Tyco Electronics

TE News

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"In a World Where Everything is Connected..."

Requirements for Next Generation Connectors

There is widespread consensus on the view that internal combustion engines, although continuing to improve, will in the long term be replaced by electric drives. The timing for the substitution depends on political motivations and actions as well as the comparative cost/performance curve of electric drives versus internal combustion systems.

Viewing rival drive technologies, it becomes clear that although electric drives possess many positive advantages, ultimately it will only be quickly adopted in vehicles through a low-cost reproduction of the complete drivetrain.

Figure 2 (on page 2) shows a basic overview of various current and future vehicle drive systems. The applications illustrated already reveal initial leanings towards combining units and components in specific performance classes, potentially contributing to reduced costs.

Electric Drivetrain Components

The high voltage onboard power supply is typically a separate supply structure in hybrid or electric vehicles and consists of the following components (Figure 1):

- Energy storage system (battery, ultra capacitors, fuel cells, ...)
- Electric motor
- High voltage switching and distribution unit
- Electric HV components (relays, power resistors)
- HV & LV connectors & cable assemblies for the aforementioned components
- Voltage converter HV DC/DC-LV, for supplying the 14 V power unit
- Voltage converter HV-DC/AC-HV, for supplying the electric drive
- Control devices for HV applications, e.g. hybrid controllers
- Sensors (current sensor, resolver, gear sensor, HMI sensors)

Electric Connector Requirements

The aforementioned components must be connected to one another electrically. Diverse, specific requirements arise due to the voltage level used. A summary of the main electrical, mechanical and material-related parameters can be found in.

- Voltage up to 1,000 V_{DC}, continuous current up to 400 A
- Short circuit currents up to over 4,000 A
- Air and creepage distances (isolation resistance)
- Selected materials with high CTI (Comparative Tracking Index)
- Test voltage over 3 kV
- Finger protection
- Safety functions, e.g. interruption detection (interlock)
- EMC shielding
- Contact options for specific shielded HV cable types (16–50 mm^2)
- Sealing measures

AUTOMOTIVE – ALTERNATIVE POWER SYSTEMS

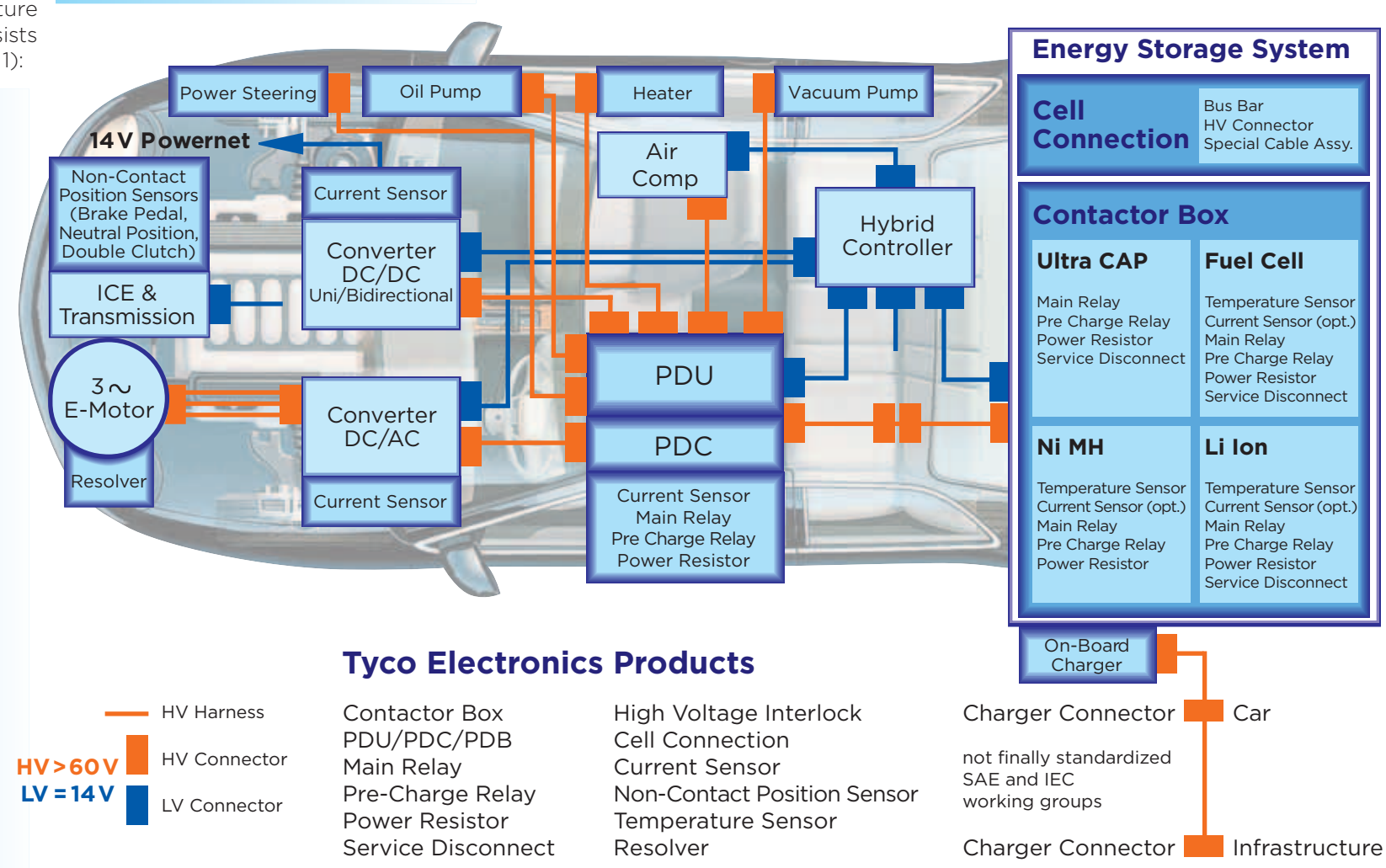


Figure 1: HV on-board power system overview

Continuation on page 2

Continuation from page 1

In addition, there are requirements which mirror the increasing complexity entailed by using connectors in high voltage onboard power supplies.

- Round contacts (for optimum ampacity with higher currents)
- Shielding (single or family shield)
- Protection class (e.g. IP6K9K – dust-proof, watertight, contact-protected IPX7 when mated and when unmated, contact-protected IP XXB)
- Interlock safety function to ensure main contacts mate first, break last relative to interlock signal contacts

The many possible combinations of these product requirements can result in large number of diverse, highly specialised products. Aside from high direct product costs, disadvantages caused by additional approval, certification and integration costs could also be expected.

For this reason, leading German OEMs defined the LV215-1 during the AK 4.3.3. working group. It lists the technical requirements that should be satisfied by new high voltage connectors. This approach will promote standardisation and facilitate bundling of small production volumes expected during the comparatively slow market take-off.

With this in mind, Tyco Electronics drafted pioneering product proposals which observe this groundbreaking specification.

The main feature is the voltage class up to 850 V_{DC} and a division into two current categories that cover the most common HV applications. The first category, up to 40 A, is for conductor cross-sections of 2.5 ... 6 mm^2. In the second category, currents of up to 250 A are defined for cable cross-sections ranging from 16 ... 50 mm^2. These parameters were intentionally selected to avoid too great a diversity of versions in HV contact systems. Aside from stationary operating points (continuous current), the prescribed dynamic load profiles were assessed which also permit higher current values for short periods.

In order to give designers greater flexibility when using connectors, the same mounting geometry/opening on the aggregate device is applicable to both 90° and 180° cable outlet directions. This means that a 90° or 180° plug coupling can be selected without having to change the aggregate device mounting geometry/opening. All categories are available in 2- and 3-pin versions.

The contact protection requirement deserves mention here as only then can comprehensive safety be ensured against potential dangers during assembly, service or field operation. The 8 mm round contact for conductor cross-sections > 16 mm^2 (category 2) offer design and space advantages in comparison to flat contacts. The protection level when mated is the equivalent of IPX7, IP6k9k and in unmated applications, IPXXB.

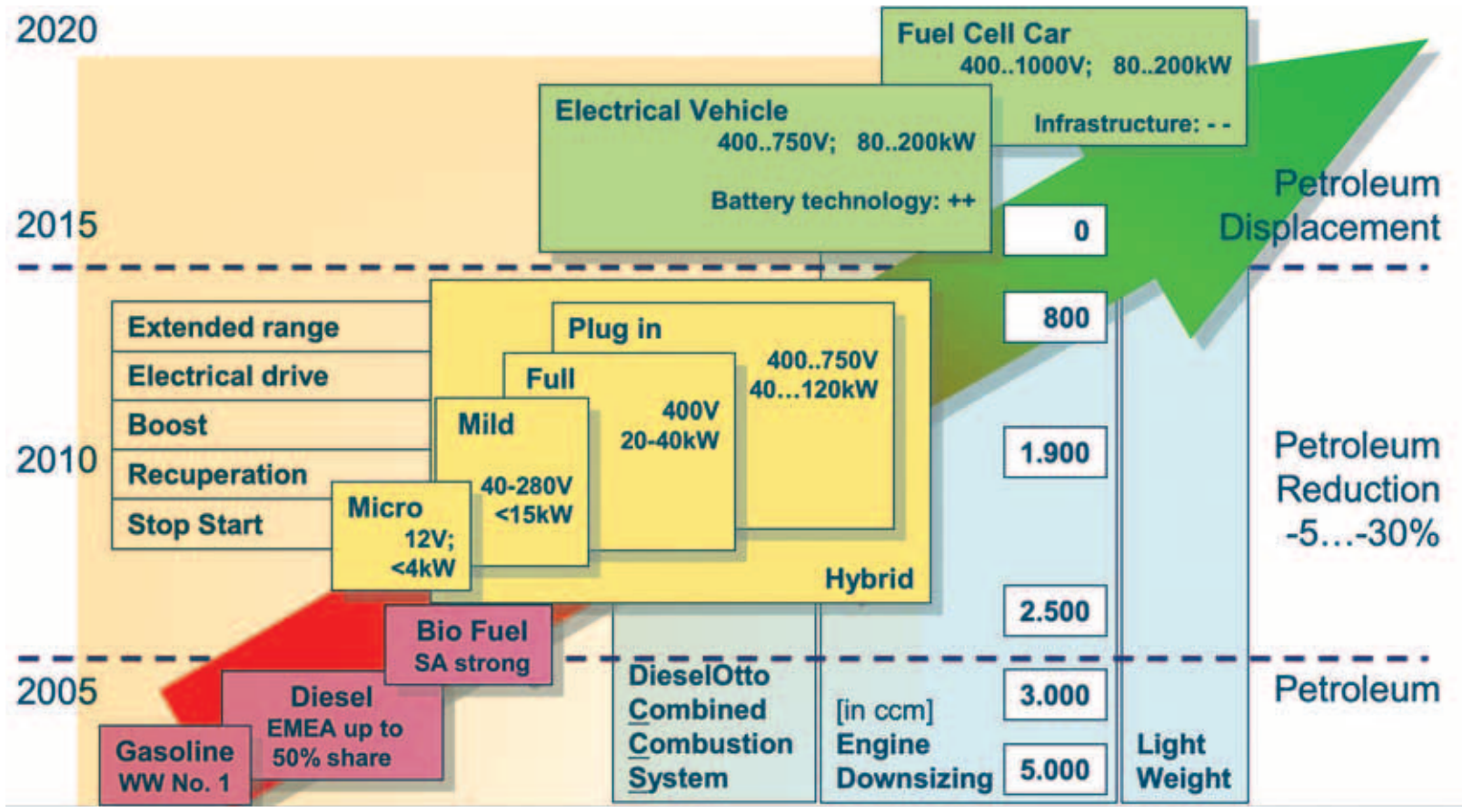
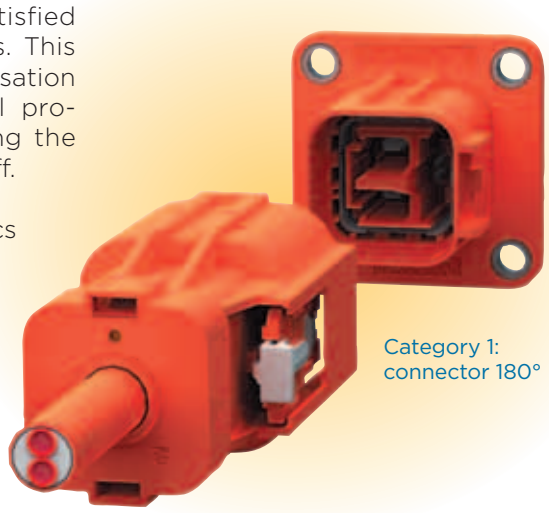


Figure 2: Overview of current and future drive systems



Category 1: connector 180°

The mating condition is detected by an interlock contact integrated in the connector.

To facilitate connector integration in automobile production from an ergonomic point of view, insertion and withdrawal forces are reduced to < 100 N by a lever system.

The large conductor cross-sections implemented and the dead weights thus entailed result in increased mechanical strain on connectors. This is a particular challenge when fulfilling the relevant vibration classes. Conductors must be effectively bound (strain relief) or their weight minimized in order to reduce strain. In the future, aluminium conductors will play a greater role.

Category 2: connector 90°

Vehicles with electric drives will also have to satisfy high EMC requirements in view of major advances in communication technologies and entertainment electronics. For this reason, the connectors presented are completely shielded and designed for the use of shielded conductors.

Due to the high voltage onboard power supply topologies and shielding concepts used, induced currents of up to 10 A, and for short periods, even 25 A, may occur on the shields.

A non-wearing electric drive makes demands on the longevity of connection components. A mating cycle count of up to 50 underscores this demand. With the aim of minimizing potential accident repair costs, priority was placed on the 5-fold replaceability of housing and contact, a help for OEMs in achieving attractive insurance classifications for end users.

Summary and Outlook

The complexity of this new AK interface is defined by a high number of specification parameters mutually defined by leading German automobile manufacturers. These new interfaces therefore possess high application potential in future high voltage onboard power supplies.

Tyco Electronics views the development of these components as a further consistent step towards optimising onboard power supply structures and thus reducing system costs and increasing robustness. The market launch is expected at the beginning of 2011.

As an important link between the energy storage system, electric motor, voltage transformers, control electronics and sensors; these connectors must guarantee reliable power supplying.

The successful implementation of the new systems in vehicles brings with it many technical challenges, while at the same time offering a unique opportunity to establish modular product standards based on harmonized requirements.

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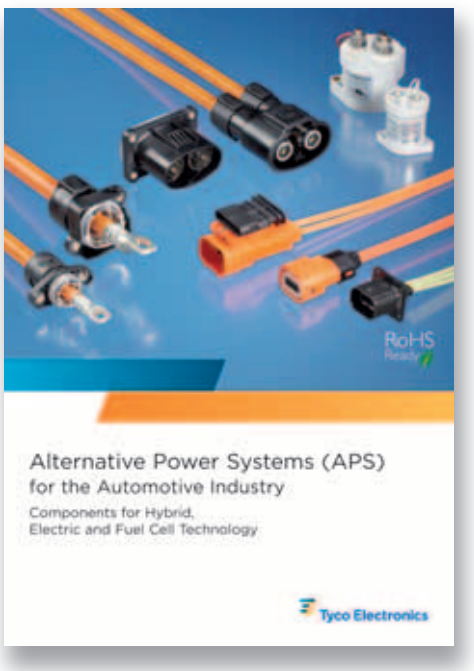
Literature Available:



Alternative Power Systems (APS)
for the Automotive Industry
Literature No. 1654294-3

Connecting High Bandwidth Data

The demands on the automotive industry to accommodate the growing requirements for the integration of consumer based products, as well as responding to the drivers capabilities to process higher data content, remains a significant challenge for the industry. Tyco Electronics is the only connector supplier which can offer solutions based on all connectivity mediums such as electrical, optical or coaxial, as well as potentially wireless.

Through the intensive local presence in each of the automotive markets combined with the global product development and manufacturing footprint, Tyco Electronics will lead the way in defining the next generation of connection systems which will be used in the application field what is now commonly known as Infotainment.

Optical Based Solution

Tyco Electronics was the first connector company to support the launch of an optical based automotive network with the D2B system. This network was later replaced by the MOST 25 standard, which is now available on all high end automotive platforms covering the multi media networking solutions, mainly focused on digital audio streaming.

Tyco Electronics was the connector representative on the MOST physical layer development team, and offers the widest product portfolio to the market for all the physical layer components. Picture 1 shows an example of the MOST network. In picture 2, is an example of one of the new MOST pigtail types launched recently to the market. The MOST 25 micro pigtail 180° is focused on applications where the optic cable routing is not compatible to the form of the existing micro pigtail 90°.

Common applications areas are the instrument cluster connections. This pigtail is fully compatible to the MOST 25 optical requirements as well as the MOST 2+0 mechanical requirements. It also includes an option of reflow soldering when combined with a reflow compatible FOT (Fiber Optic Transmitter) and delivered in a two piece format.

The MOST 25 standard covered data rates up to 25 MBit/sec, with the growing requirements for digital video streaming as well as the added functional requirements of an Ethernet channel to transmit internet protocols within the automobile, the need to widen the bandwidth of the MOST protocol was required. This update will be accomplished with the introduction of the MOST 150 specification.

The MOST 150 connectors will increase the data rate transmission to 150 MBit/sec while maintaining the existing Plastic Optical Fibre (POF) physical layer currently used on MOST 25 connector system. This limits the overall impact of the change and the existing wiring harness logistics channel will remain unaffected by the upgrade. What will change is the light source and optionally the method how the light source and photo diode should be packaged.

Much discussion has taken place regarding the best method to integrate the next generation optical transmitters and receivers in to the MOST networks. Proposals have being made based on surface mount devices.

This would result in the traditional flexible pigtail being split in two separate components. The SMD (surface mount device) device housing the light source and the photo diode and the POF assembly which will make the connection to the MOST interface.

This concept has the advantage of removing the thermal sensitive POF from the soldering process, but could prove costly from a material and a manual assembly aspect.

AUTOMOTIVE – INFOTAINMENT

Picture 2: MOST 25 - Micro Pigtail 180°

Picture 1: Example of MOST Network

Another option is the side-looker form which is already available for MOST 25 and can be expanded to cover the MOST 150 requirements. The present MOST 25 device has four pins, with MOST 150 device this will be increased to 7 pins to accommodate the additional functionality. To safeguard the higher data rates the shielding concept will also be upgraded with the addition of shielding pins to the PCB. It is the philosophy of Tyco Electronics to build on the positive building blocks of previous generations.

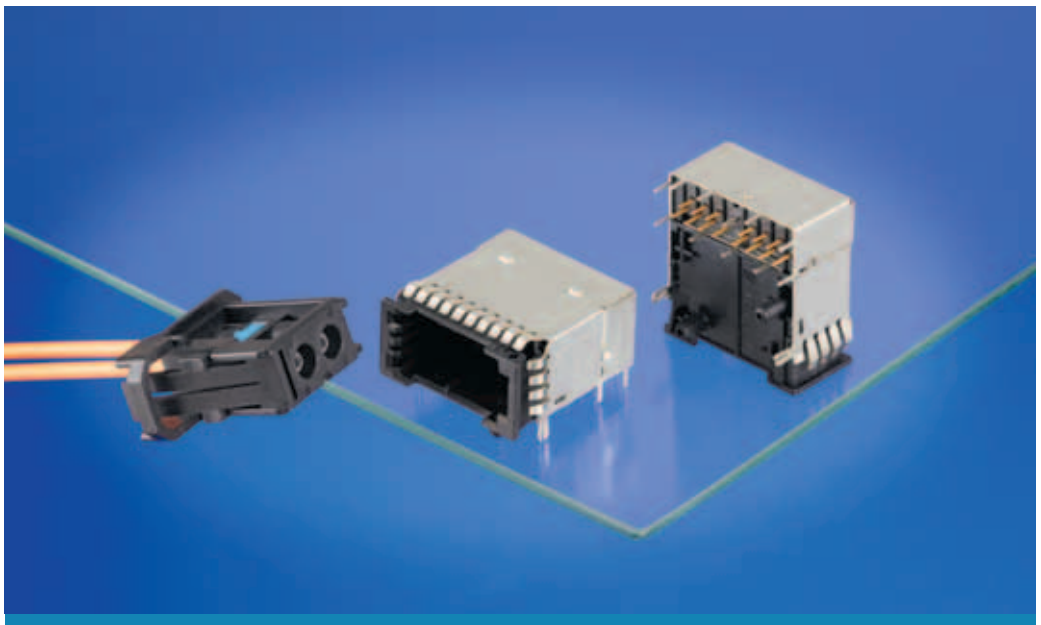
So Tyco Electronics will offer the existing product concept for the micro pigtail as well as fulfilling the MOST 150 requirements and upgrading the product to be compatible with reflow (Pin in Paste) process requirements of the Tier 1 manufacturers.

The MOST 150 micro pigtail can be seen in picture 3. The difference to the existing MOST 25 micro pigtail which has being successfully used by all MOST OEM car makers can be summarized in two ways. Firstly to accommodate the new packing form of the MOST 150 side-looker FOT's the connector needs to be extended by 2.4 mm due to the second row of pinning.

