



Terminals & Connectors

for the Automotive Market



Tyco Electronics Ltd. is a leading global provider of engineered electronic components, network solutions and wireless systems, with customers in more than 150 countries. We design, manufacture and market products for customers in industries from automotive, appliances and aerospace and defense to telecommunications, computers and consumer electronics. With over 8,000 engineers and worldwide manufacturing, sales and customer service capabilities, Tyco Electronics' commitment is our customers' advantage.

GLOBAL AUTOMOTIVE DIVISION TERMINALS & CONNECTORS

Tyco Electronics offers a broad range of high quality electronic component products. We provide solutions for OEM applications, utility and energy, outside plant and premise networking installations and more. Products from well-known brands include connectors and interconnection systems, terminal blocks, relays, circuit protection devices, fiber optic components, wires and cables, switches, wireless components, sensors, touch screens and application tooling. We also provide products to insulate, protect, hold, bundle and identify electrical harnesses.

Our electrical and electronic connectors and interconnection products are used in an endless list of automotive applications. Connector products are used to electrically and mechanically join wires and cables, integrated circuit packages and batteries. Our continually expanding capabilities include new copper and fiber optic connectors, wires, cables and cable management systems that are designed to meet automotive industry demands. The AMP brand encompasses the broadest range of connectors in the world, including high-density, high-speed designs for leading-edge communications equipment.



TECHNOLOGY

CONNECTORS AND INTERCONNECTION PRODUCTS

The Global Automotive Division offers a fully comprehensive range of electrical and electronic interconnection products and solutions. Our continuously expanding capabilities are more than just providing the automotive market place with cutting edge components for advanced safety systems, highly integrated engine control components or superior management modules. We are also working with customers on using proven components in evolving applications or helping them engineer completely new solutions.

The growing number and complexity of vehicles make reliability an increasingly important issue. In order to make electronic systems reliable, the basic design of each component must be completely dependable. Consequently the function of all components dictates special technical requirements that the designer must comply with. Tyco Electronics' product portfolio has been extended during the last decade to offer our customers a complete program. Our core competencies are to offer complete solutions for complex high quality system modules.

ADVANCED CONTACT DESIGN

A reliable and high performance interconnection point is of greatest importance for the function of the whole vehicle. In addition to this, the working conditions are extremely tough. This creates very high demands on the contact design.

To meet the requirements of the automotive industry, Tyco Electronics has developed a two piece contact design where performance, reliability and high quality is achieved by using high conductive material for the contact body and



The AMP MCP terminal system is a two piece contact. Each contact consists of a flat receptacle or socket which is mated to a flat tab. Every contact has a stainless steel spring and a copper alloy body. One end of the contact is crimped to the wire and the other end mates with the matching tab.



The new generation MCON-1.2 mm contact system has eight defined contact points. The innovative contact spring design results in an increased safety margin at high vibration loads. The robust closed box design guarantees an optimized protection of the contact body. In addition, the plastic deformation of the spring will be prevented by an integrated overstress protection feature. For fast and economic processing, Tyco Electronics offers fully-automated application tooling as well as hand tools.

stainless steel for the spring. Characteristics for these two materials are quite different and several requests can be fulfilled. The stainless steel spring will contribute to avoid overstress of the contact body, for example by mating test equipment or an improper tab. By choosing contact material due to electrical conductance and crimping quality, this will guarantee the highest electrical performance. The two piece contact design enables simple terminal extraction and better thermal conductivity between spring body and housing. The contact body is protected from mechanical damage during transport or assembly.

ADVANCED PLATING TECHNOLOGY

Applied plating technologies include high speed selective plating, hot dipped alloy-tinning and lead-free tin plating of contact and solder area. New development in plating technology includes nano dispersion layers with built in particles or film hardening and additives of micro capsules filled with different lubricants to improve durability. Plating technology, together with contact design solutions also offers a way to handle the problem of fretting corrosion. The reason for fretting corrosion is minimal relative movement of contacts parts where oxides is formed.

ADVANCED CONTACT TO WIRE CONNECTION

Tyco Electronics has developed a new termination process by utilising resistance welding for sensitive circuits in safety applications. A resistance welding module is being adapted in a fully-automatic applicator. Further advantage of this new technology combined with the contact design is that the same contact can be used for several wire sizes.



