembly line. The progressive degree of automation, increasingly decentralized intelligence in the systems and modular machine concepts require a variety of wirings. Modern installation concepts aim for economic efficiency and flexibility. As a consequence of this assumption, future connectivity for industrial applications have to enhance secure, and reliable operation for minimizing production downtime and saving both, time and labor.

Connectors as PCB terminal blocks play a dominant role here – this product category is at the heart of almost every application in the automated world, e.g. in industrial controls, human machine interfaces, data communication, motion



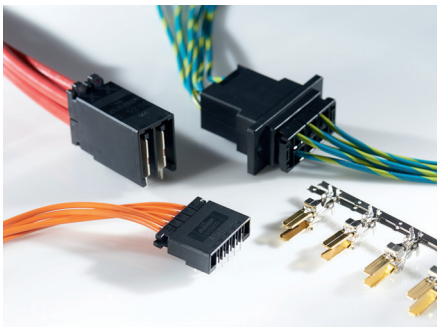
& drives, machinery controls, robot control and servo drives. Logically also PCB terminal blocks need to provide reliability and long service life to meet future productivity challenges.

TE Connectivity's Dynamic Series connector solutions range from signal level circuitry to power circuit connectivity – all in a ruggedized, industrialized package. Our engineers have designed this product range for use in control system applications to suit high density, signal, and power applications. These wire-to-board, wire-to-panel, and wire-to-wire connectors have diverse housings that can meet harsh requirements in industrial applications. The key is the smart combination of a robust housing structure and a high quality crimp contact system.

The housing features of Dynamic Series are designed to withstand even most inhospitable environments, in which

- a strong locking mechanism prevents unmating of the connector pair under stress
- additional retention legs withstand axial pullout forces applied to the harness
- all products are designed for vibration & shocks exposed applications
- contacts retention lance is supporting pullout force, which can be applied

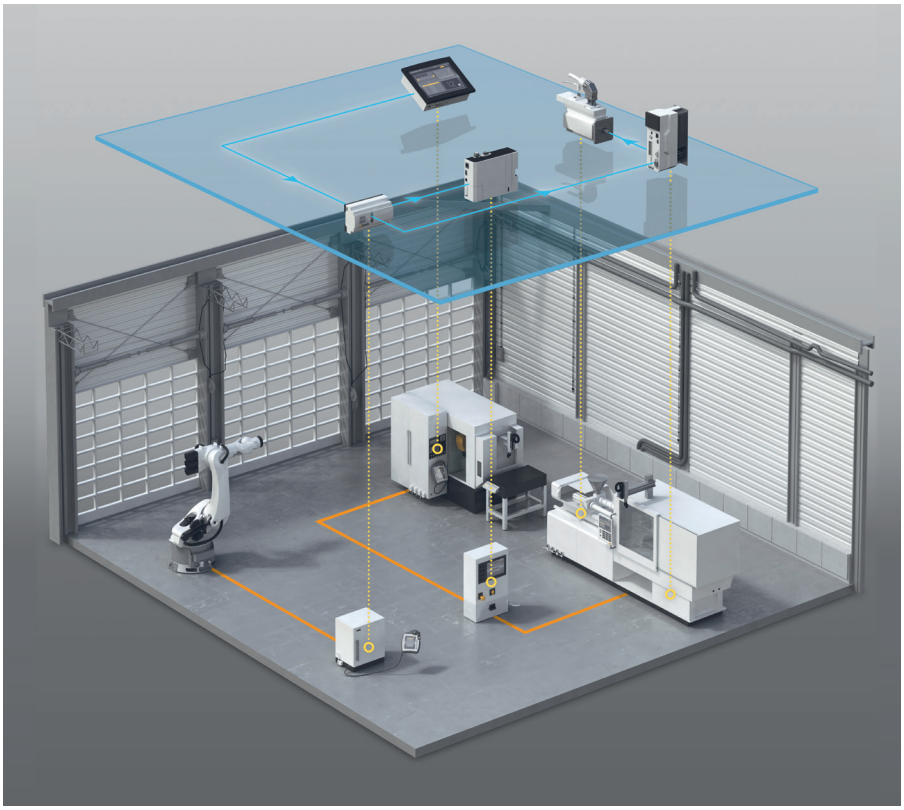
Micro movements of the contact system in vibrated environments or under thermal cycling can lead to temperature rise, fretting corrosion ("fretting" is a term to describe a small



amplitude rubbing motion between two surfaces) and finally oxidation.