Secondly the added features building on the success of the MOST 25 version, such as the fully shielded connector body, extra grounding pins to the board as well as the shielding option to the device casing and also an option of pin in paste / reflow soldering compatibility. This is achieved by removing the heat sensitive POF currently used in the MOST interface and replacing with a Glass Optical Fiber (GOF). This product is also fully compatible to automatic pick and place processing.

In comparison to the SMD version a number of critical advantages are present. Firstly a cost advantage, due to the material savings. Fewer parts are required and processing savings compared to the extra manual assembly operation of the pigtail assembly to the SMD housing. Secondly space savings on the PCB, as only one element is required. Thirdly quality, as the part is processed within a fully controlled automatic operation from pick and place to potentially pin in paste / reflow processing. The MOST 25 micro pigtail was extensively applied by all MOST connector system users and Tyco Electronics will continue to offer the tried, tested and trusted technology with the improved processing capabilities to all MOST 150 connector users.

The focus is now on the next generation optical system. As bandwidth will increase driven by the increased connectivity requirements in the automobile and when this is coupled with the growing number of sources which create



Picture 3: MOST 150 – Micro Pigtail

interference, such as high current / voltage networks due to alternative power systems. Then the future demand for an interference immune data signaling system such as an optical based solution will grow in attraction.

Copper Based Solution

Not all OEM's are comfortable with the fibre optic solution, additionally due to the increased data rates for applications such as real time visual data transmission for safety relevant camera applications, high resolution displays or high speed USB applications, the current automotive grade POF and LED based FOT's do not offer an adequate solution. Even though significant development has taken place with polymer cladding silica (PCS) and laser (VCSEL) technology, the majority of the mentioned applications are currently based on an electrical medium and in the case of camera and display links utilizing the LVDS protocol.

Tyco Electronics is the main supplier of the automotive grade 4 channel LVDS based on the 10 Way MQS connection system. With the continuous development of the IC technology improving on the automotive grade performance combined with increased bandwidth capabilities, allows high speed links to increase proliferation in automotive applications. A four way LVDS Interface is now being launched into the market, this technology is being identified as the Tyco Electronics High Speed Data (HSD).

This product family is completely compatible to the planned German "Facharbeitskreis Automotive" Specification for one channel LVDS communication based on the Shielded Star Quad connection system.

Picture 4 demonstrates an overview of the Tyco Electronics HSD product portfolio. The focus is on a complete product portfolio of terminals, connectors, PCB headers and cable assemblies.

Picture 5 shows the new HSD 4 way header from Tyco Electronics. The fully shielded header optimized for two channel differential signal transmission with target system impedance of about 100 Ω for each channel. The header was developed under the conditions of excellent RF performance and mechanical robustness as well as achieving the market cost requirements.

These three opposing parameters can be unified when modern methods of simulation are adopted and applied at the initial phase of the mechanical design. A simple measurement can give us an indication of the RF performance related to the mechanical and material attributes. It is a time domain measurement method that shows the impedance over the propagation path, please refer to picture 6. If there are ripples with high dynamic and big width we can imagine that the signal will be reflected at those areas. A typical connector system has a lot of these areas. Different diameters of pin contacts and socket contacts, the crimping zone, the area between the twisted cable and the contacts, the difference of the grid dimension of the cable and the connector. Typical standards specify measurement signal rise times at about 100 ps and even more for time domain measurements. In that case the corresponding fundamental wave is about 3.5 GHz. The graph shows the same PCB header before and after fine tuning (the two red coloured lines showing the impedance limits).

Picture 4:
Tyco Electronics High Speed Data (HSD) Product Overview

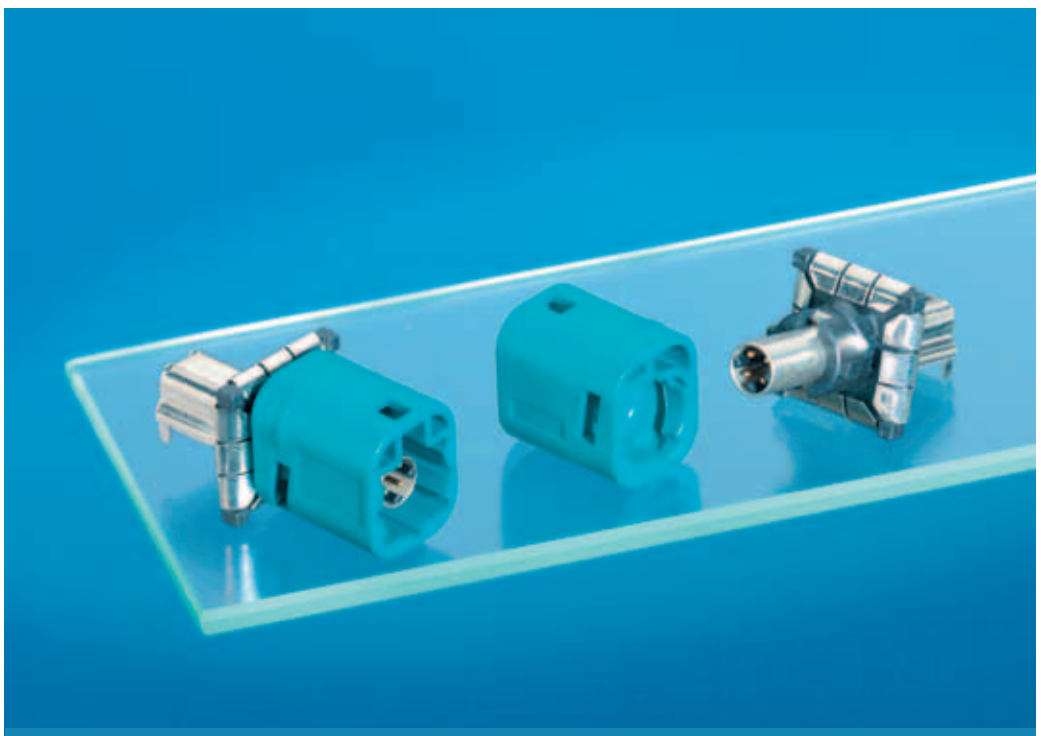
The Impedance is measured by means of a signal rise time of 27 ps. This represents a fundamental frequency of 12 GHz. The Tyco Electronics HSD (high speed data) PCB header fulfils even the impedance limits at a signal rise time of 27 ps! This behaviour predestines the header for high speed data transfer up to more than 1 GBit/s. Measurements of other RF-parameters will confirm this.

An important aspect for the HSD connector is the system performance, but just as important is the compatibility to the processing requirements further down the logistics chain which can have a significant impact on the overall system cost. The HSD header system from Tyco Electronics is acutely aware of the requirements of the Tier 1 (Device) manufacturers and these requirements have being taken in to deep consideration during the development process. The Tyco Electronics HSD connector is fully pick & place as well as reflow pin in paste compatible. The shielding connection to the device casing is achieved through the integration of the shielding lock into the coding cover cap. This eliminates the use of extra tooling and reduces significantly the assembly effort.

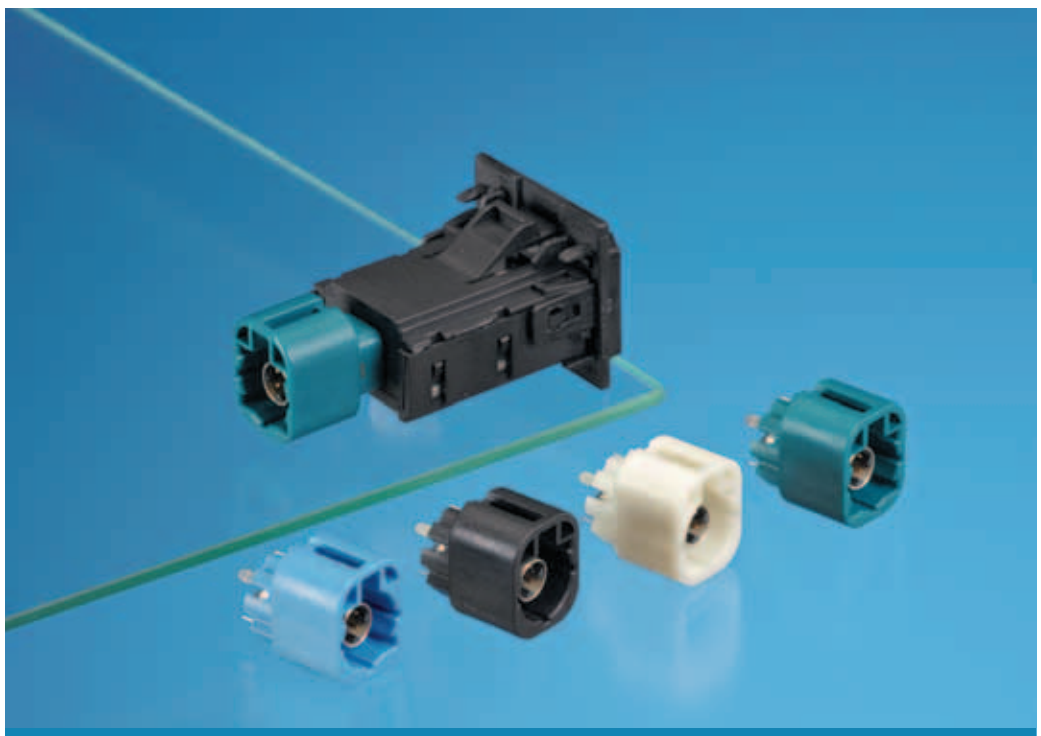
Picture 7 shows header forms based on a 180° connection direction as well as incorporating the HSD interface which has the same electrical performance as the above shown 90° version. The 90° version is also available in using a one piece design with device casing shielding connection as well as a version without a device case shielding connection. Picture 7 also shows a USB connection combined with a HSD header, this allows the consumer interface to be introduced in to the car and accommodating the automotive requirements. As the USB interface was originally developed for consumer applications, it is not ideally suited to the automotive environment. But the USB connector solution based on HSD overcomes this issue, the USB devices will be connected to the automobile's electrical infrastructure through the automotive based HSD connection. This consumer port concept can be developed further to incorporate Aux-In connections as well as SD card reader slots on one side which is then coupled to automotive grade connectors such as HSD on the opposite side. Service issues can be easily accommodated by replacing the consumer hub in the event of any damage to one of the consumer interfaces.

Tyco Electronics also provides a complete range of HSD cable assemblies, with the latest addition being the sealed plug and inline connections which are ideally suited to camera applications, picture 8 shows parts. All varieties of cable assemblies combining the unsealed 90°, 180° as well as the 180° inline and the newly available sealed connections can accommodate all cable assembly needs for electrical high speed connections.

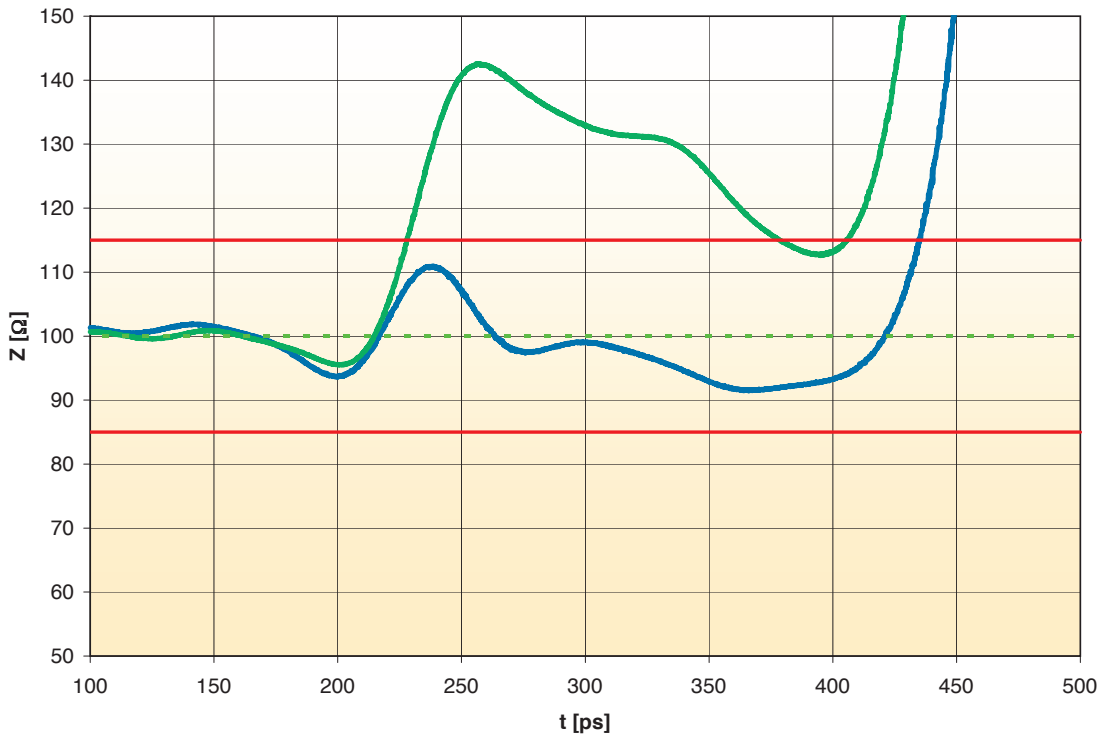
The innovation is continuing in this area which will see the shielded four way connector form being available in low cost versions as well as product families based on already qualified automotive grade terminal systems. The cost focus will also continue in the optimization of processing of the cable assembly to improve the shielding effectiveness as well as the overall cost.



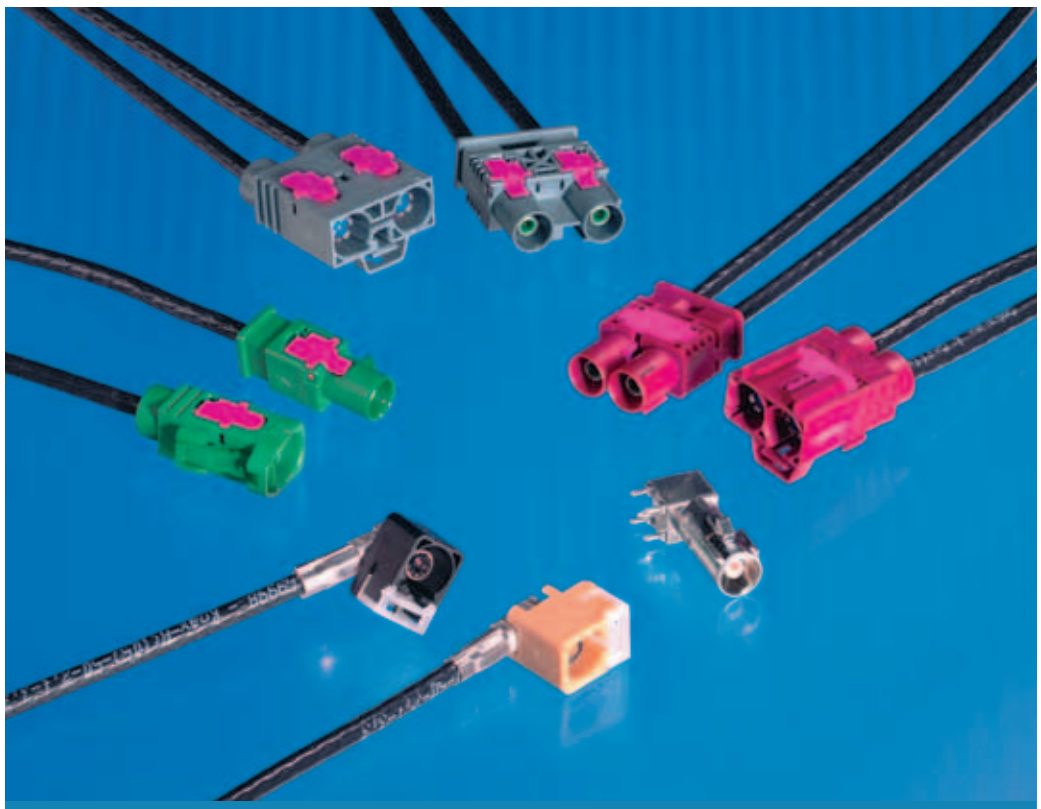
Picture 5: Tyco Electronics HSD 90° Header and Cap



Picture 7: HSD – USB Adapter and HSD 180° Headers



Picture 6: HSD Header Impedance



Picture 9: RF Fakra Components

Coax Based Solution

The German "Facharbeitskreis Automobil" (Fakra) Council is widely accepted as the standard for coaxial connections within the automotive industry. This standard covers the design of the connector interface for the mechanical and electrical characteristics' which also encompasses the testing methods.

Over the last ten years this standard has gained world wide acceptance for the distribution of coaxial based connections in application areas such as antenna to head unit for GPS, GSM & AM/FM signals. Tyco Electronics offers a wide portfolio of product based on this standard. The core product is the terminal and connection system with a broad range of market products available to the automotive market, picture 9 shows some of the Fakra components.

For customer specific requirements Tyco Electronics can also offer products for specialized applications. Parts can be supplied as individual items combined with processing know how or as part of a customer specific cable assembly. The connection system is based on all widely used coaxial cable types and due to the continuous development in the cable market this list is being constantly updated to ensure all market requirements and new application types are being covered. Complementing the harness components is a full range of header products performing to the highest requirements' and guaranteeing signal quality through the life of the device.

Tyco Electronics was the first component supplier on the market to supply the contact system based on a stamped inner contact and the innovation focus is currently on fully automated cable assembly to reduce the overall cost of the system.

For customers who require cable assembly RF products, Tyco Electronics can offer support at this level from application engineering know how up to full logistical support. Through Tyco Electronics' intensive global footprint which is present in all automotive markets and supported by our team of locally positioned sales and application engineers will ensure a world class service.

Not all car manufactures want to use the RF Fakra standard so for these applications an alternative to the RF Fakra product line is required. Tyco Electronics has now launched a new product line of RF products called stripline RF connector. This product line is based on Insulation Displacement Technology (IDC) coupled with the stripline principle which is already widely used in other industries. Picture 10 shows an overview of some of the products already available in the stripline RF connector product family which can offer an advantage in RF performance as well as processing costs. As per the RF Fakra product family, Tyco Electronics will offer a full range of products from terminals and connectors to PCB headers as well as cable assemblies.

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Picture 10: RF Stripline Connectors

Picture 8: HSD Sealed Cable Connections

Literature Available:

FAKRA RF Connector System
Literature No. 1308073-1

High Speed Data Communication
Literatur No. 1308074-1

AUTOMOTIVE – SENSORS

Multi Coil Resolver (MCR)

The Tyco Electronics E-Motor Commutation Sensor Technology

The MCR resolver is measuring the rotor angular position of a synchronous electrical engine, using analysis of magnetic fields. The performance of this smart technology has been recently improved by a Tyco Electronics development.

Automotive industry is progressively moving towards hybrid or electric powertrains, where electrical engines, mainly from synchronous type, are being used. This growing market needs higher performances for these e-machines. One critical point for the engine is to determine accurately the rotor angular position, in order to enable its control and allow phase inversions at the right timing. The accuracy of this angular position influences the engine efficiency, but also the torque control for optimum driving sensation. Such angle sensors need to be able to work in harsh environments, be accurate, safe and reliable.

The Tyco Electronics MCR resolver strength is to be able to determine the angular position without placing coils on the rotor, this principle is cost effective and reliable. Its basic working principle is a metal part, with a symmetrical shape, which is placed on the rotor, and which acts as the rotating target. The resolver is fixed on the stator (non-moving part), where coils are placed all along the radius. Depending on the angle of the rotor there is a high or low coupling to the Sin- and Cos- windings. The specific combination of windings in series gives a U_{sin} and U_{cos} signal. Out Of of these two signals the electronics calculates the position angle with the tangent equation. This principle, which is using Tyco Electronics know-how in terms of winding, magnetics, packaging and assembly, allows us to adapt to the different customer needs. Tyco Electronics resolver design is robust, cost-effective, flexible and can accomodate different sizes and different numbers of electrical engine speeds.