VITAL CONTACT FEATURES

- Low contact resistance
- High current carrying capacity
- High signal frequency capability
- Low mating and unmating forces
- High durability, maximum number of mating cycles

VITAL DESIGN FEATURES

- Possible variety of wire size
- Normal and single wire seal possibilities
- Good guidance inside the cavity
- No possibilities of miss-mating to the tab
- Robustness against mechanical damage

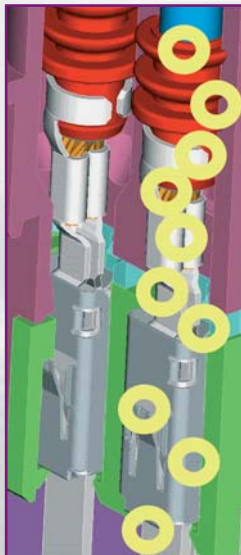
TECHNOLOGY

ADVANCED CAVITY AND CONNECTOR DESIGN

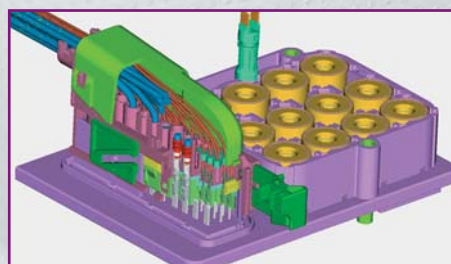
One issue of interest is the demand for miniaturization, in order to save weight and space in the vehicle. At the same time the number of positions in the applications are increasing. The task is to fulfil the technical requirement of the automotive industry in the smallest possible way. In all our research areas we are constantly pushing the limits and thus evolving new innovations.

Together with the design of the contact, the design of the cavity inside the connector and the connector itself must guarantee high performance, quality and reliability to meet the requirements of the automotive industry. The influences to consider at the cavity and connector design are mating forces of the contacts, of the seal and the warpage, also material friction adds to the challenge.

The design of the contact in combination with the cavity and the sealing determines the pitch which in the end determines the size of the connector. With the increasing number of contacts in today's connectors, the assembly situation must also be considered carefully. The design must result in robust and ergonomic connectors where mating forces are as low as possible. To ensure a secure interconnection, different solutions are available which also may function as a mating aid: snap fit connection, sliding mechanism, lever with cap, tooth track mechanism or bolt driven connectors.



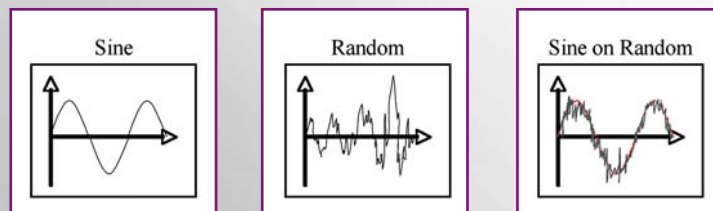
and ergonomic connectors where mating forces are as low as possible. To ensure a secure interconnection, different solutions are available which also may function as a mating aid: snap fit connection, sliding mechanism, lever with cap, tooth track mechanism or bolt driven connectors.



This model shows the complexity of contact, cavity and connector design. The circles indicate where the design is extra crucial to the function of the whole system.

In parallel with the development, all kinds of possible rough treatment of the connector must be taken into consideration. Tyco Electronics works according to the Koshiri philosophy where the design, starting from the first draft, aims at a good guidance at mating and to eliminating possible quality problems due to handling.

The connector must meet a large number of requirements: dimensional and visual, electrical, mechanical and environmental. All connectors from Tyco Electronics are tested according to international standards and will meet or even exceed the expectations from the automotive industry. The contact and connector design of primary and secondary locking will guarantee the loading of the connector and the application will withstand high level of vibrations, mechanical shock as well as combined random vibration.



Generally there are three profile types of a vibration test: Sine, Random and Sine on Random. Sine loads are normally only applied to components which are directly mounted on the engine or the gearbox. Sine on Random will be frequently used for components in close proximity to the engine, because in this area there is no absolute Sine- or Random broadband noise stress.

The profile “broadband noise” is used for components, which are either in the cabin, rear of the vehicle, or other places near by shock absorbing elements.

ADVANCED SEALING DESIGN

Advanced choice of contact and connector material will guarantee excellent performance even at extreme temperatures, both as a result of temperature rise due to electrical load or ambient temperature. For automotive applications it is also important with a capability to withstand chemicals such as oil, fuel or battery electrolyte. Watertightness will be assured by highly developed sealing design. For the contact to the housing there are two existing solutions; single wire seal or flat seal, also called family seal. For the connector housing, inline and interface, radial seal are preferred. Also requirements for sealing of special application can be achieved by using advanced brand new insert mold techniques.