Opposite to the standard tin-based plating of Euro style terminal blocks, the standard plating for Dynamic Series is gold-based,

- preventing oxidation of the conductive layer under micro movements better than tin plated terminal contact
- performing better under contact pressure increasing the contact area and decreasing the resistance
- offering higher performance in terms of mating cycles (500 cycles for gold plating vs. 100 cycles of tin plating)
- allowing low mating/unmating forces even for multipole connectors



Vibration being one of the most critical factors for long-term stability

One of the most severe factors for the durability of the electrical and mechanical connection is the degree of vibration which the application is exposed to. In terms of industrial equipment, this can be caused by either the factory environment (constant movements of robot units, machinery tools) or the application itself (switching operations in a control cabinet).

In order to determine the performance of Dynamic Series PCB connectors compared to general Euro style terminal blocks, TE Connectivity tested the mechanical performance of the common Dynamic D-5000 Series (10.16mm pitch 2 piece PCB terminal block with crimp contacts, gold plated) against competitor parts of company A and B (both 10.16 mm 2 piece PCB Terminal Block with Screw Clamps, silver plated). Testing was performed at the TE Connectivity Harrisburg Electrical Components Test Laboratory (HECTL) and the Harrisburg Fiber Optic Components Test Laboratory (HFOCTL) between December 15, 2016 and March 22, 2016.

The following **5 trials of vibration** were conducted, applying each time a more severe vibration profile to the specimen of Dynamic Series and the Euro style terminal blocks of company A and B. Throughout the entire test, the samples were monitored for any discontinuities equal to or exceeding 1 microsecond.

Trial 1	Testing was performed per IEC 60068-2-6 7th edition dated 2007-12. Each sample was subjected to a simple harmonic motion having either a 0.35-millimeter double amplitude or a 5 g peak amplitude, whichever was less. The entire vibration frequency range of 10 Hz to 150 Hz and return to 10 Hz was logarithmically swept at a rate of 1 octave per minute. These sweeps were repeated for a period of 2.5 hours in each of 3 mutually perpendicular axes. Total exposure time during the vibration test was 7.5 hours.
Trial 2	Testing was performed per EIA-364-28F, Test Condition II. Each sample was subjected to a simple harmonic motion having either a 0.06-inch double amplitude or a 10 g peak amplitude, whichever was less. The entire vibration frequency range of 10 Hz to 500 Hz and return to 10 Hz was logarithmically swept over a period of 15 minutes. These sweeps were repeated 12 times for an exposure time of 3 hours in each of 3 mutually perpendicular axes. Total exposure time during the vibration test was 9 hours.
Trial 3	Testing was performed per EIA-364-28F, Test Condition III. Each sample was subjected to a simple harmonic motion having either a 0.06-inch double amplitude or a 15 g peak amplitude, whichever was less. The entire vibration frequency range of 10 Hz to 2000 Hz and return to 10 Hz was logarithmically swept over a period of 20 minutes. These sweeps were repeated 12 times for an exposure time of 4 hours in each of 3 mutually perpendicular axes. Total exposure time during the vibration test was 12 hours.
Trial 4	Testing was performed per EIA-364-28F, Test Condition IV. Each sample was subjected to a simple harmonic motion having either a 0.06-inch double amplitude or a 20 g peak amplitude, whichever was less. The entire vibration frequency range of 10 Hz to 2000 Hz and return to 10 Hz was logarithmically swept over a period of 20 minutes. These sweeps were repeated 12 times for an exposure time of 4 hours in each of 3 mutually perpendicular axes. Total exposure time during the vibration test was 12 hours.
Trial 5	Testing was performed per MIL-STD-202G, Method 204D, Test condition G. Each sample was subjected to a simple harmonic motion having either a 0.06-inch double amplitude or a 30 g peak amplitude, whichever was less. The entire vibration frequency range of 10 Hz to 2000 Hz and return to 10 Hz was logarithmically swept over a period of 20 minutes. These sweeps were repeated 12 times for an exposure time of 4 hours in each of 3 mutually perpendicular axes. Total exposure time during the vibration test was 12 hours.