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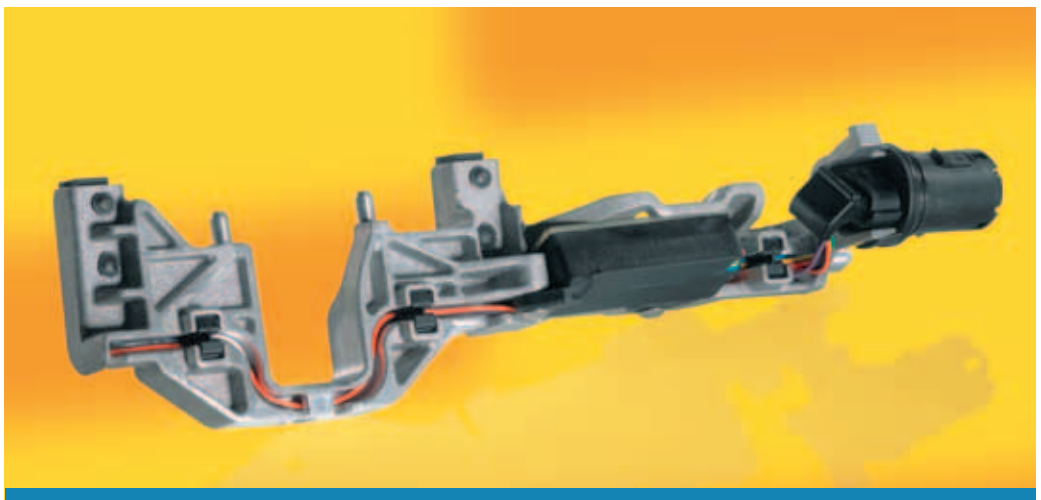
More information:
www.tycoelectronics.com/automotive/sensors

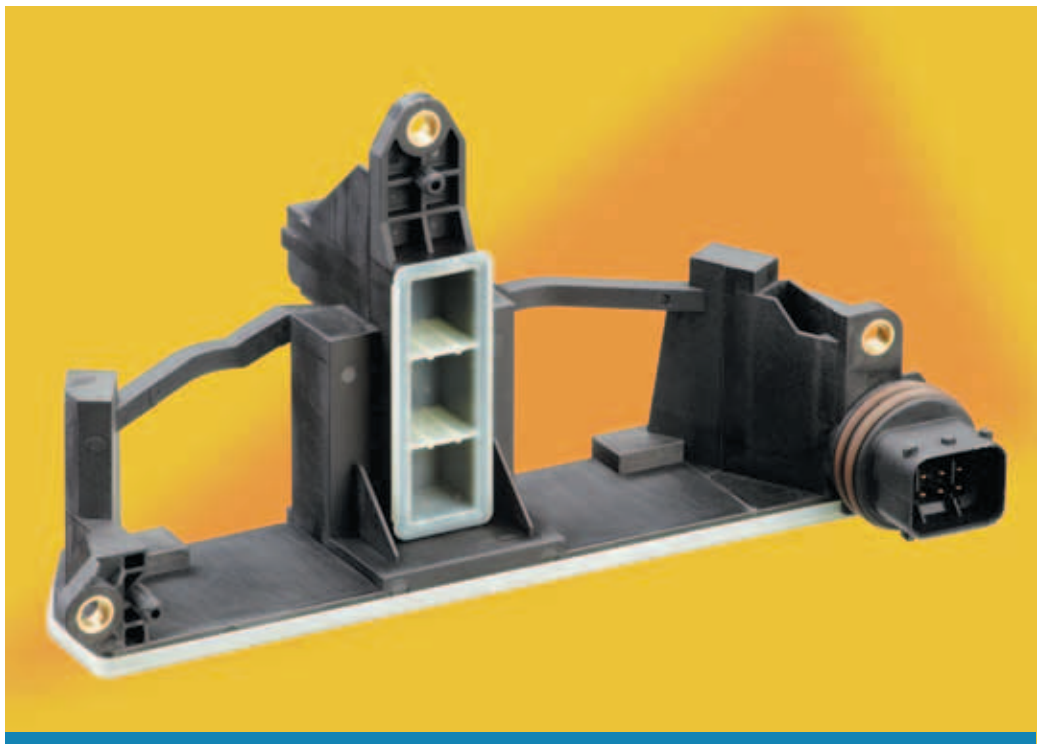
Transmission Sensor Modules

The increasing amount of sensors within new transmission concepts continuously lead to high integrated sensor modules. In special Dual Clutch Transmissions (DCT) require new modular concepts in order to package the various sensor functions.

Typical sensors for integration are:
- Drive mode travel or rotary sensors
- Gear fork travel sensors
- Clutch travel sensors
- Gear wheel speed sensors
- Clutch pressure sensors
- Temperature sensors



Sensor Module with integrated Drive Mode (P-R-N-D) and Speed Sensors (DCT)



Sensor module with integrated Gear Fork (4x) and Speed Sensors (DCT)

By integrating the single sensor units into their function-oriented position and adjusting the inter-connection technology accordingly, the final 3-D configuration of the complete module is determined.

The wide product- and process portfolio of Tyco Electronics offers for this an ideal base for the development and production of such robust and reliable sensor modules. Tyco Electronics' extensive design and process capabilities include:

- Functional safe according ASIL requirements
- Power distribution and electrical interface for hydraulic or electrical actuators
- Single conductor wiring for optimized interconnections
- Oil and water tight sealed pass through connectors
- Robust interface technologies like i.e. press fit, soldering or welding

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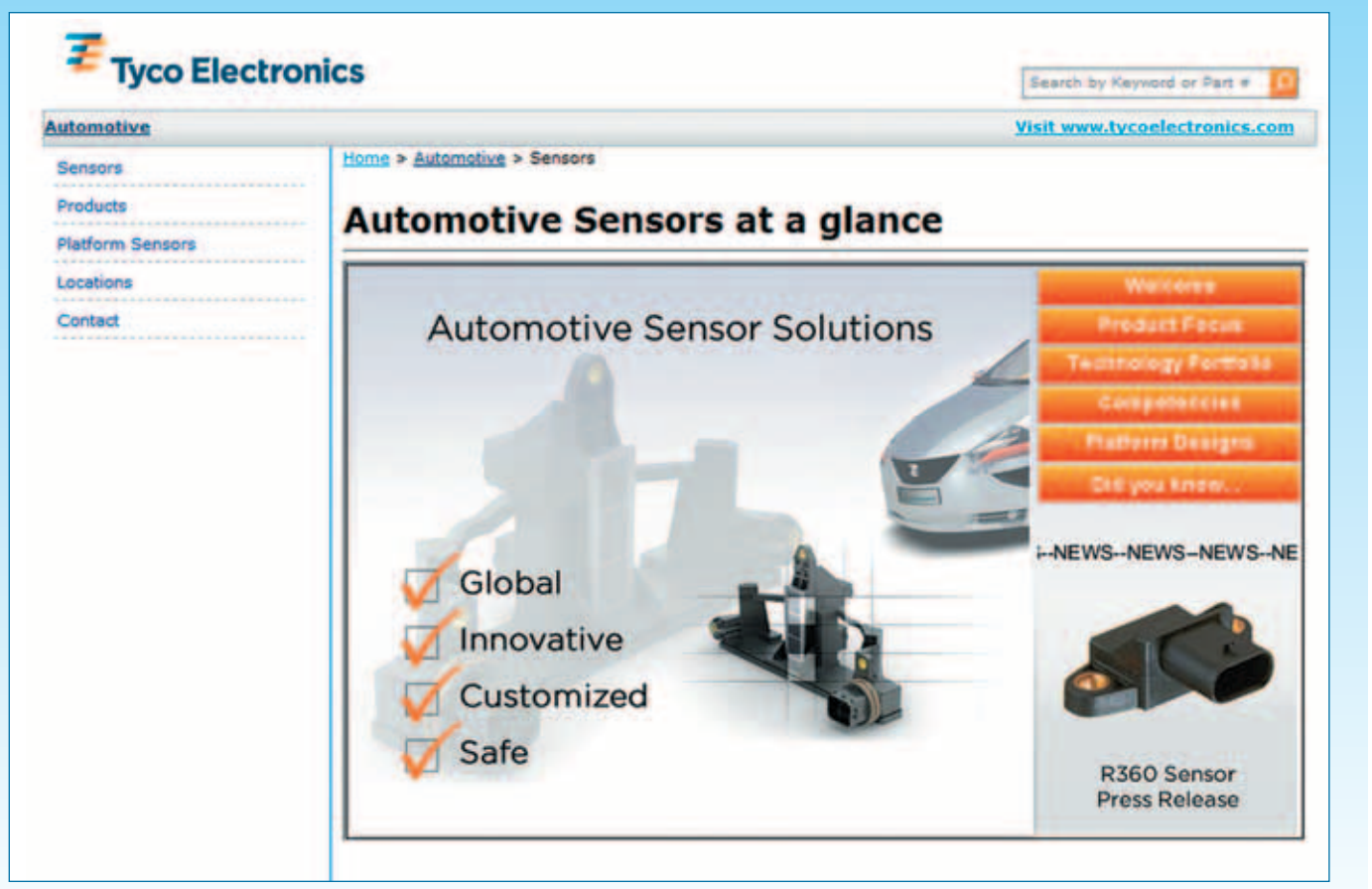

More information: www.tycoelectronics.com/automotive/sensors

The Time Has Come to Get Smaller

Innovative New Miniature Connector Series for Automobiles Named NanoMQS Terminal Has Arrived

AUTOMOTIVE – MINIATURIZATION

Reducing the existing MQS series in volume by 70%, in weight by 50% and in hight by 50%, you can definitely talk about miniaturization. To stay the market leader in connectivity for thin-type computer units, high-density printed circuit boards and ultra-narrow wiring, Tyco Electronics has developed the NanoMQS terminal for the automotive industry.

Since 2007, Tyco Electronics has been working on concepts for smaller terminals and connectors based on the 0.64 and MQS connector family. The design of the new connector family was inspired by operators and customer needs. Creating a significant smaller terminal was mainly driven by keeping the electrical performance for signal distribution like MQS and 0.64 connector series. After proving performance the first housings are now available for serial applications – already used at various OEM´s and aggregate manufacturers.

The products enable a reduced PCB size for electronic components, smaller wires down to 0.08 mm^2 and reduced total connector package. These features combined conserve energy, resources, weight with the ultimate benefit of reducing CO_2.

The advantages of the Tyco Electronics NanoMQS system allows in addition a modular integration to enabling the connector system to be hybridised with MQS terminal, PQ (Power Quadlok), MPQ (Micro Power Quadlok), and MQS 1.5 terminal as the primary and secondary lock are on the same level. Headers can be designed with press fit, through hole and SMD board termination technology to complement to product options.

Additional Features

- Pitch of 0.75 mm for surface mount PCB
- Minimum pitch of 1.5 mm for wire harness
- Lead free solder compliant
- Pin geometry compliant to Asian 0.5 series

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Literature Available:

MQS Interconnection System
for the Automotive Industry
Literature No. 1307999-3

Standby Power – Useless Energy Consumption

Modern households have a large number appliances that consume energy when they are not in use due to their standby mode. These appliances include televisions and radios, video recorders, electric toothbrushes, set-top boxes, satellite tuners, chargers for laptops and mobile phones.

The European Union took up arms against the consumption of energy as early as 2008 and passed corresponding directives – Directives 2005/32/EC and 2008/28/EC. One of the first measures related to the "Energy-using products directive" (Eco-design directive)[1] will permit a drastic reduction in the standby power consumption of household appliances and office equipment.

The „standby" regulations apply to all electrical appliances used in households and offices such as televisions, computers, microwave ovens etc. Depending on the functionality of the product, a maximum power consumption of either 1 or 2 Watts is defined for the standby mode in 2010. From 2013 the maximum power consumption is 0.5 or 1 Watt, an amount that is close to the values that can be achieved with the best technology available.

With the regulations it is intended to reduce the power consumed by the standby mode in the EU, currently approaching 50 TWh per year, by 73% by 2020. These savings represent the annual power consumption of Denmark and an annual saving of 14 million tonnes of CO_2 emissions. Further savings can also be expected in other regions of the world, as many of the products affected are sold worldwide.

In Germany no-load losses in private households and offices are responsible for consuming at least 22 billion kWh of power per year. These losses result in annual costs of at least four billion euros. The new EU regulations should reduce this power consumption by more than six billion kWh per year – a reduction of almost four million tonnes of CO_2. This reduction will allow at least one large 800 Megawatt power station to be saved. The appliance users will also save a good 1.2 billion euros in annual electricity costs.

As the regulations only cover a specific part of the no-load losses, further appreciable savings are possible in IT networks (so-called network standby) as well as by using zero-Watt circuits. According to an estimate by the German Federal Environment Agency, in this way the power losses across the EU could be reduced by a further 7 billion kWh, and in Germany by around 1 billion kWh.

The regulations were the first so-called implementing measure for the Eco-design directive.

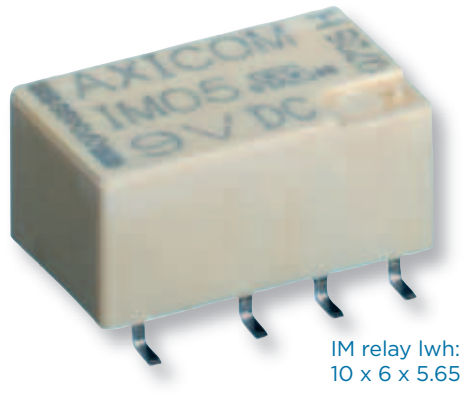
More information: http://relays.tycoelectronics.com/axicom

Chargers for mobile phones – example of a zero-Watt circuit

Mobile phones are currently the most widespread electronic devices. The number of active mobile phones is around 5 billion units worldwide. There exists a similar number of chargers to operate the mobile phones. Typically these chargers are always connected to the electricity supply and draw standby power. Even if the standby consumption of the individual chargers is only approximately 50 mW, with 5 billion chargers the energy consumption is 250 MW just in the standby mode. This energy is converted completely uselessly into heat.

Zero-Watt circuits such as in the charger shown below are electrically isolated from the electricity supply after the charging process. This isolation is performed by a Tyco Electronics IM relay. If the charger is connected to a discharged device, the discharged device is detected and the electricity supply switched back on.

Specific characteristics are required for this function. A two-pole, bistable relay with a coil power rating of 30 mW is used. Due to the very short set and reset pulses, only 90 QJ are required to actuate the relay. The relay must also have reinforced protective insulation and high resistance to mechanical shock to withstand the typical handling received by consumer appliances. All these requirements can only be met by electro-mechanical relays.



IM relay lwh:
10 x 6 x 5.65 mm

For example: World's first charger with zero-Watt circuit. Complete shut down is performed using an IM relay with a physical size of 10 x 6 x 5.65 mm

[1] Deutsche Energieagentur (German Energy Agency): http://www.thema-energie.de/strom/stand-by/anteil-stand-by-am-stromverbrauch.html

[2] Umweltbundesamt (German Federal Environment Agency): http://www.umweltbundesamt.de/uba-info-presse/2008/pd08-054.htm

[3] http://www.umweltbundesamt.de/produkte/dokumente/oekodesignrichtlinie.pdf

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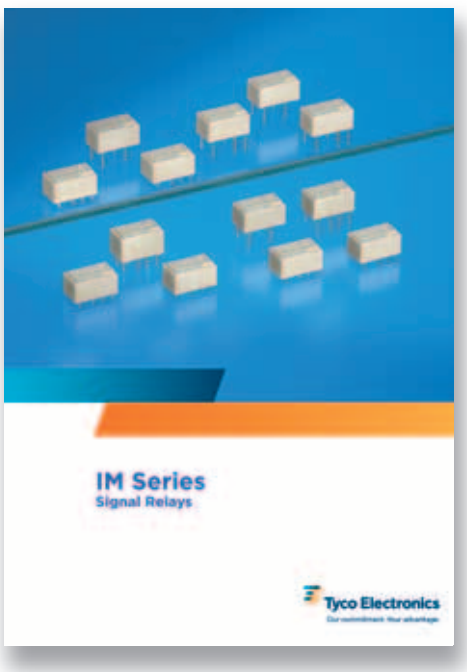
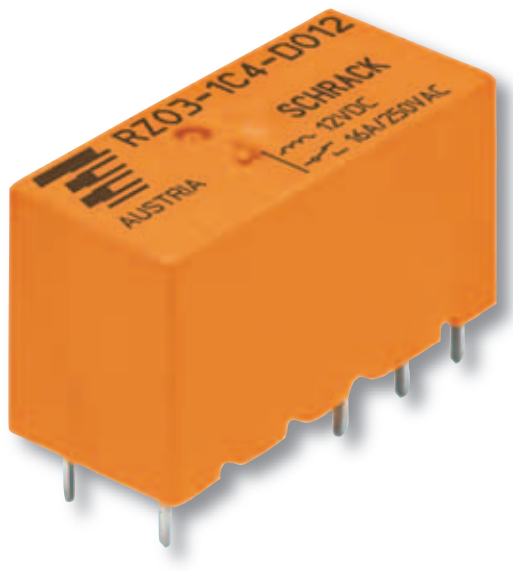
Literature Available:



IM Series – Signal Relays
Literature No. 108-98001

RZ Relay – Excellent Performance and Delivery Capacity



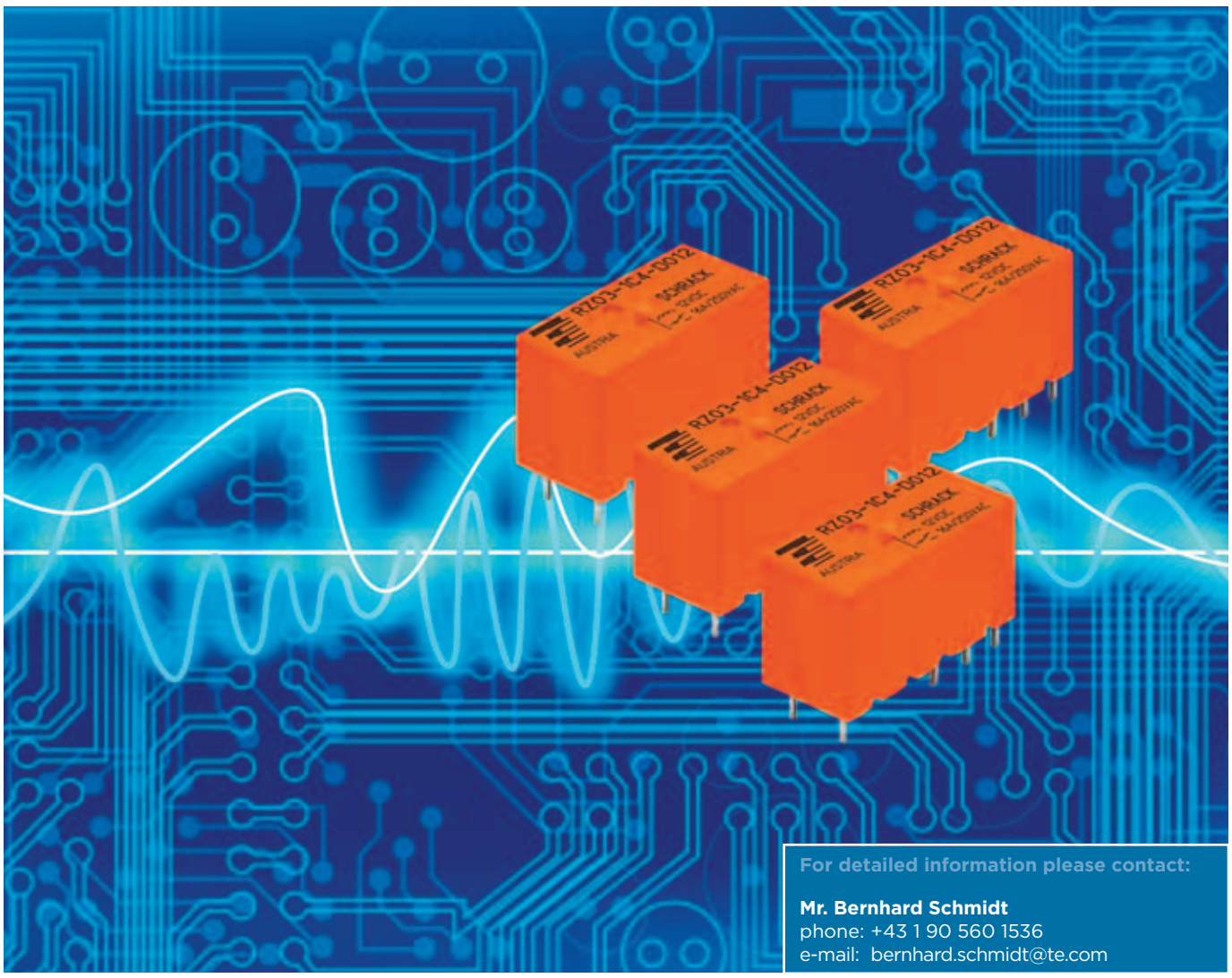
The RZ relay is the next generation of the successful RT series product line, a relay delivering excellent performance.

The switching contacts of the RZ relay perform remarkably well. At 85°C ambient temperature and 16 A switching current, 50,000 cycles are VDE approved and UL recognized. The RZ relay range is comprised of single-pole relays with normally open or changeover contacts, and it offers a choice of AgNi or AgSnO contact materials. Standard 85°C ambient temperature models are available, as are 105°C versions and models with transparent covers.

The rated coil power is 400 mW. The product fulfills the glow wire test according to IEC60335-1 and is RoHS compliant.

The RZ relay is suitable for a broad range of electronic applications in areas such as energy management systems, household appliances, boiler control, timers and garage door control.

Tyco Electronics' RZ relay is produced on a fully automated production line in Waidhofen, Austria, and is available at short lead times.



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Features at a Glance:

- 1 pole 12/16 A, 1 CO or 1 NO contact
- DC coil 400 mW
- 5 kV/10 mm coil-contact, reinforced insulation
- Ambient temperature 85°C, HOT version for 105°C
- Product in accordance to IEC60335-1

Typical Applications:

- Energy management systems
- Household appliances
- Boiler control
- Timers
- Garage door control

Literature Available:

http://relays.tycoelectronics.com/schrack/relays/pcb.asp

High Current Relay Facilitates Start/Stop Function

Tyco Electronics' High Current Relay 200 (HCR 200) was specially designed for fuel-saving automotive start/stop functions. During the cranking phase of restart, the relay disconnects the starter system from the vehicle's primary power system which is temporarily supported by a second battery.