VITAL CONNECTOR FEATURES

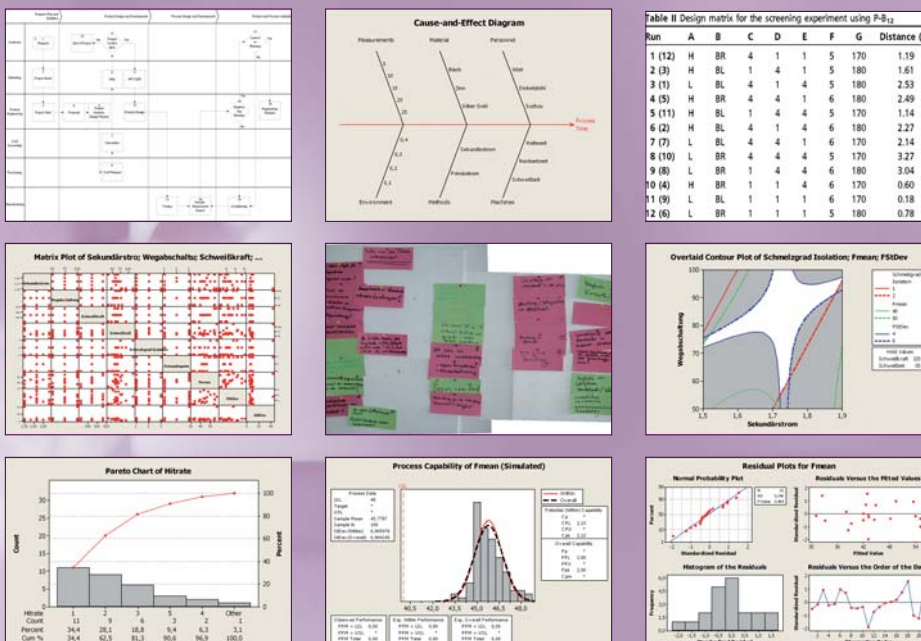
- Fulfil visual, electrical and environmental requirements
- Low mating and unmating forces
- Robust and ergonomic design

COMPETENCIES

DESIGN TO COST, INCREASED RELIABILITY AND SIX SIGMA

Beside the support of the automotive customers and application engineering, development activities for future terminals and connectors are performed continuously. Design to cost and increased reliability are objectives of highest priority. To stay your number one preferred partner, Tyco Electronics Global Automotive Division is working along with our process excellence initiative which is comprised of three key areas: Operational, Transactional and Lean Design for Six Sigma. All three are techniques to create quality products, improve and maintain solid delivery times, and bring about more cost efficiency, all while making sure the voice of the customer is being reflected in each of these processes. We implement initiatives across our company to achieve best-in-class operating practices and leverage company-wide opportunities, utilizing Six Sigma measurements.

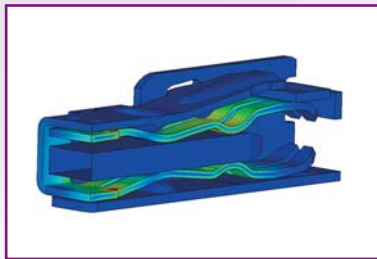
Tyco Electronics actually is working according to the Six Sigma methodology in multiple projects. Always if the engineers are faced with high process complexity or unclear requirements they will be supported by special trained colleagues to follow the structured and data driven problem solving approach of Six Sigma. In the example below a Welding Process was successfully optimized with a minimum on effort and a maximum on precision. This reduces cost, increases reliability and improves our process capabilities.



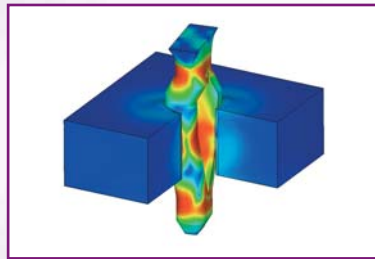
This extract from a Six Sigma project shows the results of the statistical tools that are used. The collected data is calculated in pre-defined ways and shown in this graphical way. The proposed model is then analysed to show the relation to investigated real life situation.

INTEGRATED VIRTUAL PRODUCT DEVELOPMENT

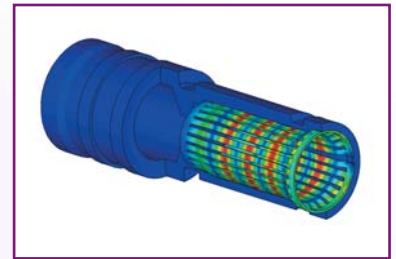
To stay market leading, actors in the automotive segment must find ways to handle increased complexity and shortened life cycles. Tyco Electronics works with well defined processes and advanced tools to find the best result. Experience from engineering results in a basic model for further advanced development. The proposed solution is designed with computer aided drawing tools, where digital mock ups are powerful instruments to simulate the final result. The Finite Element Method, FEM, is used to analyse mechanical stresses, for example the effect on a socket when a tab is inserted. Strength calculations will early on indicate possible weakness of the contact or connector design and changes can be made to avoid high internal stress of the material.