Test Results

Referring to the following table for the vibration results: Specimens from each test set were subjected to multiple rounds of vibration testing. The specimen(s) removed from testing had a discontinuity of one microsecond or greater occurring during testing. Specimens not removed from testing had no apparent physical damage or discontinuities of one microsecond or greater occur during testing.

	TE	Company A	Company B
Trial 1	a	a	Failed
Trial 2	a	a	a
Trial 3	a	a	Failed
Trial 4	a	Failed	Failed
Trial 5	Failed	Failed	Failed

Interpretation for industrial applications

The test result clearly shows the outstanding performance of Dynamic Series connectors over the standard Euro style terminal blocks, available in the market. Key success factor is among other things the vibration proven housing structure (see above standard housing features of Dynamic Series) as well as the vibration proven gold plated contact system. Especially in severe environments with micro-abrasions, thermal cyclings, the presence of corrosive gas gold plated contacts is the best choice versus the other products tested in the study.

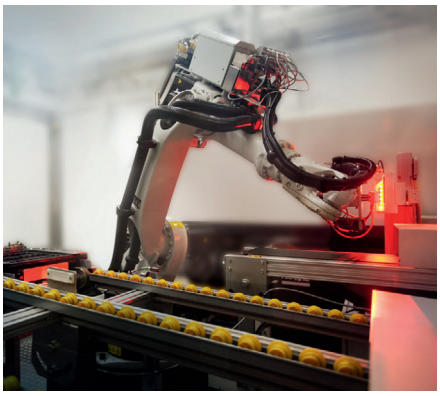
Besides the pure mechanical and electrical strength of Dynamic Series, this connector family reflects the need of today's smart factories for

- fast installation while saving both time and labor through automated harness assembly and quick plug and play installation afterwards through the 2 piece connector design,
- secure and fast operation while preventing human errors during the installation process with the integrated keying function

These characteristics are linked directly to the total cost of ownership (TCO) for our customers. TE has a long legacy of pioneering wire harness production and printed circuit board processing.

For crimping a terminal onto a wire, TE offers a full range of semi or fully automated equipment optimized for your production needs and budget. Semi-automatic benchtop stripping and crimping machines are suitable for high-mix, low-volume wire processing applications, whereas fully automatic cutting, stripping and crimping system is the best choice, if thousands of identical crimped wires in a shift need to be produced. The cost saving potential versus the manual wiring of screw clamp terminations correlates with the degree of automatization.

Automatic equipment removes the human element from high-volume wire processing applications, while improving quality and reducing costs. For instance, state-of-the-art automatic crimping machines can process wires at rates above 4,000 pieces per hour with absolute precision and in-process



inspections. The following table provides an overview of the applied cost of using our Dynamic Series vs. screw clamp terminal blocks based on the cost saving potential of automated wiring, showing, that based on the output to be produced, some machines could pay for itself within a year.

Given the test results for vibration resistance and applied cost saving potential, Dynamic Series connectors are your best pick among the products tested to meet the efficiency requirements of the factory of the future today by reducing applied cost while increasing system reliability. You can count on TE to work with you every step of the way to meet those requirements by developing solutions for all aspects of your production processes. Because TE designs and manufactures solutions that connect and protect the flow of power, data and signal — in every aspect of our lives.

Application	Robot Control Cabinet
Scenario	15 connectors used in the machinery control unit for I/O modules and main + auxiliary power; EAU 10,000 units; labor rate 50 $/h, life time volume = 10 years with a EAU for 5,000 units; semi-automated Crimp Tool = 20,000 $
Benefit	Secure and fast operation compared to traditional screw clamp connectors, which require a lot of manual installation time (approx. +100 %)
TCO of Dynamic Series	Material + Installation + applicator tooling = (15 x 1.5 $ + 0.2 h * 50 $/h) x 50,000 + 20,000 = 1,64 5,000 $
TCO of screw clamp terminal blocks	Material + Installation + checking of correct mating = (15 x 1.5 $ + 0.4 h x 50 $/h) x 50,000 = 2,125,000 $
Lifetime Savings	$ 480,000

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