The HCR 200 relay is designed as a monostable, normally-closed relay, providing electrical continuity in case of a failure in the control circuit. The current carrying capability is up to 130 A continuous at 110°C ambient, enabling its integration into pre-fuse boxes and power distribution boxes in the engine compartment. Continuous current up to 175 A can be carried at +85°C ambient. Compared to conventional electronic solutions, the relay offers the additional advantage of galvanic isolation.

Features at a Glance

- Normally closed contact arrangement
- Limiting continuous current 130 A at +110°C
- Compact design
- Optimized for integration in pre-fuse boxes
- Minimal contact resistance
- High shock resistance (30 g)
- Galvanic isolation

Typical Applications

- Energy management
- Dual battery power net
- Start/stop

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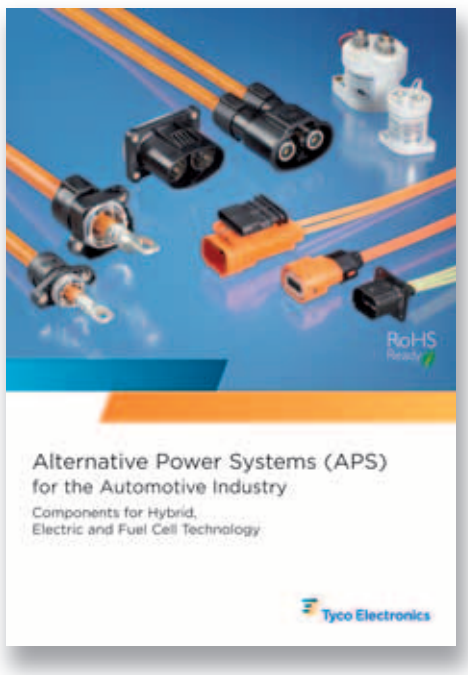
Literature Available:



Alternative Power Systems (APS)
for the Automotive Industry
Literature No. 654294-3

Electric Mobility – Relays for Alternative Drive Concepts in Hybrid Vehicles and Electric Vehicles

Tyco Electronics supports its customers with products for power distribution in high-voltage vehicle electrical systems such as high power connectors, high-voltage relays, sensors and components for thermal protection, as well as concepts for their appropriate use. Relay applications of key importance for the electrification of future vehicle drives are considered in more detail in the following.

The car industry is working urgently on reducing the importance of fossil fuels and making the transition to the electrified drive train in the context of "electric mobility". In the next few years, significant quantities of hybrid-electric vehicles (HEV), battery-electric vehicles (BEV) and also fuel cell vehicles (FCV) will be on the market. Also auxiliary devices and ancillary units will be electrified ("X-by-wire" applications, e.g. electrical power steering). The effects will not only be profound for the vehicle manufacturers and battery suppliers, but also for utilities and grid operators; within the next ten years there will be millions of vehicles with electric primary drive on our roads.

Independent of the level of electrification (drive power rating between 10 kW and more than 120 kW), electrified vehicles have common key features and a more complex vehicle electrical system: the operating voltage must be significantly increased in comparison to vehicles with a pure combustion engine (12 V_{DC} / 24 V_{DC}), and high-voltage batteries integrated in the vehicle electrical system as rechargeable energy storages. As a result the requirements for components such as relays, connectors and wiring will increase in these vehicles, to some extent there will be new requirements.

For instance the vehicle's operating and safety concept must ensure that physical contact with hazardous potentials is excluded and the safety of individuals is ensured, as voltages of up to 1,000 V_{DC} and short circuit currents in the kilo-ampere range may occur. Furthermore, in a wide range of situations it must be pos-sible to actively isolate the high-voltage energy storages from and also to re-connect them to the vehicle's electrical system. In normal operation, during servicing/maintenance and particularly in the case of an accident or a fault (e.g. crash, wire break) electrical isolation must be possible. Relays cannot perform this task on their own, here the matched usage of special high-voltage fuses in conjunction with high-voltage relays is necessary.

Basic Properties of HV Relays

Tyco Electronics can draw on decades of proven industrial solutions for relays in high-voltage applications. These solutions are tried and tested for disconnecting high currents and provide safe arc quenching. At voltages to be isolated of up to 1,000 V_{DC}, various design measures must be combined. On main relays these include bridging contacts in hermetically sealed quenching chambers that contain a pressurized gas filling (hydrogen or nitrogen). Quenching magnets force the arc out of the area of the opening contacts with their field. Pre-charge relays mostly do not need a gas filling, but do also require quenching magnets.

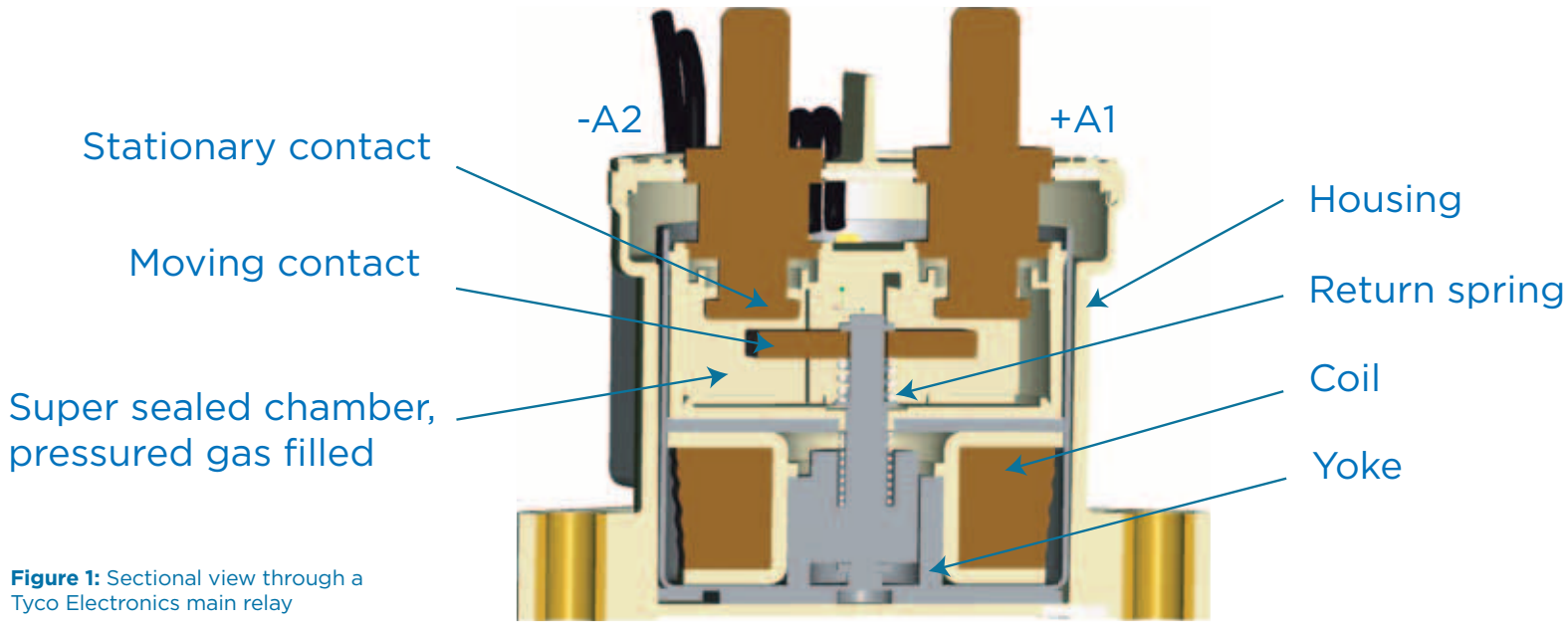


Figure 1: Sectional view through a Tyco Electronics main relay

Relays in the High-Voltage Vehicle Electrical System

While aspects such as the energization, switch-on and switch-off conditions play an important role in the design of classic relay applications in the 12-Volt area, these aspects take on an even more existential meaning in the high-voltage area. Contact-wearing switch-off arcs must be kept as short as possible, for this reason high dynamic performance with short switch-off times is incorporated in the design. The effect of components connected in parallel (e.g. diodes) for coil damping must be considered very carefully, as these components can cause an increase in the drop-out times; this situation also applies to energization using pulse width modulation (PWM).

The dynamic performance necessary for switching off is a disadvantage when it comes to switching on high currents: specifically, there is a problem if the high dynamic performance causes the contacts to bounce into these high switch-on currents – that is if repeated undesirable opening and closing of the contacts occurs at these high currents. Each of these uncontrolled switching operations generates an arc, the contact surfaces partially melt, and the contact may stick. A pre-charging circuit can help in this situation, a circuit that was not necessary in previous 12-Volt automotive applications.

Figure 2 shows part of a HV vehicle electrical system as an example. The requirements on the main relay and the pre-charge relay can be explained based on the possible situations in operation.

Pre-Charging and Switch-On Process in Normal Operation

First main relay 2 closes the battery's negative path without load (HV negative is not connected to the vehicle bodywork as in 12-Volt electrical systems). Then the pre-charge relay closes and the capacitors are charged, the pre-charge resistor limits the current. This process can take several hundred milliseconds. Main relay 1 is only enabled once the voltage at the capacitor has reached around 90... 95% of the nominal voltage. As a result main relay 1 only needs to switch a small current with a small voltage difference. The pre-charge relay can now be switched off without load. A prerequisite for successful pre-charging is the clean disconnection of all loads prior to the pre-charging process, as these represent a voltage divider and would therefore make it impossible to precharge the capacitor to the required voltage. As a consequence, the main relay would be damaged by the higher switch-on currents and switch-on voltages.

Carrying Load Current and Switch-Off Process in Normal Operation

In normal operation, both main relays must carry currents of up to several 100 A. Prior to switch off in normal operation, most of the loads are shut down to keep the load for relay 1 low. This relay is opened first on switching off and disconnects the currents due to the loads at the full voltage. Now main relay 2 opens without load.

Load Isolation by Relays in Case of a Fault

On opening the contacts in the HV vehicle electrical system, the high voltages and currents produced result in an arc of high energy that is much more damaging

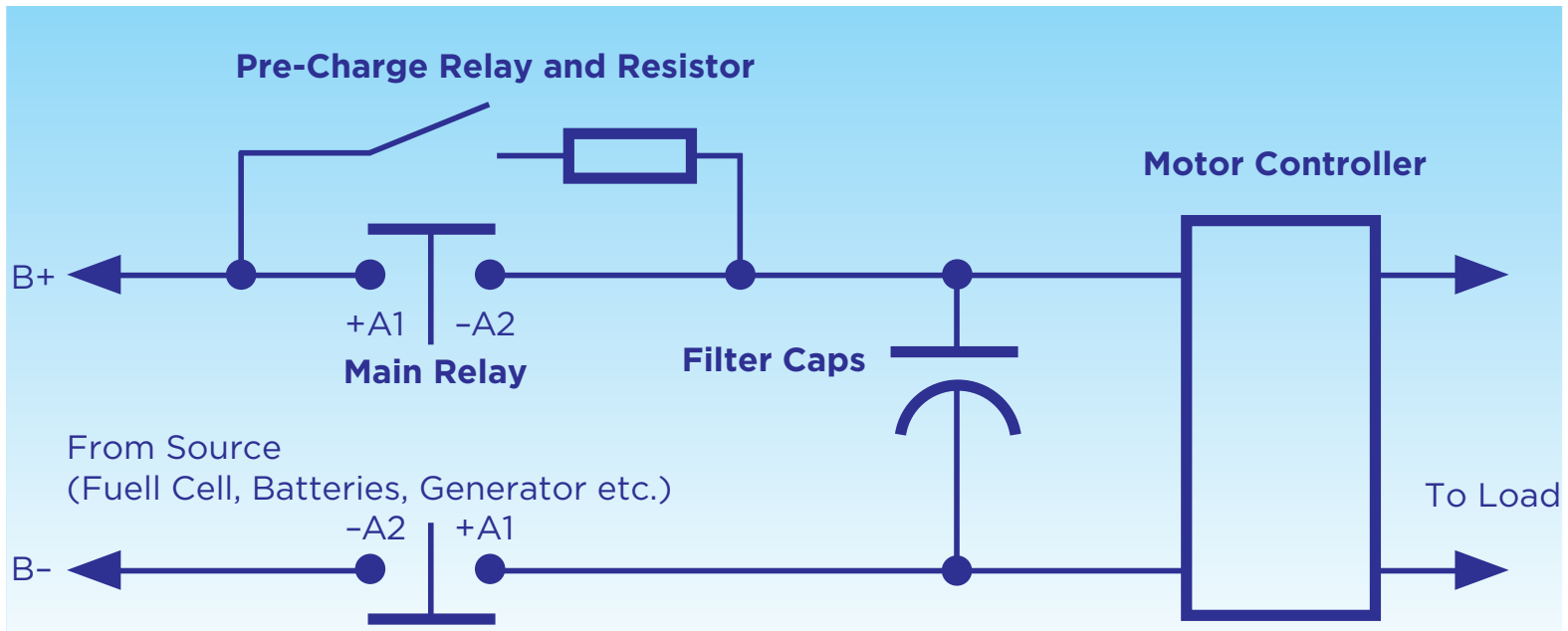


Figure 2: Main relay and pre-charge relay in the HV vehicle electrical system

than in the classic 12-Volt vehicle electrical system. The duration of the arc is defined by cable resistances and parasitic capacitances and inductances, these features are therefore more important in the HV vehicle electrical system; in the classic vehicle electrical system they can often be ignored. Main relay 1 must be able to shut down the circuit with a full load power of several hundred kilowatts in case of a fault.

Load Isolation by Fuse in Case of a Short Circuit

The main relay in the size necessary for automotive applications would be overburdened by an attempt to isolate a short circuit load involving short circuit powers of up to 2 MW and would be destroyed. For this reason the fuse and the relay in the current path must be matched. It must be ensured that the fuse isolates the circuit at short circuit currents (4 kA for future Li-based batteries, with even lower internal resistances as much as 6 kA). For this reason the design must prevent the relay contacts levitating as a consequence of the action of the force due to the enormous short circuit current (brief undesirable contact opening).

Figure 3: Tyco Electronics main relay EV200

Summary

- Operating voltages up to 1,000 V_{DC}
- Operating currents up to several 100 A
- Pre-charging to avoid high switch-on currents
- Clear specification and limiting of shut-down power / shut-down frequency
- Full load shut down: several hundred kilowatts, extreme arc power
- Two main relays in series: homogeneous redundancy
- Currents in case of short circuit up to 4,000 A (in future even approx. 6 kA)
- Fuse design matched to the relay

Outlook

Tyco Electronics is continuing to drive forward the adaptation of its high-voltage relays to the environmental conditions in the car. Miniaturization efforts will result in additional weight and cost reductions. To ensure the reliability of its products in applications, Tyco Electronics provides application guidelines, application questionnaires and or course personal consultation.

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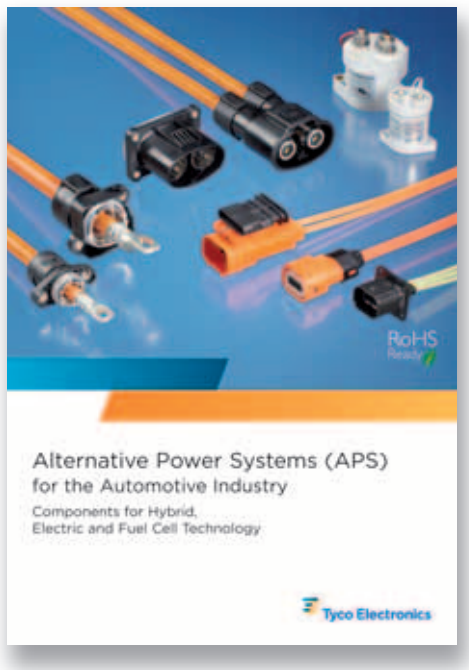
Literature Available:



Alternative Power Systems (APS)
for the Automotive Industry
Literature No. 654294-3

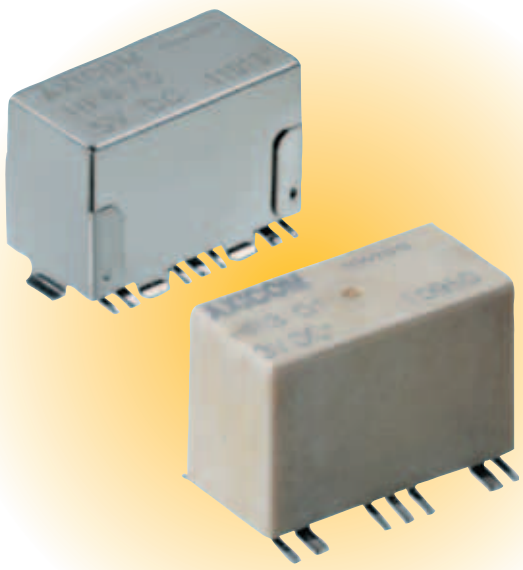
Extended Product Line – Surface-Mounting High-Frequency Relay/Switch

With the AXICOM HF3 relay, Tyco Electronics offers one of the smallest and one of the best performing high-frequency (RF or Microwave) relays currently available. This relay series is now supplemented with two further versions – the HF3S and HF6 relays.

The HF3S is suitable for particularly high RF powers up to 150 W and the HF6 for frequencies up to 6 GHz. Relays within the HF product line are pad compatible.

HF relays are particularly suitable both for intermittent operation as well as for continuous switching such as test equipment. The HF product line has been developed in compliance with RoHS and other environmental requirements, and it is halogen-free.

HF product line



Features

- Y-Design
- Frequency range DC to 6 GHz
- Impedance 50 Ω / 75 Ω
- Small dimensions (15 x 7.6 x 10.6 mm)
- 1 change over contact (1 form C/SPDT)
- Low power consumption (≤140 mW)

Typical Applications

- Signal Amplifiers
- Head End Equipment (CO switch in Telecom)
- Set Top Box (Focus on HDTV)
- Antenna switches
- Video overlay
- Wireless infrastructure
- ATE (Automated Test Equipment)

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Literature Available:

HF 6 Series
Literature No. 180-98022

Datasheets HF3, HF3S, HF6
http://relays.tycoelectronics.com/axicom

Relays in Modern Inverters

The total amount of energy that can potentially be obtained from sunlight worldwide is around 15,000-times the amount of electrical power currently consumed. This energy can be converted into electrical power using photovoltaic systems installed on the roofs of houses and factories, or communal high power systems.

A photovoltaic solar power system comprises the photovoltaic generator (solar module) and the inverter with a grid connection. The energy from the sun is converted into electrical energy (DC) in the solar modules. This electrical energy is fed to the inverter that has several functions. It converts the DC power obtained from the solar modules into an AC grid voltage (e.g. in Europe usually 230 V / 50 Hz) with as few losses as possible; this AC voltage is fed, phase-synchronized, into the low voltage grid using intelligent electronics.

During this process the limits for the introduction of interference to the grid in the form of harmonics and electrical noise must be met. Modern inverters operate with an efficiency of up to 98%. For safety reasons an automatic switching device with isolating function must be used between the generating system and the grid feed point (Figure 1).

This isolating function is integrated into the inverter and ensures safe isolation in the case of:

- Insufficient energy generation
- A malfunction in the photovoltaic system
- An aberration of the voltage and / or frequency between the inverter voltage and the low voltage grid
- Maintenance of the photovoltaic system

This switching device is, however, intended not only to isolate, but in normal operation also to establish the connection to the grid if the light from the sun is supplying enough energy and isolated operation is not required. It is precisely these important switching functions that are performed by the relay. The relays used must operate reliably over a long period (basis for calculations is around 20 years) to ensure the system is highly cost effective.

The supply of energy via automatic switching devices to the utility's grid is subject to special regulations that are given in the standard VDE 0126-1-1 (Automatic disconnection device between a generator and the public low-voltage grid). The isolation requirements in this standard are based on the standard EN60664 (Insulation coordination). The result is the following safety-related requirements on the relay:

The isolation of the network must comply with at least overvoltage category II. A minimum contact separation of 1.5 mm between the photovoltaic system and the grid is required on each conductor.

This is probably the most important point in this standard and ensures safe isolation of transient overvoltages up to 2500 V max. such as static charging and HF interference that may occur within the PV system.

For PV systems with electrical isolation using a transformer and single-phase AC feed, at least two normally open relay contacts (each with 1.5 mm contact separation) are used; one each for the phase conductor L and the neutral conductor N.

In the case of PV systems without electrical isolation using a transformer, safety is ensured by two relays connected in series per current path. Both series switches must be of electromechanical design. In special cases, the shutting down unit of the solar module panel can replace one relay contact in series. In any case the isolation must be provided by four electromagnetic contacts; two for L and two for N.

Three-phase systems require a correspondingly higher number of contacts.

Efficiency

The special requirements on inverters include the minimization of the power loss in the device. For the highest efficiency, every single percent improvement in the efficiency counts. The power loss must be kept as low as possible to prevent an excessive increase in the temperature inside the device.