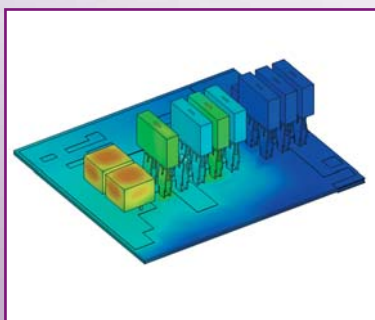
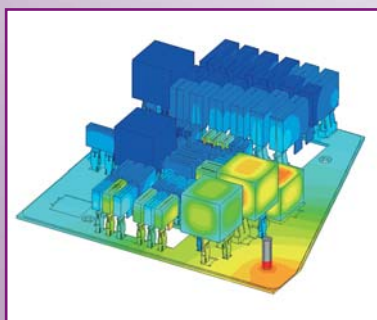
This is a model of the MCON-1.2 mm contact, showing a structural finite element analysis. The sectional view shows the mechanical stresses during the insertion process of the tab.



ACTION PIN contacts are applied to printed circuit boards in a nonsolder process. Press fit connections like this put high demands on both pin and PCB. This simulation shows the mechanical stress distribution in the ACTION PIN as well as the printed circuit board.



For high applications such as hybrid vehicles, high current contacts are needed. This is a 8 mm high current contact and the simulation shows the mechanical stress distribution which will be the result when the pin is inserted.

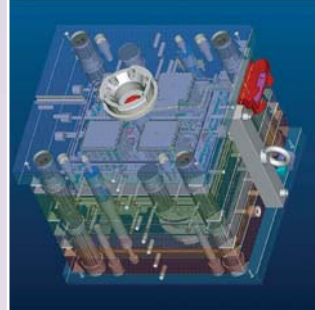


Thermal-electric analyses are performed to show the temperature rise and temperature distribution due to current load. These are of multilayer printed circuit boards and components used in a Power Distribution Unit. The boards are equipped with relays, fuses and socket contacts.

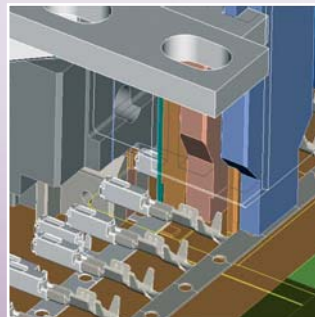
INTEGRATED VIRTUAL PRODUCT DEVELOPMENT

Statistical analysis of tolerances are implemented to optimize the balance between technical needs and cost effectiveness. Another method that is used to reduce costs is mold flow analysis to simulate the flow of raw material inside the mold, with the objective of reduce the amount of scrap and the lead time of each part and to ensure that the proposed design also is suitable for manufacturing. Manufacturing methods must be considered early in the development process. The design of the connector must comply with the physical limits of the material and its behavior in the mold cavity. The stamping procedure of connector manufacturing is also simulated to see the advantages and disadvantages of design changes of new innovations, where effects on both contact and tool can be analysed.

Increasingly important requirements for the OEM's are the mating and unmating forces. The connector must fulfil a combination of low mating forces and ergonomic design. The high level of complexity and multiple input in the design work is processed by using computer aided engineering. The output of the calculations will be taken into consideration when continuing with the design of the contact or connector. Unacceptable high mating forces are discovered and avoided early in the development process since different input can be calculated and analysed to find the best result.



Computer aided 3-D model of a mold tool



Computer aided 3-D model of a stamping tool



Test setup for fuse and relay box, combined static and electric load testing



Microscope equipment for visual examinations

VERIFYING THE RESULTS

Virtual simulations together with testing in laboratory will investigate and verify the technical characteristics of the newly developed product to guarantee the best possible performance. Tyco Electronic has extensive testing possibilities where for example verifications tests are made for all new products. The possibilities to apply several circumstances at the same time is a way to imitate the actual working conditions as close as possible, although often the tests are much tougher than real life. For example, the loaded connector is exposed to static loads and electric load at the same time. Random vibration tests are performed together with extreme temperature variations and electrical performance is continuously measured at different ambient temperatures. Electron microscopes are used for visual exams of the contact point when all verification tests have been completed.