As a result relays must be used in the inverter and must use the lowest possible coil power during continuous operation (contact closed). Due to the defined switch position on power-up or in case of power failure, monostable relays are preferred. Large contact separation and the lowest possible power consumption during continuous operation require special design, sizing and usage of the relays.

A particularly important aspect is the circuit for operating the relay coil so that high switching performance can be utilized at high ambient temperatures, and the power loss in the coil can also be reduced. An efficient method for the optimal operation of the solar relay is now described based on the example of the PCFN Solar relay (Figure 1).

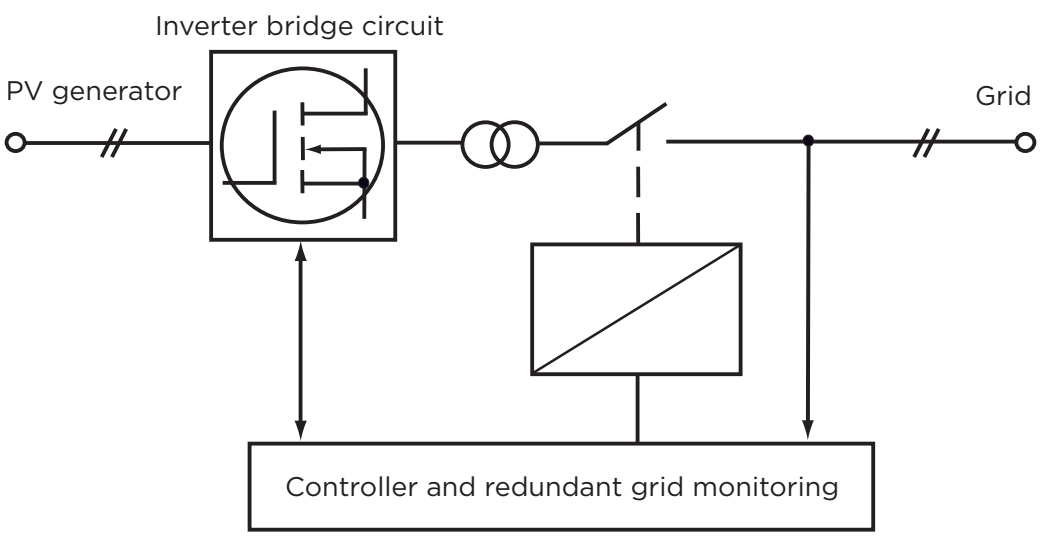
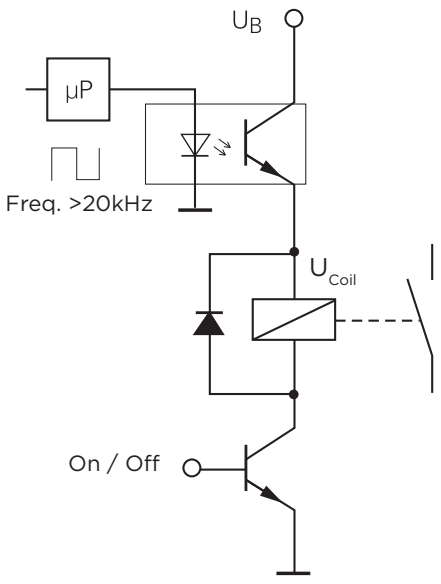


Figure 1: Block diagram of an automatic switching device (example for photovoltaic)

Figure 3: Tyco Electronics EV200 for voltages up to 900 V_{DC}

After an energization pulse lasting at least 100 ms, the power consumption can be reduced, either by regulating the holding current for the coil using Pulse Width Modulation (PWM), or using a fixed pulse width that ensures the holding voltage for the coil stays within the permissible range over the entire operating temperature range.

The frequency should be selected such that it is outside the audible range (> 20 kHz). The energization pulse (on the PCFN Solar: at least 12 V) to close the contacts must be applied for 100 ms with a voltage above the minimum energization voltage for the coil. For the PCFN the subsequent reduced coil voltage must be in the range from 4.4 to 6 V (Figure 2).



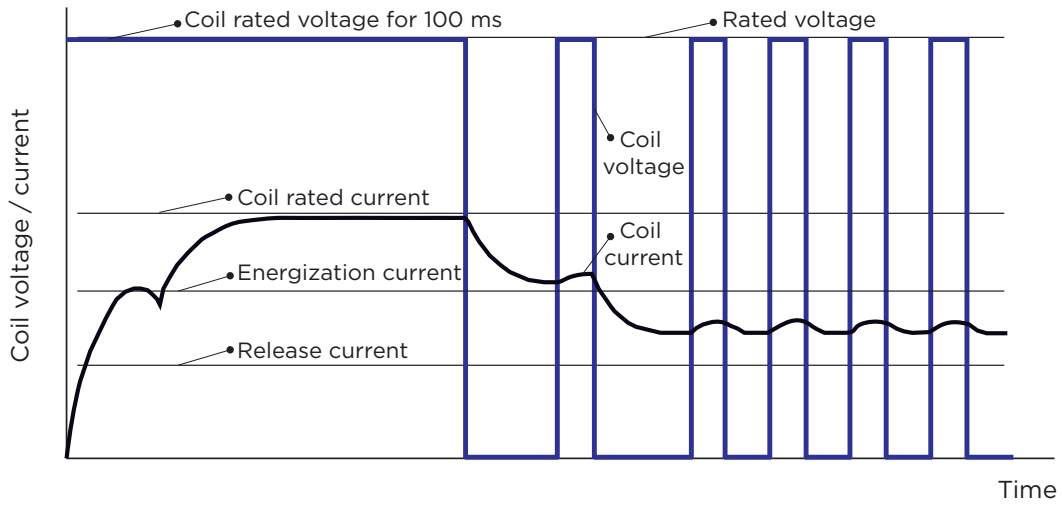


Figure 2: Circuit example and coil

Other Relay Applications in Inverters

While electromagnetic relays are required by the regulations for the AC disconnection device, they are not yet required on the input side (DC input) of the inverter.

However, if the user decides to use an electromechanical relay, various special functions, e.g. remotely powering up and shutting down the solar module panel via the internet or using a mobile phone, as well as simple service shut downs and reversible emergency shut downs in case of a fault can be realized.

As high voltages may occur if there is no load on the PV modules, with the EV200 (Figure 3) Tyco Electronics offers a low-cost solution for voltages up to 900 V_{DC} covering the usual PV module current ranges.

A further application for the relay inside the inverter is applications in the interface area (e.g. a floating contact), or switching internal measurement and test functions (earth fault tests). In this way test procedures can be automated, operating states indicated, or subsequent events triggered. Often relays with a large contact separation are also required here, e.g. the RP920145 from Tyco Electronics.

Relay type	PCFN	EV200	RPII/2
Inverter application	Grid isolation	Solar panel isolation	Measurement system
Contact design	1 normally open	1 normally open	2 normally open
Switching capacity	26 A / 277 V_{AC}	100 A / 400 V_{DC}	3 A / 250 V_{AC}
Service life	30,000 operations at 75°C	Up to 50,000	100,000
Dimensions	30.4 x 16 x 26.5 mm	66 x 80 x 72 mm	29 x 12.6 x 25.5 mm
Contact separation	> 1.5 mm	> 1.3 mm	1.5 mm
Dielectric strength coil/contact	4,000 V_{eff}	2,000 V_{eff}	4,000 V_{eff}

Table: Technical overview PCFN, EV200, RPII/2

Figure 4: Modern 5 kWp inverter from SMA with relays from Tyco Electronics (top left RP relay and top right PCFN Solar)

Future Perspectives

The portion of electrical power generated using solar energy is still very low compared to the total amount of power generated globally. In 2007 the total accumulated power rating of the PV systems installed worldwide was estimated at 9,200 MW. In comparison, at the end of 2,000 there was only 1,200 MW. Thanks to the advantages of this alternative form of energy production, rapidly increasing growth is expected in the coming years.

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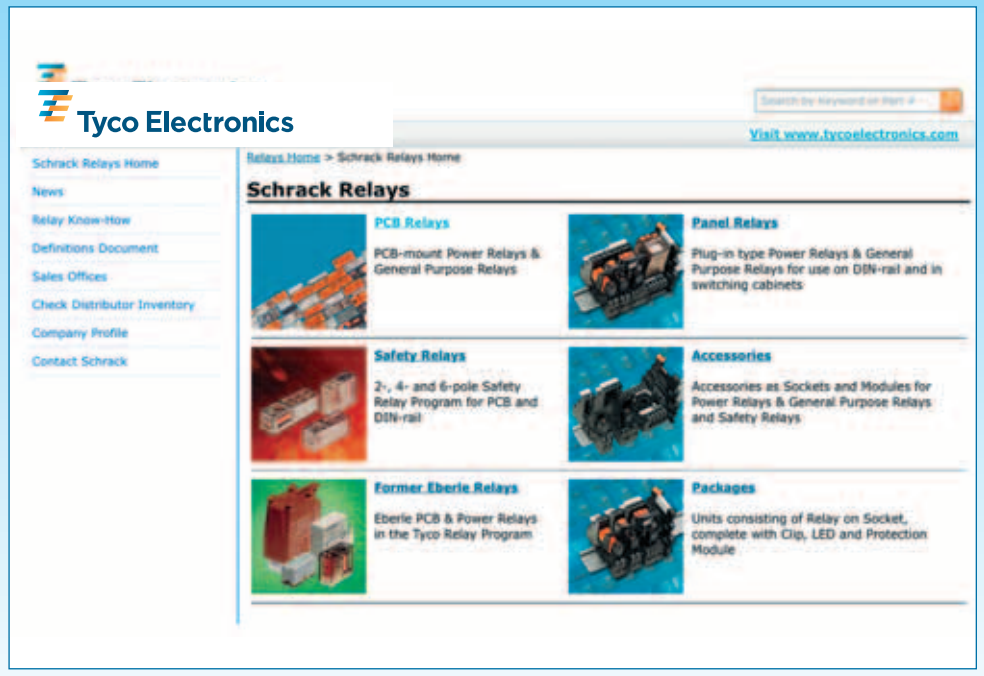
Literature Available:



Datasheet site:
http://relays.tycoelectronics.com/schrack/relays/pcb.asp

Efficient Customer Solutions for Long-Term Partnership

The cooperation between INT autotechnik GmbH Germany and Tyco Electronics' GATD (Global Application Tooling Division) business unit has successfully passed a new milestone.

As a long-time partner of the international automotive industry, INT autotechnik GmbH specializes in the development, design and high end production of stainless steel and aluminium doors sill protectors. Not only the workmanship, but also the design is a quality feature.

And this captivates with its timeless elegance and grace. The aesthetic tactfulness with which customers' ideas and preliminary designs are implemented is the key to the company's long-standing partnerships with reputable auto brands. In order to understand the meaning of the slogan ETERNAL BEAUTY, you need to be convinced of the uniqueness of the end product.

Intolerance also appears a guiding principle of INT autotechnik GmbH, at least when it comes to production quality. Taking a new project into production, project manager Tobias Holtkotten contacted Tyco Electronics' business unit GATD requesting the processing tool to be assessed from a productivity and crimp quality perspective.

Project manager Tobias Holtkotten

Horst Strebert, Key Account Manager Global Application Tooling, analysed the tooling used for the crimp contacts to be made in the production process. A range of solutions were discussed with the client, culminating in a new tool introduced to cater for the specific production constraints.

"If we had known that Tyco Electronics GATD could offer such quick and straight forward customer advice on site we could have invested more of our time dealing with our own production analyses in-house", claimed Tobias Holtkotten.

"Satisfied customers are a quality feature of our partnership", replied Horst Strebert, who constantly strives to support customers with high grade tooling and sound advice.

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Tooling for High Voltage Applications

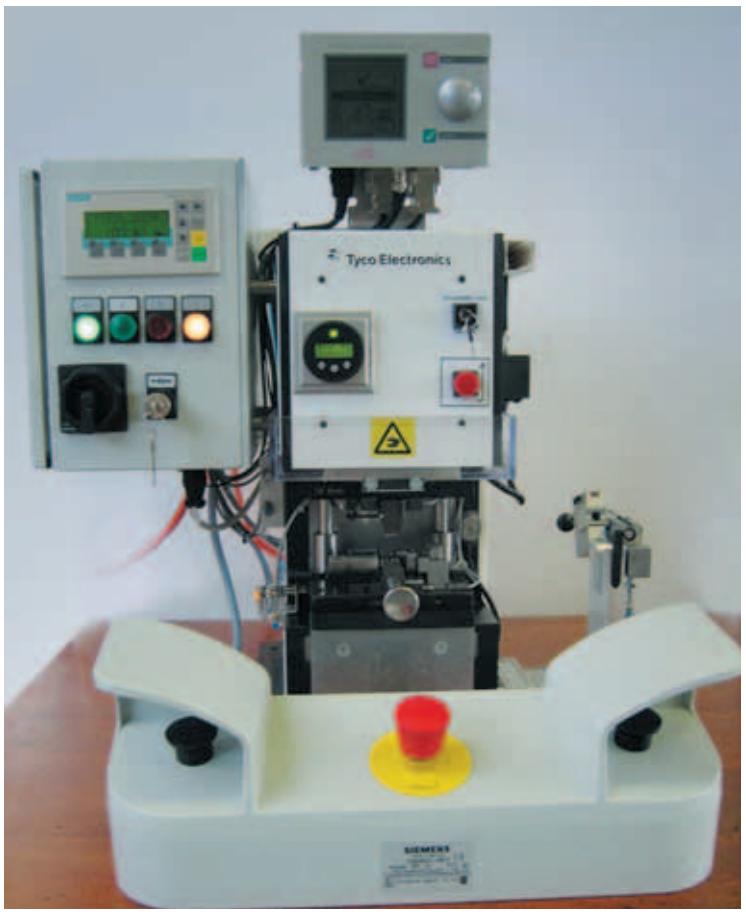
With fossil fuels in increasingly short supply and a growing environmental awareness, almost all car manufacturers are now offering electric powered vehicles. The current focus is on hybrid technology. To direct the power created to the various units, the contact components need to be sized accordingly. The new HV 8 mm contact system caters for the 16 – 50 mm cross section range.

To date batch totals have been relatively small, which means that the manufacturing process has been carried out by hand in several stages.

To prepare the wires, which consist of the following process stages:

- Imprint the wire,
- Strip the wire,
- Trim the wire and
- Coil the wire,

special stripping devices are used with a coiling mechanism. The challenge here is to handle this kind of wire dimension, as the process can quickly produce wires weighing in excess of 30 kg. Another challenge is to process the braid.



To do this, a production concept developed by Tyco Electronics is used whereby the individual process stages form a partially automated and monitored process chain.

During crimping, i.e. when the contact is pressed together with the wire and the shield sleeve is pressed with the braid, the previous process – which used two crimp cavities each fitted in a separate hydraulic hand tool – is replaced by a hydraulic terminating machine with crimp force monitoring.

The terminating machine uses applied encodings to detect whether the right tool has been used. The operator now positions the contact part with the wire in the specified crimp position and fixes the wire with a clamping device.

The crimping process can now begin through two-handed operation. When the wire has been crimped, the crimp cavity carriage is moved to crimp the braid. Monitoring the crimping process with proven crimp monitoring systems and using a PLC ensures a high quality crimp connection; it also ensures that the operator carries out the processing stages in the right order using all the components.

Only when the crimp monitoring system certifies a good crimp and the programmed process stages have been observed can the fully crimped wire be removed.

The terminating machine used has been designed to allow other tools for different contact types to be used. There are currently two other tools available for HF06 crimp barrel series and ring tounge contact component.

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P 50 Manual Bench Insertion Machine

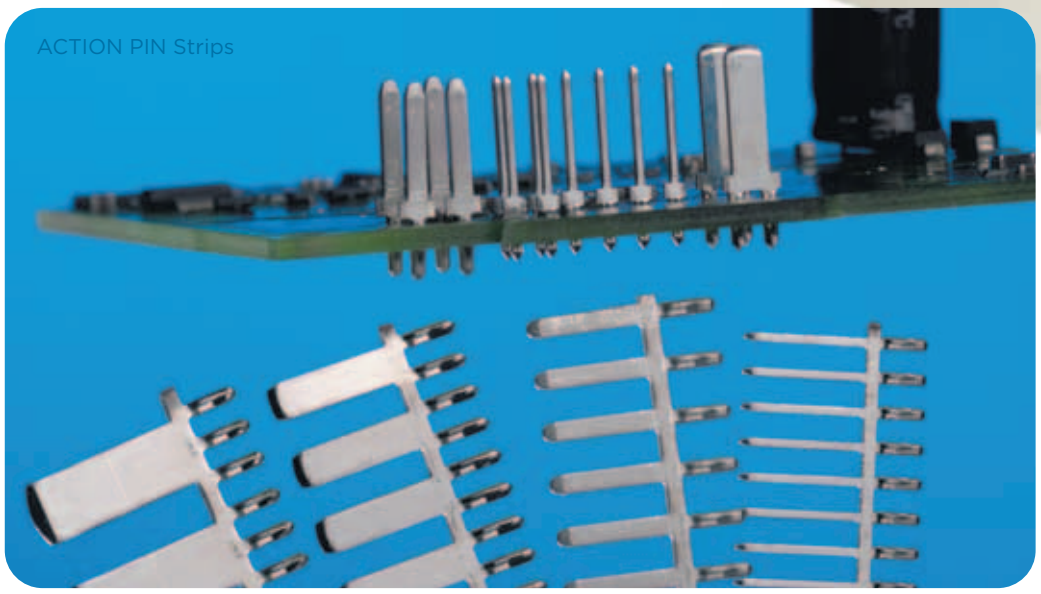
The successful product line of single pin insertion machines has been expanded with the addition of a manual operated bench machine for low volume production, repair work and sample production.

The P 50 manual bench insertion machine uses a tracer slide to position the PCB under the pneumatic insertion head. A regular PCB is used as master to position the indexing pin above the insertion hole. When activating the two hand start, the indexing pin extracts. If a hole is detected, the terminal is inserted into the board in production.

To fulfil automotive requirements, the P 50 insertion machine can be equipped with an insertion force monitoring system. In cooperation with an optional barcode scanner, the insertion forces can be stored for traceability purposes.

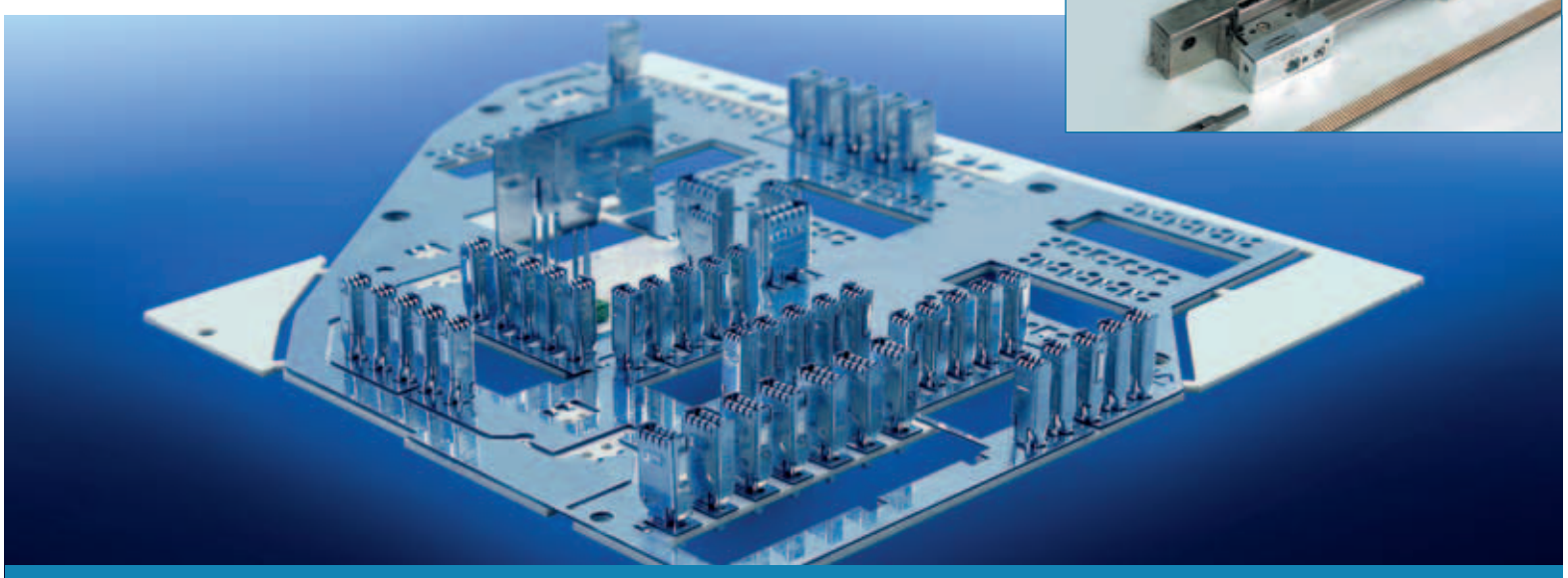
The newly designed pneumatic insertion head uses the well known conversion kits from the upper range of P 300 / P 350 machines and can also be used on other machines of the product line. These conversion kits can easily be changed to run different terminal types and provide all features to feed, cut and insert the terminal. The rotary insertion finger is a standard feature of the pneumatic insertion head to allow the terminal insertion at different angles without the need to re-load the PCB in different orientations. A simple mechanical pin is used to switch from one insertion angle to the other.

P 50 Pin Insertion Machine



ACTION PIN Strips

P 50 Conversion Kit



Printed Circuit Board

For detailed information please contact:

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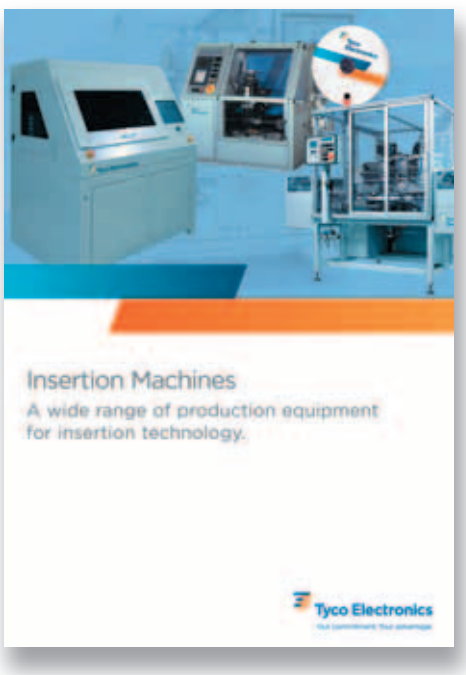
Literature Available:



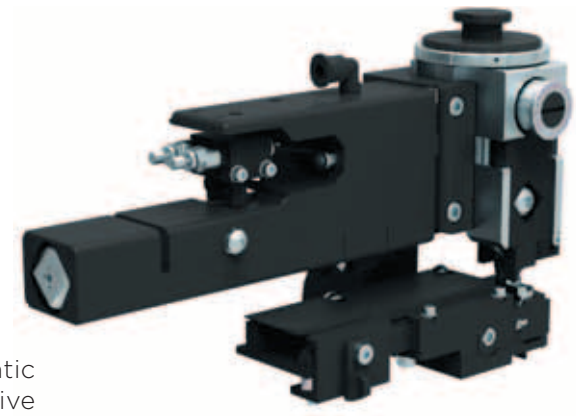
Insertion Machines
A wide range of production equipment
for insertion technology.
Literature No. 7-1773439-0

The Tyco Electronics Next Generation Applicator

With the knowledge and experience of over a half century designing and manufacturing world leading applicators and tooling, Tyco Electronics is taking terminal crimping to a new level. Using the time proven HDM and HDI applicator platforms as a base and the innovation and improvements from the System III applicator, TE is taking a large step forward. TE has listened to customer input and market demands to innovate and improve the combined strength of these industry leading designs to create the Generation-X applicator.

The lead and harness industry of today is more price and quality competitive than ever before. Crimping standards continue to be raised to higher levels of quality and repeatability. The industry continues to expect more from application tooling. The TE Generation-X Applicator was designed specifically to exceed the requirements of today and meet the demands of tomorrow.

By consolidating our Applicator offering to the Generation-X Applicator, TE can provide design consistency and tooling standardization to the market. One of the major benefits to the customer is offering the ultimate flexibility with a choice of feeding options. New and improved Mechanical and Pneumatic feeds combined with the innovative and precise Servo feed option. The Generation-X Applicator design makes it possible for customers to perform field upgrades to System III technology in the future. It will provide an upgrade path for terminal intelligence that allows the machine to obtain set-up features as power sources are upgraded.



For detailed information please contact:

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Antenna Solutions

Tyco Electronics global antenna capability continues to grow. The test center in 's-Hertogenbosch / Netherlands has leading edge technology equipment allowing the team of RF & mechanical engineers to create high performance embedded and external customer optimized solutions, specializing in diversity, MIMO and upcoming LTE applications. Tyco Electronics has a global presence with manufacturing and design locations around the world providing a full range of manufacturing technologies.

6 Key Elements of Service to Our Customers

- Complete RF & mechanical design, development and test support
- Complete antenna module assemblies
- Global support and logistics
- Complete range of manufacturing processes
- Peripheral component support
- Commitment

Applications

Tyco Electronics designs and manufactures antennas that comply with the most stringent operating requirements. Our antennas fulfil the wireless industry's move towards increased complexity and the need to integrate a multi-radio environment into one component. Diverse technologies and optimal solutions are offered for the following markets:

- Mobile phones, MID's
- Notebooks, netbooks, PC's
- Wireless access terminals (gateways / routers, femto cells, set-top boxes)
- Wireless accessories
- Game consoles
- Headsets
- POS terminals
- Wireless cards
- TV
- Remote meter reading
- Vehicle tracking system
- Alarm, monitoring and control systems

Manufacturing Technologies

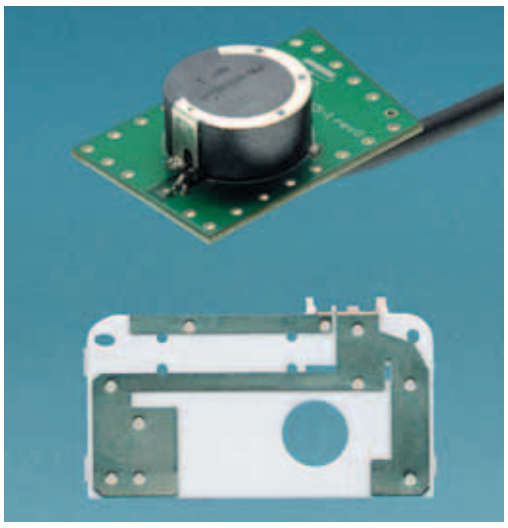
Molded Interconnect Device (MID)

We provide over 25 years of experience in design and manufacturing of MID solutions. Cost effective and repeatable 3D geometries are made by selectively plating of plastic parts using three different processes:

- 2-shot molding
- Laser direct structuring (LDS)
- Laser imaging

Stamped Metal

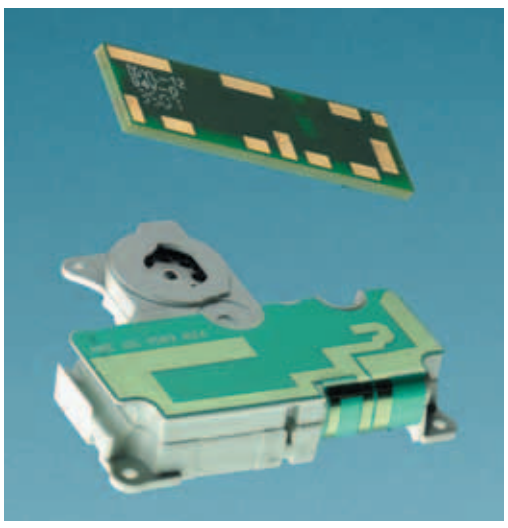
A line of high performance, low-cost solutions for single and multiband applications is available. Standard or customized solutions can be combined with ground plane and cable assemblies or integrated spring contacts.



FPC and PCB

Flexible Printed Circuits and Printed Circuit Boards are ideal for multi-band antennas, address the needs of a variety of wireless applications and offer several advantages such as:

- Low cost tooling
- Flexible pattern change
- Short lead time



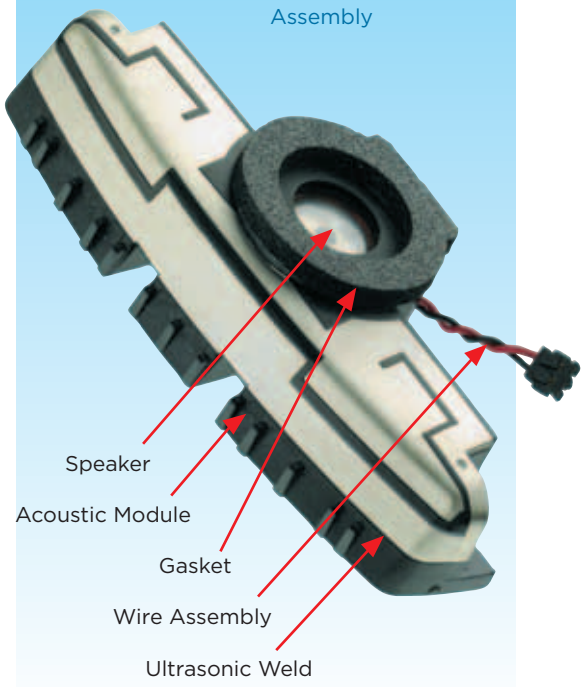
Value-added Integration

Design and manufacturing locations around the world provide a full range of value-added production processes onsite. State-of-the-art measurement capabilities ensure all of our products satisfy today's most discriminating performance and quality requirements.

Enhanced Value Through Onsite Manufacturing Processes:

- Molding, plating, overmolding
- Cable and acoustic assembly
- Ultrasonic welding, heat stacking
- Hermetic seal
- Wave, reflow, hand soldering
- Wire bonding
- Snap fit, press fit
- Sliding wiping contacts
- Painting, adhesives

Example:
MID 2-Shot Antenna Assembly



For detailed information please contact:

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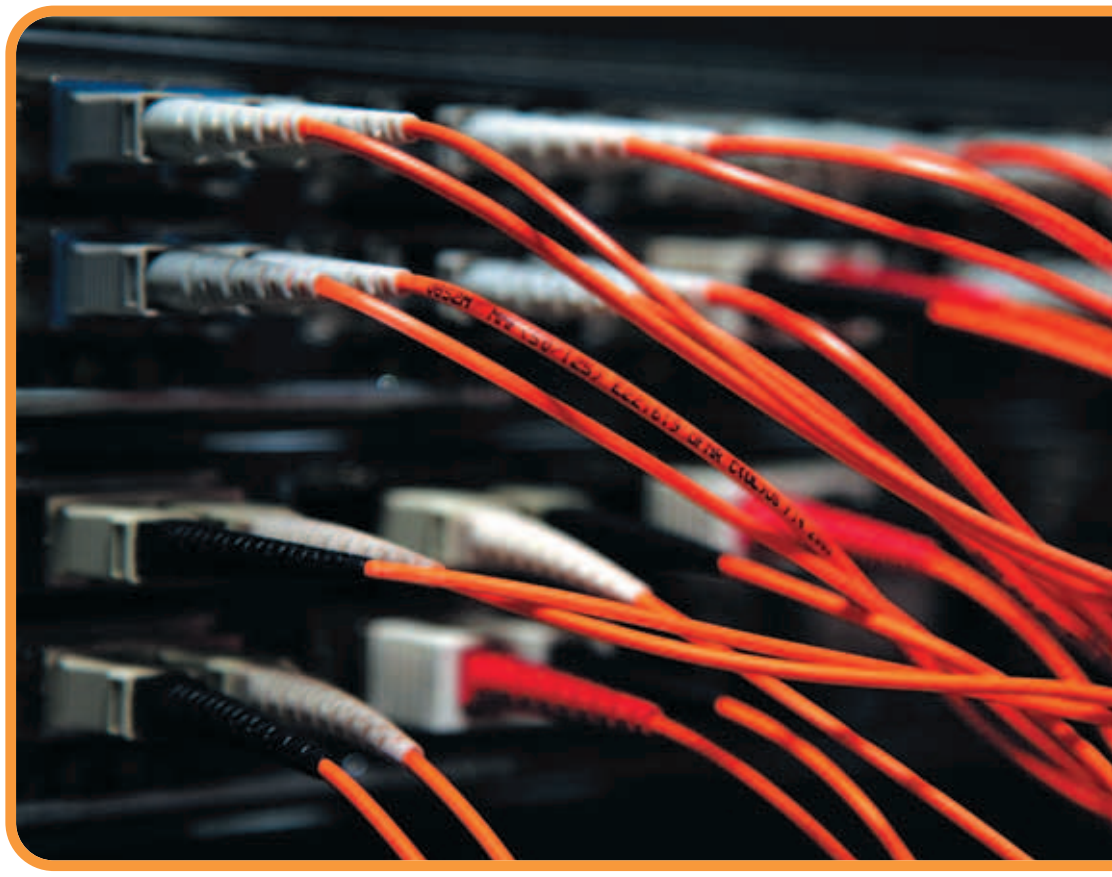
e-mail: christian_koehler@te.com

Literature Available:

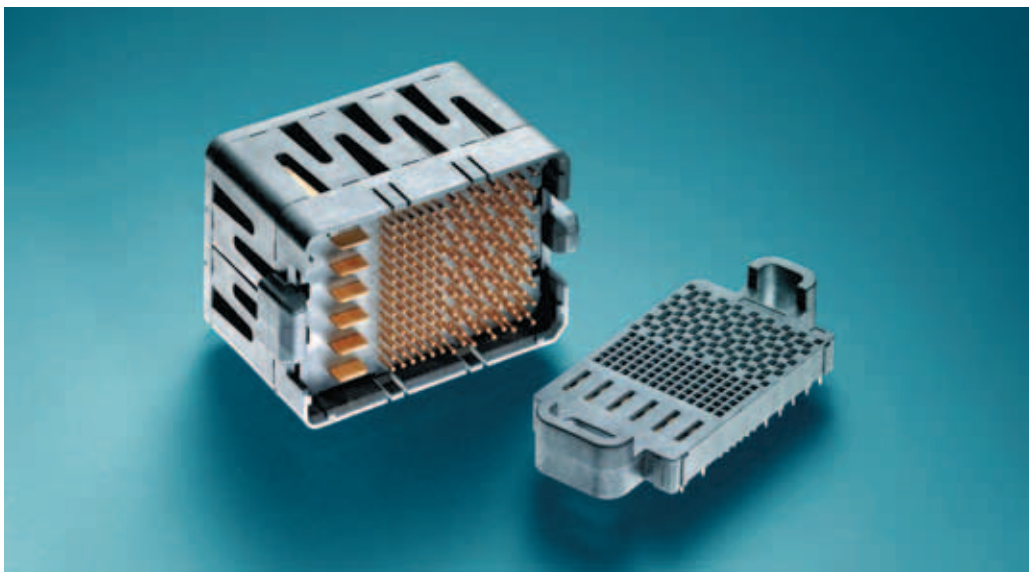
Antenna Products
Literature No. 1773452-8

STRADA Mesa Mezzanine Connector System Is Designed for Future High-Speed Requirements



The STRADA connector product suite has been specifically designed for future high-speed system requirements. The first connector series offered – the STRADA Mesa Mezzanine connector system – offers a pin and socket signal contact design that can be arranged in either high-speed differential, high-density single-ended, and/or coax patterns.

Additionally, the connector offers integrated power contacts, each capable of carrying 14 A of current. It is an ideal solution for high-speed and high-density stacking applications.



Benefits for Customers

STRADA Mesa connectors are available with stack height options ranging from 8 mm up to 42 mm in 1 mm increments. The connectors have been specifically developed for high-speed differential architectures utilizing printed circuit boards arranged in a mezzanine application.

The new STRADA Mesa connector system delivers over 15 Gb/s performance and is available in three sizes, which when fully loaded with all differential pairs will yield 40 pairs, 80 pairs and 120 pairs. The receptacle and header assemblies are press-fit to the Printed Circuit Board (PCB). Samples are available upon request.

Design Features

- 1.5 mm nominal contact wipe
- 100 Ohm impedance
- Open space to allow for airflow through connector
- Optional guide system to accommodate blind mating
- Press-Fit (Eye-of-the-Needle) attach for the receptacle and header
- Optional power contacts combined with signals for matched stack height
- Power contacts rated for 14 A per contact and spaced for 48 V applications per UL 1950
- Low mating forces for signal contacts (target: approximately 40 g/contact)
- Footprint and performance characterization for signal contacts arranged in a Coax/RF application
- Optional high-density contact footprint for single-ended signals

For detailed information please contact:

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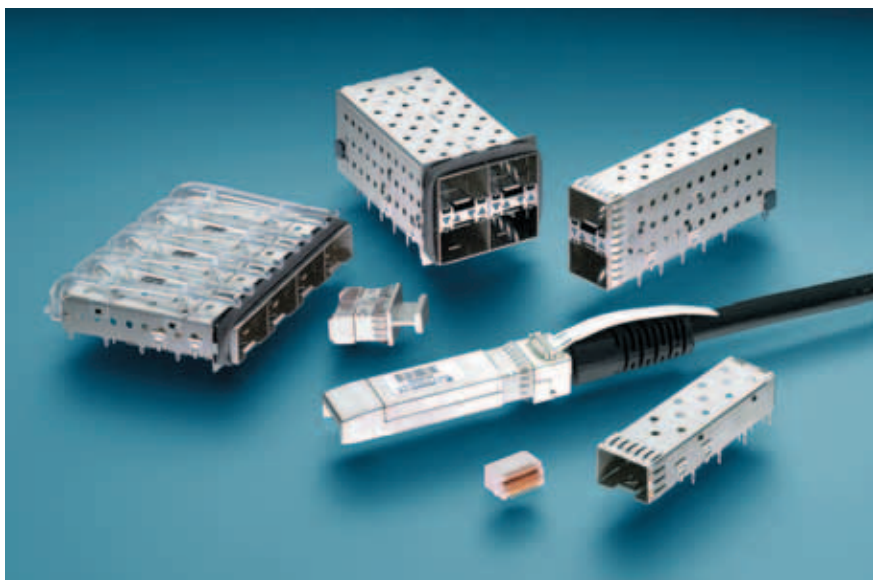
Active SFP+ Direct Attach Copper Cable Assemblies Are Interchangeable & Hot-Swappable with Fiber Optic Modules

Available from Tyco Electronics are SFP+ active direct-attach copper cable assemblies: The new cable assemblies are high-speed, cost-effective alternatives to fiber optic transceivers and MPO cables in 10GB Ethernet, 8GB Fiber Channel and InfiniBand applications.

The active design offers signal amplification and equalization in cable assemblies with low power consumption of 500 mW per cable end. Active cables also incorporate Rx LOS and Tx Disable functionality. Tyco Electronics offers these cables in standard lengths from 0.5 through 15 meters.

Benefits

SFP+ active copper cable assemblies are beneficial to hardware Original Equipment Manufacturers (OEMs) and data center operators as they offer high port density and configurability at a low-cost, and reduce power requirement. The new devices supplement Tyco Electronics' existing passive direct-attach copper cable assembly product offering. All SFP+ cable assemblies support serial data rates up to 10 Gbps and meet the industry MSA specification for signal integrity performance. Both passive and active cables are available in wire gages from 24 AWG through 30 AWG, and incorporate a 360 degree cable braid-crimp termination designed to suppress EMI leakage and provide superior cable strain relief.



Technical Features

- Pull-to-release retractable pin latch supports belly-to-belly applications
- Insert-molded pull tab
- Highest possible port density
- Built with Madison Cable brand 10G
- TurboTwin parallel pair cable

Applications

- Switches
- Networking equipment
- Enterprise storage
- Telecommunication equipment
- Network Interface Cards (NICs)

For detailed information please contact:

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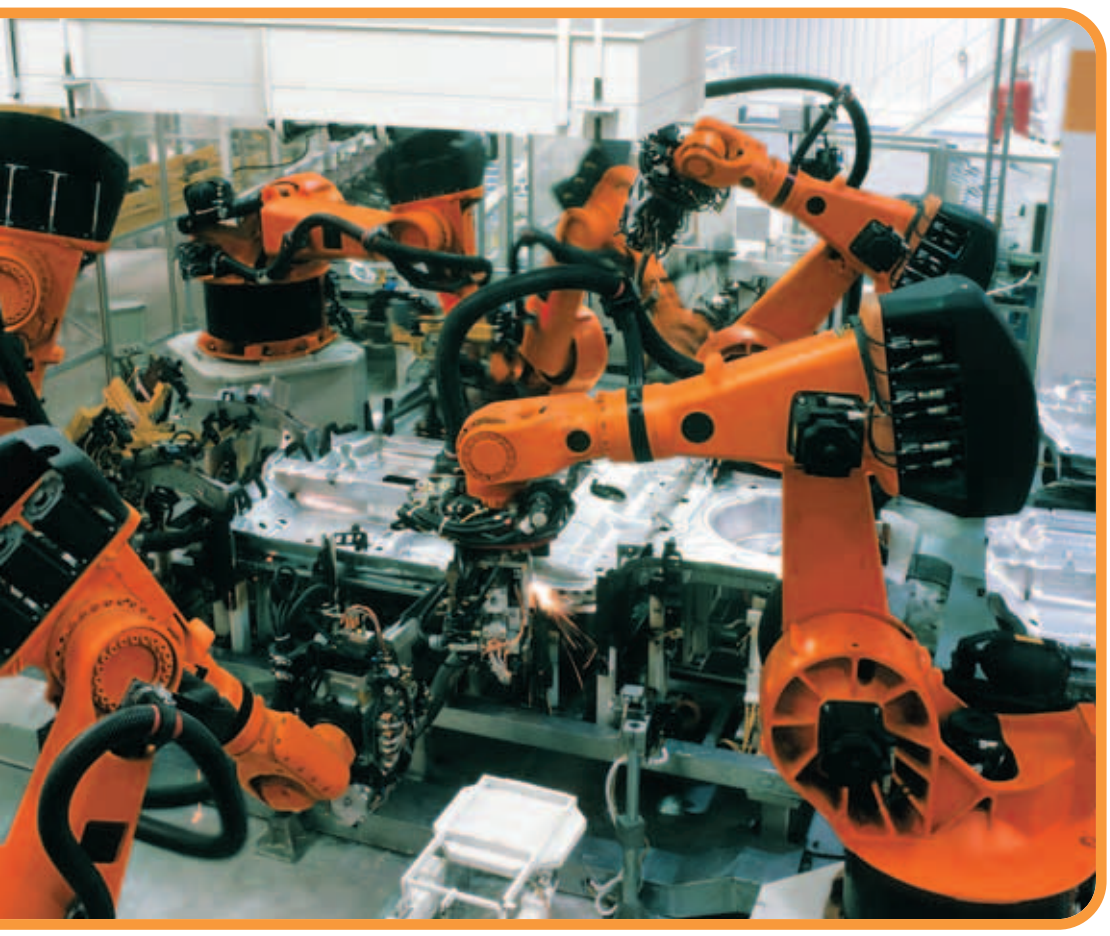
Literature Available:

Quick Reference Guide
SFP+ High Speed Copper Cable Assemblies
Literature No. 1-1773456-2



Jumper Cables for Rail Vehicles Provide Reliable and Maintenance-Free Solution to Reduce Total Life-Cycle Costs

Type E and Type F jumper cables from Tyco Electronics provide a reliable and maintenance-free solution as inter-car jumpers in high voltage roof-lines (on high speed trains and EMUs) and pantograph connection cables.