ELECTRICAL TESTS:

- Contact resistance
- Current carrying capacity
- Current excess temperature distribution
- Insulation resistance
- Tracking resistance
- Dielectric withstanding voltage

MECHANICAL TEST EQUIPMENT:

- Tensile testing machines
- Contact force testing

ENVIRONMENTAL TEST EQUIPMENT:

- Climatic-/temperature test chambers
- Heat chambers
- 4 components mixed flowing gas test unit with climatic test chamber
- Thermal shock chamber/2-chamber method
- Salt fog chamber
- Vibration systems combined with climatic-/temperature test chamber

WATER AND DUST SEALING TESTS / IP-CODE:

- Water spray test chamber IPX 4K
- High pressure water test chamber IPX 9K
- Dust and sand test chamber IPX 6KX

APPLICATIONS



POWER DISTRIBUTION COMPONENTS

A new contact series was developed to the reliable transfer of high currents. The innovative high current contact system is available in a diameter of 8 mm, 13 mm and 16 mm. The contact consists of a massive machined body and a stamped contact spring, both in high-conductive copper material. The contact spring concept reaches remarkable current values at high temperatures.



Current Carrying Capability at +105 °C

Contact	Wire Size	I
8 mm	50 mm ²	200 A*
13 mm	70 mm ²	230 A*
16 mm	120 mm ²	344 A*

* Derating acc. to DIN-IEC 512 Part 3 (Contact)

* Current Limitation Wire acc. to DIN-VDE 0298 Part 4



The search for environmentally friendly power systems is receiving increasingly more attention. To avoid a global climate change a further reduction of the CO₂ levels is required. Fuel cells are a favorite solution in this respect. The advantage of generating electricity from fuel cells is that the vehicle only emits water. Tyco Electronics has developed power distribution components together with fuel cell manufacturer Ballard Power System. This power distribution unit, PDU, distributes the power generated by the fuel cells to the individual consumers in the vehicle. The watertight PDU has a total of 8 outputs, which can handle a load up to 25 A, 70 A or 230 A. The maximum allowable voltage is 500 V. The PDU as well as the HVCs ensure, as a result of their fully shielded execution, a good Electro Magnetic Compatibility (EMC).

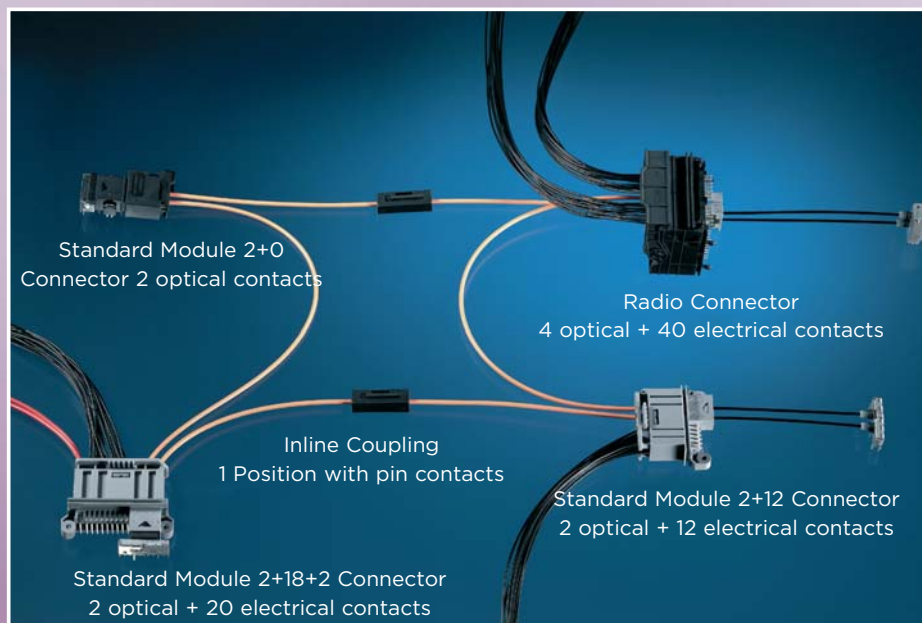
OPTICAL INTERCONNECTIONS FOR AUTOMOTIVE NETWORK SYSTEMS

Due to the increased requirements of large amounts of data transfer with automotive electronics control systems, system suppliers and users are now using fiber optic systems to achieve this quickly and reliably. Presently Tyco Electronics has experience with the following Automotive Fiber Optic Systems:

- D2B
- MOST®
- Byteflight
- IEEE (first prototypes)

The introduction of MOST has established a new standard to support the introduction of intelligent information, communication and entertainment systems in the car. The innovative and open system approach is complemented by a wide range of compatible network components, allowing a wide variation of applications with a minimum number of different components. The integration of the optical system into today's vehicles has taken account of the need for hybrid connection systems in which the use of both optical and electrical connections can be realized. The current product range of connectors is completely compatible with all automotive requirements as well as being able to incorporate the next generation data bus systems with increased transfer rates. Tyco Electronics also offers a full range of application tooling to support in the preparation of the fiber optic cable for integration into the automotive signal network.