Both types have been optimised for use in rail environments, are insulated to reduce the risk of flashover, and are suitable for use between 750 V_{DC} and 25 kV_{AC}. Different conductor sizes are available giving a current carrying capacity of up to 2,000 A. The AC/DC jumper cables are impact resistant and flexible across a wide operating temperature range.

Dimensions are customizable for individual applications. The combination of industry-leading Raychem high voltage insulation materials and an engineering plastic strength spine gives the devices a design that is flexible over a wide temperature range and is resistant to the rigours of the high voltage rail environment.

Key Facts Type E Jumper Cables

Type E jumper cables are particularly suited to applications where movement is required along all three axes and where size and profile are not critical. They are flexible to take up any lateral, longitudinal and vertical movements. Jumpers are connected to terminal blocks on support insulators that provide the mechanical support and insulation to the train roof. Where the jumper is used at 3 kV and below, a secondary low voltage power or communication cable can be attached to the main loop.

Key Facts Type F Jumper Cables

Type F jumper cables are ideal where movements are relatively small and are primarily used in the plane of the jumper. They are flexible to take up movements in two directions with small lateral movements also accommodated. Jumpers are connected to terminal blocks on support insulators that provide the mechanical support and insulation to the train roof.

Custom Design Service

Tyco Electronics provides a complete design service to provide a tailor made jumper cable for each application.
The train designer needs to provide:
- Distance between car ends
- Range of possible movements in service
- Frequency of movements in service
- Current carrying requirements
- Requirements for LV cable

Tyco Electronics will design the optimum jumper cable for the application. A 2D or 3D CAD model can be provided.

Testing

HVJL jumper cables have been subjected to a range of qualification tests including:
- Whole-life flex testing
- Voltage tests
- Load cycling
- Shock and vibration
- Mechanical cycling to extremes
- Low temperature flexing

All test reports are available upon request.

For detailed information please contact:

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Literature Available:

Railway Components & Application Guide
Literature No. 4-1773453-2

HVJL Type F Jumper Cables
Literature No. 3-1773449-7

HVJL Type E Jumper Cables
Literature No. 3-1773449-8

Field-Installable Industrial Ethernet Modular Plug Requires No Tools and Saves Space

Based on the Industrial Ethernet field-installable RJ45 modular plug, Tyco Electronics now also offers a version equipped with a flexible 45° cable outlet, which saves space during installation.

The Industrial Ethernet field-installable RJ45 modular plug 45° benefits from a robust and fast termination technology, enabling a time-saving and flexible installation in the field without any special tools. The IP20-rated modular plug is typically used in compact cabinet applications in automation and network environments.

Ideal for Reliable Ethernet Applications

Ideal for fast (4 pos.) and gigabit (8 pos.) Ethernet applications, the Industrial Ethernet field-installable RJ45 modular plug 45° features a two-step locking mechanism (jack and supporting frame) for reliable connections in harsh environments: a metal-lance lock with the jack and the optional supporting frame offers a secondary locking.

Technical Features

- Rated current of 500 mA per pin
- Durability of 750 mating cycles
- Wide operating temperature range of -40 up to +70°C
- Suitable for use with 4 wire AWG 22 and 8 wire AWG 26 cables
- Meets TIA/EIA 568 category 5e requirements
- Compliant to IEC60603-7-1

For detailed information please contact:

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Literature Available:

Introducing IP20 Field Installation RJ-45 Modular Plug - Angled 45°
Literature No. 3-1773457-3

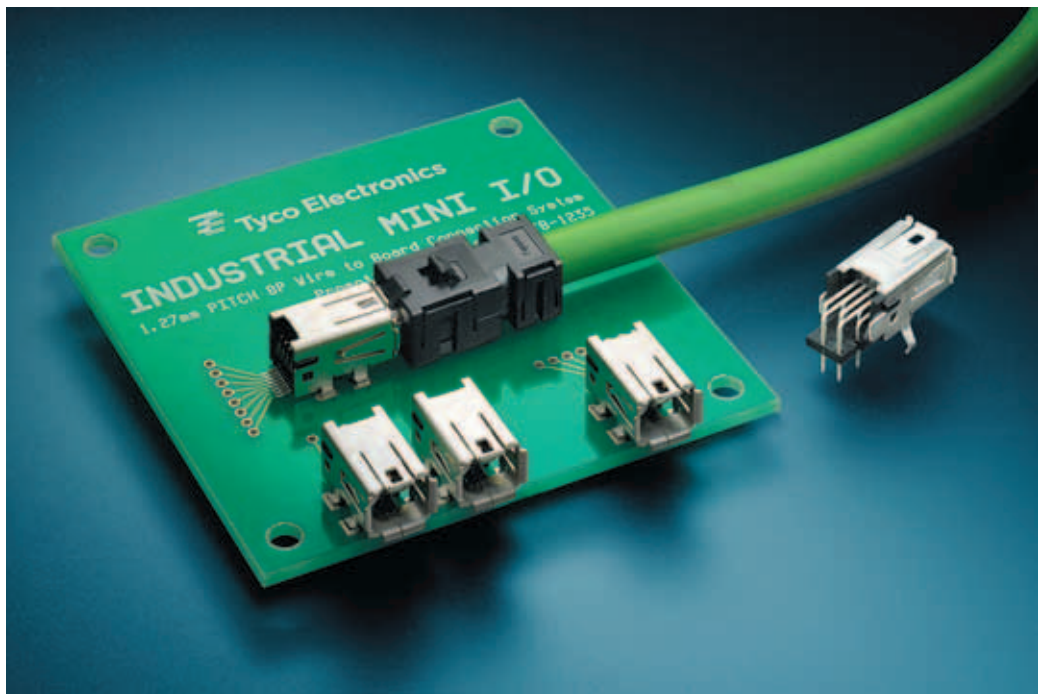
Industrial Mini I/O Connector Maintains Performance in High Vibration Environments

The Industrial Mini I/O connector system from Tyco Electronics features two points of contact to maintain performance and increase reliability in high vibration environments. The compact connector, approximately one-fourth the size of a traditional RJ45 plug, includes a latching system designed to protect the plug from pull-out during high vibration or collision.

Increased Functionality for Industrial Devices

- Rigid latching system and multiple contact points significantly reduce risk of information loss in high vibration environments
- Significantly less space requirements
- Increased functionality
- Excellent replacement for existing RJ45 technology
- Meets Cat5e requirements in Ethernet applications
- Meets the stringent demands of industrial devices.

The polarized, wire-to-board interface of the Mini I/O connector system features two keying options to prevent mismating and consists of eight individual circuits to accommodate I/O signals. Electrical specifications include a current rating of 0.5 A and a 30 V rating on 0.635 mm centerline spacing. The connector's operating temperature ranges from -40 to +70°C with a durability of 1,500 cycles. Product offering includes SMT and through-hole configurations.



Target Applications

- Industrial controllers
- PLCs
- Motion control
- Robotics in the industrial automation market

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Literature Available:

Introducing
Industrial Mini I/O Connector System
Literature No. 3-1773457-4

Straight-from-the-Box Solution for High Voltage Inter-Connector Cables on Electric Rail Vehicles

HVTT and HVTE cable assemblies from Tyco Electronics provide a "straight from the box" solution for high voltage inter-connector cables on electric rail vehicles. Using industry-leading Raychem high voltage insulation and stress control materials, combined with flexible EPR insulated cable makes the assemblies very easy to install and highly reliable for harsh rail environments.

Applications and Features

HVTT and HVTE cable assemblies are designed for the interconnection of high voltage electric equipment on locomotives, EMUs and high speed trains. HVTT cable assemblies feature a heat-shrink type termination at each end. HVTE cable assemblies benefit from a heat-shrink type termination at one end with a push-on type equipment connector at the other. HVEE cable assemblies have a push-on equipment connector at both ends. The product range is modular meaning that any combination of termination, push-on and cable can be put together.

Key Facts for Customers

- 15 / 25 kV roof-line and equipment connection cables optimized for use in the rail environment
- Assembled and tested by Tyco Electronics to simplify the supply chain and provide easy on site installation
- Custom designed for each application
- Reliability demonstrated by over 20 years service history on high speed trains
- Light weight and easy to handle compared to conventional ceramic alternative
- Impact resistant and virtually unbreakable due to the use of polymeric materials
- Maintenance free minimizing total life-cycle costs

Custom Design Service

Cable assemblies are designed to suit particular vehicle requirements for new build and retrofit purposes. In addition to the choice of termination and cable type other design options include: Dimensions and tolerances, mounting and clamping points, HV and earth connection types, arcing horns, current transformers, conduits and other accessories. Individual designs can be modelled in most major 2D or 3D drawing packages.

An on-site trial fit supported by Tyco Electronics technicians is available worldwide.

Testing

Cable assemblies have been subjected to a series of qualification tests to major rail standards, with the test reports available upon request. Each cable assembly is subjected to routine testing and certification before shipping. Assemblies are serial numbered to provide complete traceability.

For detailed information please contact:

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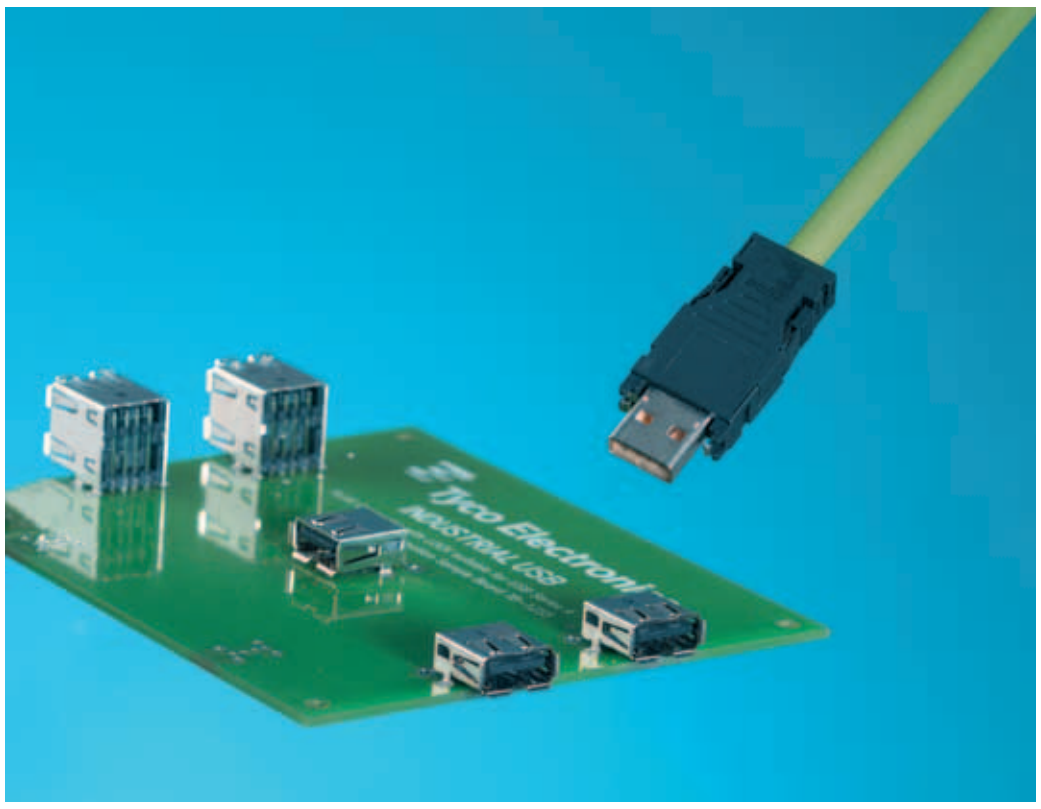
Literature Available:

Railway Components & Application Guide
Literature No. 4 1773453-2

COMMUNICATIONS & INDUSTRIAL SOLUTIONS: INDUSTRIAL PRODUCTS

Series of Industrial USB Connectors Is Suitable for Industrial Applications that Require a High Locking Force



Tyco Electronics' series of industrial USB connectors (IP65/IP67 ODVA) has been extended with a series of industrial USB connectors (IP20) that feature an integrated locking mechanism with audible and tactile feedback.

The connectors are ideal for all industrial USB applications where a high locking force is required. The devices are designed to interconnect microcontrollers with mechatronic links and I/O interfaces in industrial automation technology, mechanical engineering (e.g. connecting panels) and plant engineering. Typical applications include industrial PC solutions, control and automation, inverters and robotic applications, as well as fieldbus systems.

Features Ensure Flexibility

The industrial USB connector series is based on the USB (type A) connector system and meets USB2.0 transmission specifications. The devices can be used in multiple rows (they are equal in height), have four solder connections and are compatible with standard USB sockets (type A).

To ensure proper locking, the mating sockets from Tyco Electronics are available in a single and double row design. The sockets must protrude from the housing in order to provide secure interlocking. The devices are also PCB-mount compatible. To enable design flexibility, the USB connectors are available in several types of socket and connector mountings (reflow soldering, surface mount, surface mount with board locks). The connectors and sockets are designed for automatic pick-and-place assembly.

Technical Specifications:

- Rated voltage of 30 V AC
- Rated current of 1 A per contact
- Minimum insulation resistance of 1,000 MΩ
- Contact lifespan of at least 1,500 cycles
- Pull-out force (cable) of 35 N maximum
- Pull-out force (latching element) of 40 N (1 minute)

For detailed information please contact:

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Literature Available:

Industrial Communication – Industrial Ethernet Products
Literature No. 1654253-4

COMMUNICATIONS & INDUSTRIAL SOLUTIONS: CONSUMER DEVICES

LCD Coaxial Embedded Display Interface (LCEDI) Connectors for the PC Market

Tyco Electronics offers a next generation LCD Coaxial Embedded Display Interface (LCEDI) family of connectors designed to provide exceptional electrical performance in both low voltage differential signaling (LVDS) and embedded DisplayPort (eDP) applications.

This family of connectors is licensed by I-PEX CO., LTD. and is fully compatible and intermateable with I-PEX CABLINE-VS connector series, recently selected by VESA (Video Electronics Standard Association) as the global standards connector for LED backlight wide (16x9) panel interface. Its ultra-low profile mating configuration (1.1 mm height) makes it ideal for the slim LED backlight LCD panel of advanced notebook personal computers.

PC Requirements

Today's PCs require high-performance interconnects with sufficient throughput in order to drive the latest display technology, such as DVD/Blu-ray players, and render massive 3D imaging, real-time video or internet MPEG files. Notebook and netbook PCs use similar technology, but their display panels are slimmer thanks to the innovative power-saving LED backlight flat panel display (FPD) technology and the LCEDI family of interconnects.

Specifications

VESA recently specified that next-generation digital video interface eDP, in conjunction with standard DisplayPort V1.1a specification, will support the PC market and offer a cost effective substitute to current LVDS transmission technology. eDP architecture drives 2.7 Gbps per lane with a bandwidth of 10.8 Gbps over four differential lanes. Each data lane embeds clock signal for superb signal integrity, producing much lower EMI at higher speed data transmission.

Data Transmission Speeds

Tyco Electronics' LCEDI connector family accommodates consistent digital data transmission through one, two or four DisplayPort standard lanes at a reduced bit rate of 1.62 Gbps or a high bit rate of 2.7 Gbps through each lane, and even faster data rates over different wiring schemes. The product family offers high density for notebook PC applications, minimizing space and accommodating future pin out for LED backlight technology.

For detailed information please contact:

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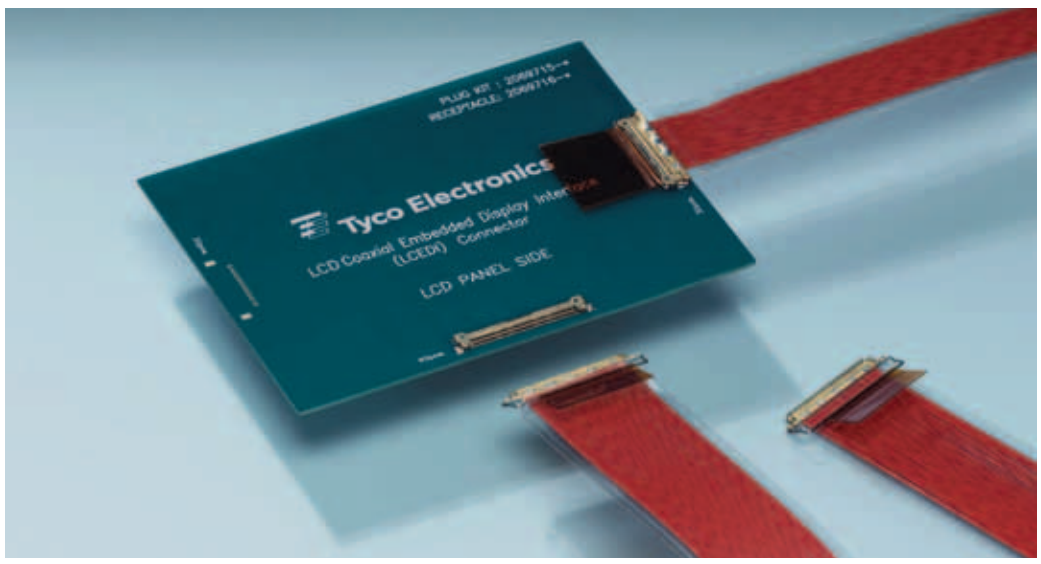
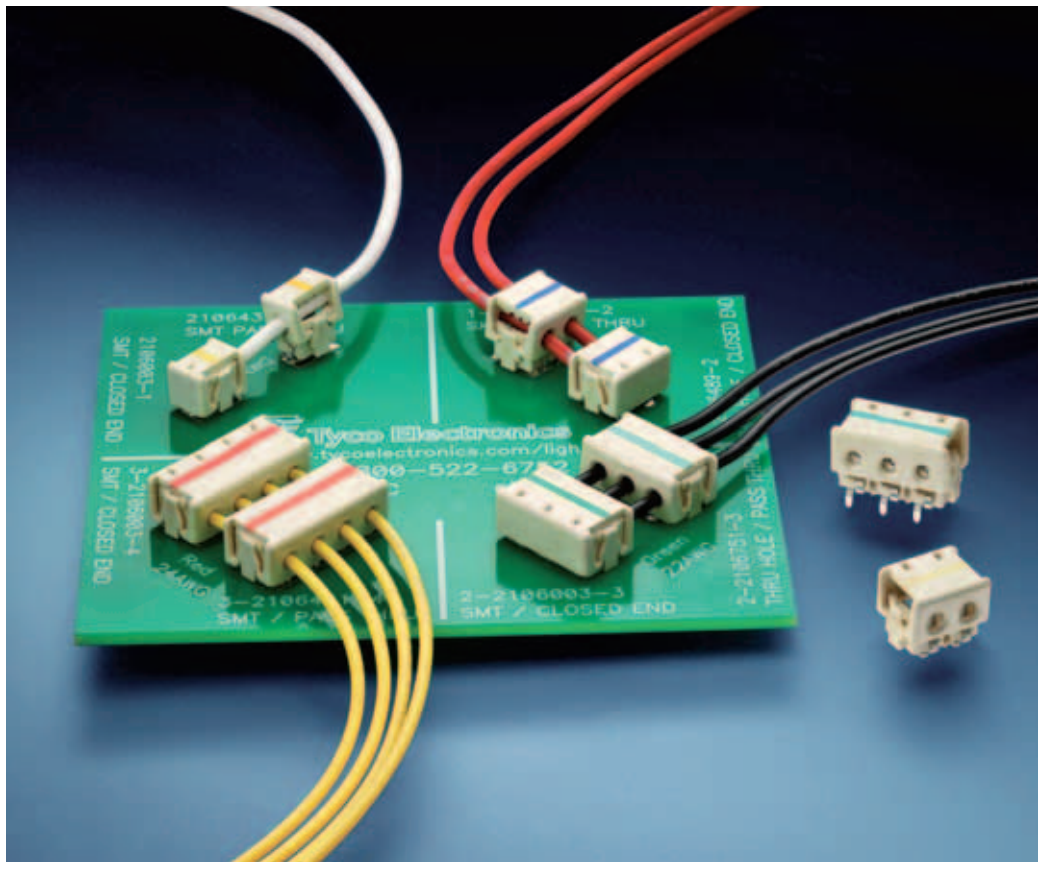


Tyco Electronics Releases RoHS-Compliant IDC SSL Connector for Quick, Toolless Termination of Discrete Wires

Tyco Electronics released the new IDC SSL connector for quick, toolless termination of discrete wires onto LED printed circuit boards (PCBs). The product terminates 18 through 24 AWG solid and stranded wire utilizing insulation displacement technology to eliminate the labor-intensive task of pre-stripping wires and soldering.