MOST® is a trademark



*Driver Information
Entertainment*

APPLICATIONS

SPECIAL CABLE SYSTEM SOLUTIONS

For special cable assemblies and cable system solutions you will find your competent partner in the special cable systems group. The group offers research and development capabilities, prototyping and samples as well as manufacturing facilities. This includes overmold technology, semi- and fully-automatic manufacturing, testing equipment and appliances and handling of high volume production. Available product lines are:



- Coax cable assemblies
- FFC cable assemblies
- Fuel tank wiring systems
- Squib airbag assemblies
- Fiber optic cable assemblies
- Cockpit cable assemblies
- Pump nozzle and engine wiring
- Power distribution cable assemblies
- ABS sensor cable assemblies
- High voltage cable assemblies

One example of advanced cable system is the cylinder head wiring. Due to their construction, modern direct injection diesel engines require electrical connection of injection valves and glow plugs within the cylinder head. The cylinder head wiring includes electrical connections between the electrical components located in the cylinder head (injection valves, glow plugs) and the engine compartment harness. Typically the cylinder head wiring ends in one connector which is mounted in the outer wall of the cylinder head, to which the engine compartment harness is connected. For this application Tyco Electronics has developed cylinder head wiring assemblies for various engine types which are designed for use under the extreme environmental conditions present within the cylinder head. High vibration in combination with high temperatures, as well as the load due to engine oil, make special demands on the connector housing, contact and sealing materials. Extensive testing of all components ensures high reliability of all cylinder head wiring for the life time of the complete vehicle.

SUN VISOR APPLICATION

As part of the general proliferation of electronics in motor vehicles, sun visors now contain active electronics such as video displays, as well as sensors and actuators for automatic reaction to detected glare. Because of these developments, in addition to mechanical fixing, when the sun visor is attached to the motor vehicle, electrical connections need to be made between the vehicle harness and the visor's internal circuits.

Existing solutions using unprotected free-hanging connectors are unacceptable due to a high risk of contact damage, as well as the inherently complex assembly process. It is therefore desirable to integrate electrical connection into the mechanical fixing operation to complete the process in the simplest most cost efficient fashion.



Convenience

The system consists of two elements. A receiving housing that is mounted almost flush to the vehicle and a hooking housing that is fitted to the sun visor. The hook is ergonomically designed to naturally guide into the receiving housing for easy mating of the two parts. When the two housings are mated, spring contacts in the hook are pressed against the contact pads in the receiving housing to complete the circuit. The assembly and its component parts occupy minimal space, whilst providing a very efficient and reliable solution to this particular mechanical and electrical connection problem.



APPLICATIONS

GLOBAL APPLICATION TOOLING AND EQUIPMENT

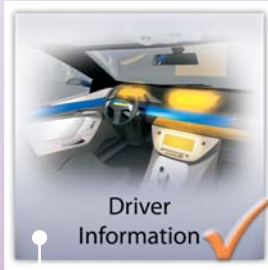
Application Tooling from Tyco Electronics is designed to perform perfect terminations, time after time. Beyond that, the result is productivity gains, yielding more terminations at less cost at the time of application and in service. It is this combination of high quality at a lower installed final cost that distinguishes the Tyco Electronics system solution.

The program is comprised of hand tools, semi-automatic bench machines and fully-automatic turn key machine systems. We provide various levels of tooling to meet the full spectrum of output requirements:

- Insertion and Seating Machines
- Lead Makers
- Applicators
- FFC/FPC Machines
- Crimping Machines
- IDC Machines
- MOST Equipment
- Hand Tools
- MAG-MATE Equipment
- Test Equipment

For more detailed information please visit our website:
www.tooling.tycoelectronics.com/europe

Our electrical and electronic connectors and interconnection products are used in an endless list of automotive applications.



ALTERNATIVE POWER SYSTEMS



CABLE ASSEMBLY SYSTEMS



HIGH SPEED DATA NETWORKING



INDUCTIVE SYSTEMS



MECHATRONICS



POWER DISTRIBUTION SYSTEMS



RELAYS & SWITCHING MODULES



SENSOR TECHNOLOGY



WIRELESS TECHNOLOGIES

OTHER TYCO ELECTRONICS AUTOMOTIVE TECHNOLOGIES



Tyco Electronics Online

The Tyco Electronics website is an innovative and interactive source for application information, product updates and technical solutions.

Our step-by-step software makes our website intuitive and user-friendly to better serve you!

Please contact us at:

www.tycoelectronics.com/automotive

Internet Homepage

www.tycoelectronics.com

www.tycoelectronics.com/automotive

Electronic Internet Catalog

www.catalog.tycoelectronics.com

Product Information Center (PIC)

You can rely on Tyco Electronics PIC Team to provide you support for answers to your general information or technical questions in an efficient and effective manner.

To reach our PIC staff, please contact your local Tyco Electronics organization.



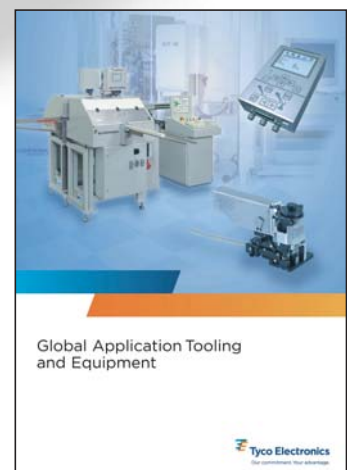
Product and Machine Literature

Tyco Electronics offers a variety of product specific catalogs, brochures and high impact flyers to help better serve you!

For more information on literature for Tyco Electronics'

Global Automotive Division, please contact your local Tyco Electronics

Organization or go to www.tycoelectronics.com/automotive



Americas

Argentina – Buenos Aires
 Phone: +54-11-4733-2200
 Fax: +54-11-4733-2211

Brasil – São Paulo
 Phone: +55-11-2103-6105
 Fax: +55-11-2103-6204

Canada – Toronto
 Phone: +905-475-6222
 Fax: +905-474-5520
Product Information Center:
 Phone: +905-470-4425
 Fax: +905-474-5525

Colombia – Bogota
 Phone: +57-1-231-9398
 Fax: +57-1-660-0206

Mexico – Mexico City
 Phone: +52-55-1106-0800
 +01-800-733-8926
 Fax: +52-55-1106-0901

For Latin/South American Countries not shown
 Phone: +54-11-4733-2015
 Fax: +54-11-4733-2083

United States
 Harrisburg, PA
 Phone: +1-717-564-0100
 Fax: +1-717-986-7575
Product Information Center:
 Phone: +1-800-522-6752
 Fax: +1-717-986-7575

Troy, MI
 Phone: +1-248-273-3359
 Fax: +1-248-273-3322

Asia/Pacific

Australia – Sydney
 Phone: +61-2-9554-2600
 Fax: +61-2-9502-2556
Product Information Center:
 Phone: +61-2-9840-8200
 Fax: +61-2-9634-6188

India – Bangalore
 Phone: +91-80-285-40800
 Fax: +91-80-285-40820

Indonesia – Jakarta
 Phone: +65-6482-0311
 Fax: +65-6482-1012

Japan – Kawasaki, Kanagawa
 Phone: +81-44-844-8111
 Fax: +81-44-812-3207
Product Information Center:
 Phone: +81-44-844-8013
 Fax: +81-44-812-3200

Korea – Seoul
 Phone: +82-2-3415-4500
 Fax: +82-2-3486-3810

Malaysia – Selangor
 Phone: +60-3-7805-3055
 Fax: +60-3-7805-3066

New Zealand – Auckland
 Phone: +64-9-634-4580
 Fax: +64-9-634-4586

Philippines – Makati City
 Phone: +632-848-0171
 Fax: +632-867-8661

People's Republic of China
 Hong Kong
 Phone: +852-2735-1628
 Fax: +852-2735-0243

Shanghai
 Phone: +86-21-2407-1588
 Fax: +86-21-2407-1599

Singapore – Singapore
 Phone: +65-6482-0311
 Fax: +65-6482-1012

Taiwan – Taipei
 Phone: +886-2-8768-2788
 Fax: +886-2-8768-2268

Thailand – Bangkok
 Phone: +66-2-955-0500
 Fax: +66-2-955-0505

Vietnam – Ho Chi Minh City
 Phone: +84-8-930-5546
 Fax: +84-8-930-3443

Europe/Middle East/Africa

Austria – Vienna
 Phone: +43-1-905-60-0
 Fax: +43-1-905-60-1333
Product Information Center:
 Phone: +43-1-905-60-1249
 Fax: +43-1-905-60-1251

Belgium – Kessel-Lo
 Phone: +32-16-352-300
 Fax: +32-16-352-352

Bulgaria – Sofia
 Phone: +359-2-971-2152
 Fax: +359-2-971-2153

Czech Republic and Slovakia
Czech Republic – Kurim
 Phone: +420-541-162-111
 Fax: +420-541-162-223
Product Information Center:
 Phone: +420-541-162-113
 Fax: +420-541-162-132

Denmark – Glostrup
 Phone: +45-43-48-04-00
 Fax: +45-43-44-14-14

Egypt – Cairo
 Phone: +202-419-2334
 Fax: +202-417-7647

Estonia – Tartu
 Phone: +372-5138-274
 Fax: +372-7400-779

Finland – Helsinki
 Phone: +358-95-12-34-20
 Fax: +358-95-12-34-250

France – Cergy-Pontoise Cedex
 Phone: +33-1-3420-8888
 Fax: +33-1-3420-8600
Product Information Center:
 Phone: +33-1-3420-8686
 Fax: +33-1-3420-8623

France Export Divisions –
 Cergy-Pontoise Cedex
 Phone: +33-1-3420-8866
 Fax: +33-1-3420-8300

Germany – Bensheim
 Phone: +49-6251-133-0
 Fax: +49-6251-133-1600
Product Information Center:
 Phone: +49-6251-133-1999
 Fax: +49-6251-133-1988

Greece – Athens
 Phone: +30-210-9370-396/397
 Fax: +30-210-9370-655

Hungary – Budapest
 Phone: +36-1-289-1000
 Fax: +36-1-289-1010
Product Information Center:
 Phone: +36-1-289-1016
 Fax: +36-1-289-1017

Ireland – Dublin
 Phone: +353-1-866-5612
 Fax: +353-1-866-5714

Israel – Petach-Tikva
 Phone: +972-3-929-0999
 Fax: +972-3-919-1088

Italy – Collegno (Torino)
 Phone: +39-011-4012-111
 Fax: +39-011-4031-116
Product Information Center:
 Phone: +39-011-4012-428
 Fax: +39-011-40-287-428

Lithuania and Latvia
Lithuania – Vilnius
 Phone: +370-5-213-1402
 Fax: +370-5-213-1403
Product Information Center:
 Phone: +370-5-211-3016
 Fax: +370-5-213-1403

Netherlands – 's-Hertogenbosch
 Phone: +31-73-6246-246
 Fax: +31-73-6212-365
Product Information Center:
 Phone: +31-73-6246-999
 Fax: +31-73-6246-998

Norway – Nesbru
 Phone: +47-66-77-88-50
 Fax: +47-66-77-88-55

Poland – Warsaw
 Phone: +48-22-4576-700
 Fax: +48-22-4576-720
Product Information Center:
 Phone: +48-22-4576-704
 Fax: +48-22-4576-720

Romania – Bucharest
 Phone: +40-21-311-3479/3596
 Fax: +40-21-312-0574

Russia – Moscow
 Phone: +7-495-790-7902
 Fax: +7-495-721-1893
Product Information Center:
 Phone: +7-495-790-7902-404
 Fax: +7-495-790-7902-401

Russia – St. Petersburg
 Phone: +7-812-718-8192
 Fax: +7-812-718-8193

Slovenia – Ljubljana
 Phone: +386-1561-3270
 Fax: +386-1561-3240

South Africa – Port Elizabeth
 Phone: +27-41-503-4500
 Fax: +27-41-581-0440

Spain – Barcelona
 Phone: +34-93-291-0330
 Fax: +34-93-201-7879

Sweden – Upplands Väsby
 Phone: +46-8-50-72-50-00
 Fax: +46-8-50-72-50-01

Switzerland – Steinach
 Phone: +41-71-447-0447
 Fax: +41-71-447-0444

Turkey – Istanbul
 Phone: +90-212-281-8181-83
 +90-212-282-5130/5430
 Fax: +90-212-281-8184

Ukraine – Kiev
 Phone: +380-44-206-2265
 Fax: +380-44-206-2264
Product Information Center:
 Phone: +380-44-206-2265
 Fax: +380-44-206-2264

United Kingdom –
 Stanmore, Middlesex
 Phone: +44-8706-080208
 Fax: +44-208-954-6234
Product Information Center:
 Freephone (UK only):
 +0800-267-666
 Phone: +44-8706-080208
 Fax: +44-208-420-8095

Tyco Electronics AMP GmbH

AMPerestr. 12-14
64625 Bensheim / Germany
Phone: +49-(0)6251-133-0
Fax: +49-(0)6251-133-1600

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1308092-2 Rev. 12-2007 4M ST