The robust design of the IDC SSL connector suits harsh environments in the solid state lighting (SSL) industry. Specific LED applications include: Lighting controls, general illumination fixtures and interconnection of strings in PCB light modules. Additionally, the product supports various non-lighting applications that require the attachment of discrete wire leads to PCBs. The RoHS-compliant connector — available in one, two, three and four positions — meets UL 1177 specifications.



Product offerings include SMT/thru-hole and closed-end/feed-thru configurations. The closed-end version contains a "viewing" window to ensure that the wire is fully seated and secure after termination.

The product, built with 94 V0-rated high-temperature resistant thermoplastic, enables reflow processing and features rounded corners to minimize shadowing. Wire gauges are color coded to enable precise wiring.

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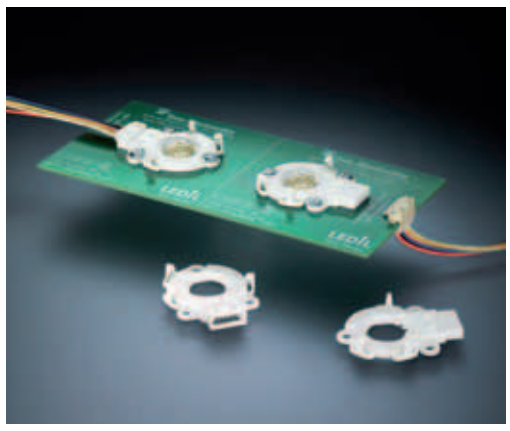
Literature Available:

Introducing IDC SSL Connector
Literature No. 5-1773455-1

Tyco Electronics' Solderless Socket Solution for the CREE XLAMP® MP-L™ LED Now Available

Tyco Electronics releases the solderless LED socket, Type CM, for easy integration of the new Cree XLamp® MP-L™ multichip LED into light fixtures.

The new socket offers customers a simple termination solution for the Cree XLamp MP-L LED while allowing ample optical clearance for un-lensed applications. For lensed applications, the socket incorporates a snap-on connect feature for the LEDIL Tyra series of reflectors, which offer directional optics in 18, 30 and 50 degree beam angles.



The solderless LED socket provides a rapid termination solution for the XLamp MP-L LED's six 0.60 mm^2 connection pads that are mounted on the top of the LED. This low-profile socket eliminates the need to solder by providing a solderless solution that reduces assembly time while providing a repeatable and separable termination. In addition, the socket is conveniently offered in two versions to suit wire or board applications – each version is offered with or without attachment features for optics.

The wire termination version incorporates a Tyco Electronics AMP Mini CT connector header that mates to a cable mounted AMP Mini CT plug – allowing for quick, easy wire connections. This version eliminates the need for a circuit board and allows the XLamp MP-L LED to be mounted directly to the heat sink using a thermally conductive adhesive. A six-inch AMP Mini CT pigtail assembly is also offered to provide a complete interconnect solution for the XLamp MP-L LED implementation.

The board termination version, suitable for PCB-mount applications, provides a solderless termination directly to the PCB from the XLamp MP-L LED. This version suits applications where drive circuitry and remote connectors are integrated onto the same board as the LED. The socket design, recognized to UL 1977 requirements (file #E28476), utilizes standard commercially – available hardware for attachment.

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Literature Available:

Introducing Solderless LED Socket, Type CM
Literature No. 5-1773457-1

New Reflowable Thermal Protection Technology Expands the Limits of Circuit Protection Devices

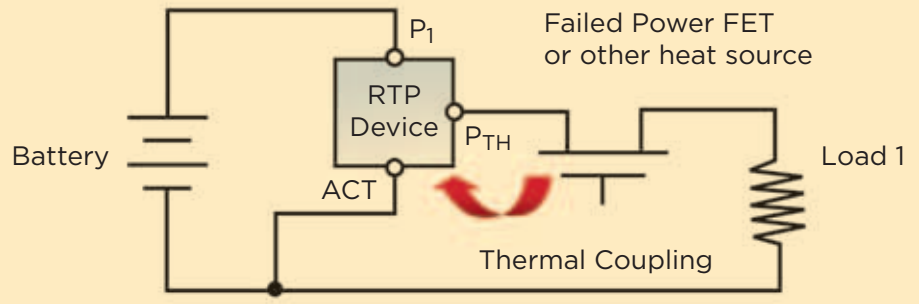

Figure 1: Typical automotive electronics design

Tyco Electronics' new Reflowable Thermal Protection (RTP) device is a high-reliability surface-mount device that is used to switch off power in case of a thermal runaway event. An industry first, the RTP device enables circuit protection designs that are robust, vibration-insensitive, DC-rated, and PB-free. The device can be installed with standard high-temperature SMD processes, yet will open at a lower temperature after installation.

Automotive application examples for the technology include ABS, cooling fan, and power steering control systems. Industrial applications include IT servers, telecom power supplies and test equipment.

A typical application for the RTP device is to help provide protection in case of power MOSFET or smart FET failures leading to a thermal event. Although today's MOSFETs are robust they can still fail in the field, especially when used in harsh environments or when exposed to many thermal cycles. Other power components such as power capacitors, power ICs or power resistors can crack, and any type of corrosion-induced heating can generate very high temperatures on PCBs.

The RTP device can help prevent failed components from leading to unsafe thermal events, smoking or desoldering on the PCB. If a power component failure or a board defect generates unsafe overtemperature conditions, the thermal protection device will open at 200°C, a value above normal operating temperatures but below Pb-free solder reflow levels.

This interrupts the current and helps prevent a thermal runaway condition from resulting in critical damage. (The opening temperature of 200°C is the specified value for the RTP200-R120SA; future devices will be available with different opening temperatures.)

Figure 1 shows a typical automotive power electronics design where an RTP device is placed in front of a PowerFET or another overheating source.

High Reliability

Resistant to shock, vibration, temperature cycling and humidity exposure, RTP devices are tested to meet or exceed some of the strictest automotive AECQ specification testing requirements. The first device being released, the RTP200R120SA, features a high-current DC interrupt rating of 200 A at 16 V_{DC} and 100 A at 32 V_{DC}, and is suitable for operation in series with 150 A-rated PowerFETs. (Note that RTP devices are also capable of interrupting AC current and voltage.) RTP devices are halogen- and Pb-free, and RoHS compliant, and allow for conformal coating.

Focused on protecting power electronics applications, RTP devices have a very low series resistance in order to limit voltage drop across their pins. The first release features a 1.2 mOhm initial resistance and a relatively flat thermal derating, as shown in Figure 2.

In this curve the primary power path resistance (Rpp) value over temperature of the RTP200R120SA device exhibits half the resistance versus temperature increase of a typical 3 mOhm PowerFET, providing very little disruption of the system in normal operation.

In order to achieve high system reliability, the RTP device should open only after the PowerFET (or other component) has actually failed or exceeded a normal operating window. This is illustrated in Figure 3 where the thermal protection device only opens at currents above the maximum current of the PowerFET,

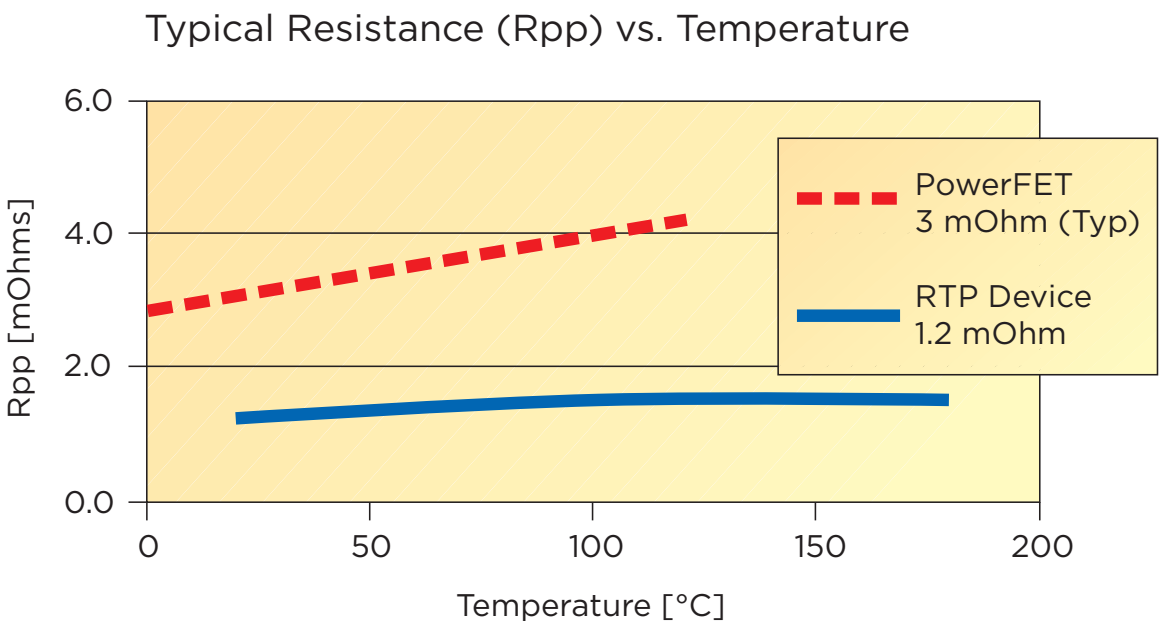

Figure 2: Thermal derating of the RTP200R120SA device compared with a typical 3 mOhm PowerFET

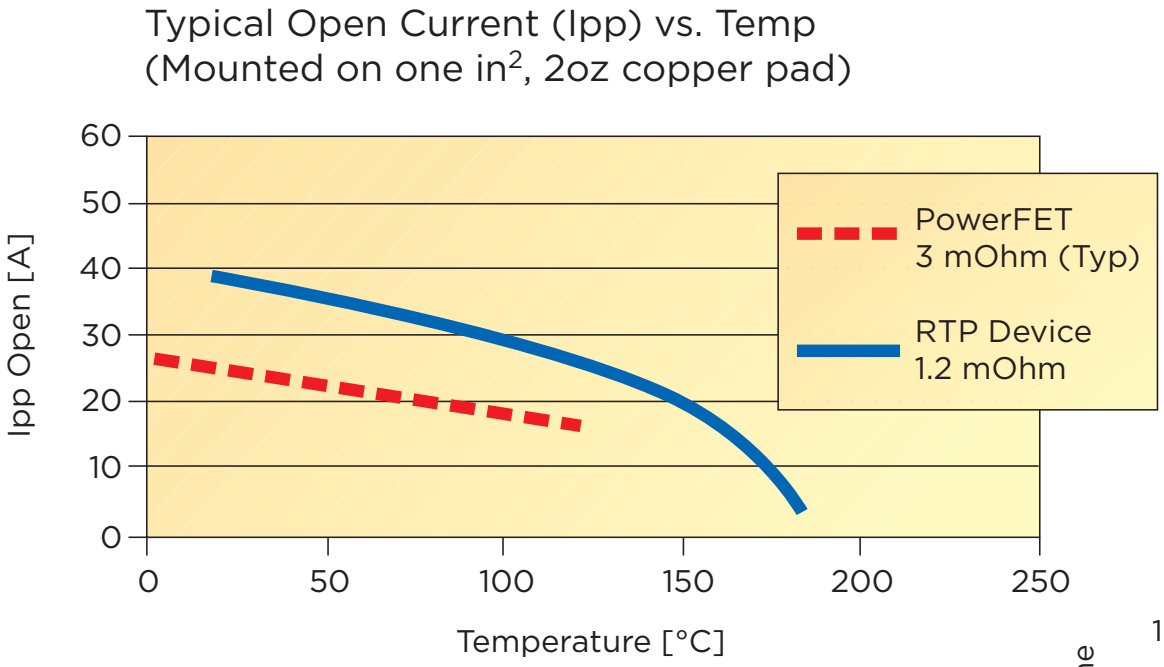

Figure 3:
Opening current vs. temperature of the RTP200R120SA device and a typical 3 mOhm PowerFET

leaving the application undisturbed during normal operation. The Ipp in the graph represents the current through the primary power path.

In some cases, failed power components may not generate a hard-short overcurrent condition but will produce a resistive short instead. This fault condition may produce severe temperatures through I^2R heating. The RTP device can help prevent damage caused by both dead short circuit and resistive short circuit conditions.

In the case of a resistive short, the resulting current may not be high enough to "blow" a standard fuse. In this case, the robust RTP device may be used to help stop thermal runaway by opening the power line.

Creative Solution for Ease of Installation

To simplify installation, improve reliability, and optimize thermal coupling with the PCB, the reflowable Reflowable Thermal Protection device utilizes a one-time electronic activation process to become thermally sensitive rather than requiring special surface-mount installation or post-assembly rework.

Before activation, the device will withstand three Pb-free SMD solder reflow passes up to 260°C without opening.

After activation, the device will open when the critical junction temperature exceeds 200°C. Activation timing is user-determined, and can occur automatically at the initial device power up or during the validation test phase.

RTP Device Advantages

As the Table shows, the RTP surface mount thermal protection device offers the best combination of features of conventional circuit protection approaches. Other solutions are limited in comparison, such as Thermal Cut-Off (TCO) devices, which are typically AC-rated, through-hole devices and are not specifically designed as automotive-grade components.

RTP devices provide a simple and easy-to-use solution for helping to protect power electronics – without having to design in redundant components (such as FETs or relays) to help protect against thermal events.

As a new passive component, the RTP device is alone in providing such a robust, re-flowable solution in a compact SMD package.

The first RTP device was developed for automotive electronics applications.

Future products in the thermal protection device family are planned to offer a variety of features including lower resistance, smaller form factors, and lower open temperatures.

Scalable design will allow RTP devices to be tailored to a variety of markets and applications that require robust, reliable thermal protection in a convenient form factor.

Benefits

- Helps prevent failed components from generating thermal events, smoking and/or desoldering
- Allows use of standard surface-mount production methods with no special assembly costs
- Minimal power dissipation and voltage drop
- Supports DC electronic circuits Scalable design

For more information about the new RTP devices, come and see us at Electronica in Tyco Electronics' booth B3.225 or contact Guillemette Paour at *gpaour@te.com* or go to:

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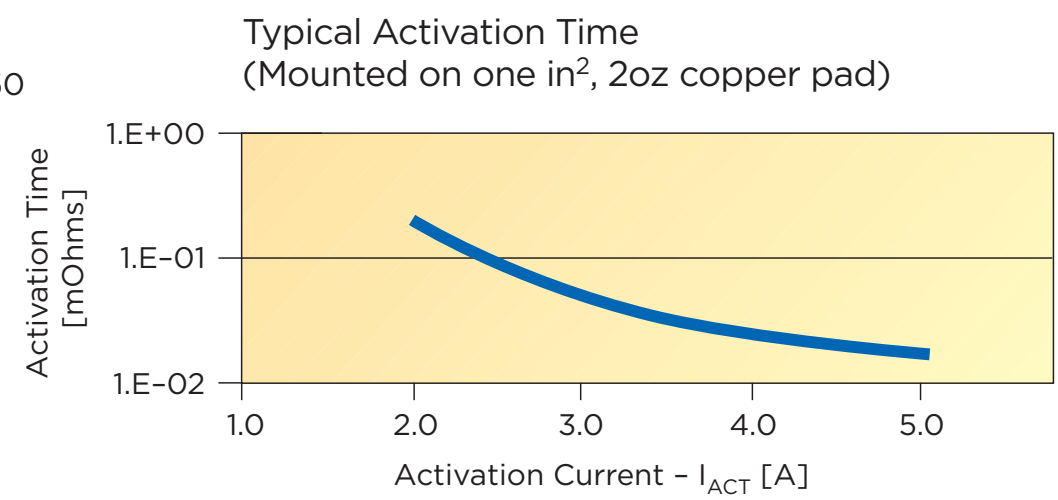

Figure 4: Typical activation time vs. applied current of the RTP200R120SA device

Key Requirements	Options			
	Traditional TCO	Traditional PPTC	Traditional Fuse	RTP Device
Low Current, Thermal Open (175 – 220°C)	✔	✘ (open < 175°C)	✘	✔
High Reliability / Auto Grade (Vibration, Shock, Aging, etc.)	✘	✔	✔	✔
Standard, Reliable, Compliant Assembly (SMD & Pb Free)	✘	✔	✔	✔
High DC Operating Current (>30 A)	✘	✘	✘ (not in SMD)	✔
High Max Interrupt Currents (>100 A)	✘	✘	✘	✔
One Time Open and Forget	✔	✘	✔	✔

Table: Device Comparison: The RTP device combines the best features of conventional technologies to provide a robust, reflowable solution for automotive and industrial power electronics applications.

New Hybrid Technology Innovation for Circuit Protection in High-Rate-Discharge Li-Ion Battery Applications

Tyco Electronics has developed new Metal Hybrid PPTC (MHP) technology that specifically addresses the need for a cost-effective circuit protection device for high-rate-discharge lithium ion (Li-ion) battery applications. This new circuit protection technology is capable of providing resettable circuit protection at 30 A+ hold currents at voltage ratings over 30 V_{DC}.

Li-Ion Battery Trends

Due to advances in Li-ion battery technology, smaller, lighter weight and higher power Li-ion batteries can now replace nickel cadmium or lead acid batteries previously used in high-rate-discharge battery applications. This has resulted in a rapidly expanding market for high-rate-discharge Li-ion batteries in applications such as cordless power tools, e-bikes and back-up power supplies. This, in turn, has created the need for cost-effective, robust circuit protection devices that provide battery safety in these products.

Until now there were few protection solutions for high-rate-discharge battery applications at ratings above 30 V_{DC}/30 A, and many of the conventional circuit protection techniques currently available are large, complex and/or expensive. The MHP30-36 device (figure 1), the first in a planned family of MHP devices, has a 36 V_{DC}/100 A maximum rating and a time-to-trip of under five seconds at 100 A (at 25°C).

This new hybrid device connects a bimetal protector in parallel with a PPTC (polymeric positive temperature coefficient) device, which helps provide resettable overcurrent protection while utilizing the low resistance of the PPTC element to help prevent arcing in the bimetal protector at higher currents. It also heats the bimetal protector to keep it open and in a latched position if an overcurrent event occurs.

Compared to other solutions, the integrated MHP device offers designers the advantages of space-reduction, cost-reduction and protection-enhancement benefits. It also offers beneficial arc suppression characteristics compared to standard breaker devices. Additionally, use of the integrated MHP device can reduce the number of discharge FETs and accompanying heat sinks in applications that typically use IC-plus-FET battery protection designs.

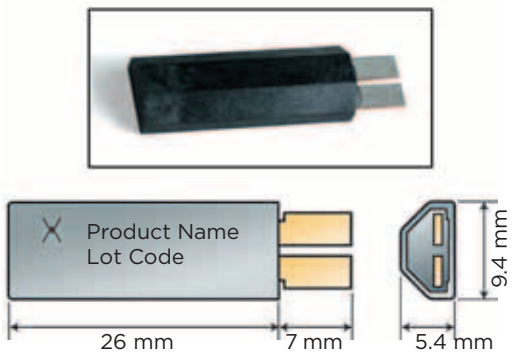

Figure 1: New MHP30-36 device

MHP Technology Innovation

Test data demonstrate how a typical bimetal protector integrated with a polymer PTC, such as a PolySwitch RXE050 device, can provide latching benefits similar to those of a ceramic PTC (CPTC) and bimetal protector combination, while also providing the additional benefit of arc suppression at higher currents. The MHP exhibits superior contact resistance compared to standard breakers that must limit the number of switching cycles since arcing between contacts may damage them.

As shown in Figure 2, the activation steps of the MHP device include:

1. During normal operation, because contact resistance is very low, most of the current goes through the bimetal protector.

2. When the contact begins to open, contact resistance increases quickly. If the contact resistance is higher than the PPTC device's resistance most of the current flows to the PPTC device and the current on the contact is reduced or eliminated. This minimizes or prevents arcing between the contacts.

3. After the contact opens, the PPTC device starts to heat up the bimetal and keeps it open until the overcurrent event ends or the power is turned off. Although it is possible to use a CPTC device in parallel to the bimetal contacts, the PPTC device's resistance is generally much lower. This means that even during a small contact opening and a small contact resistance increase the current can be shunted to the PPTC device to help prevent arcing on the contacts. The resistivity of CPTC materials makes this technology an impractical choice for making compact, arcless contact hybrid protectors.

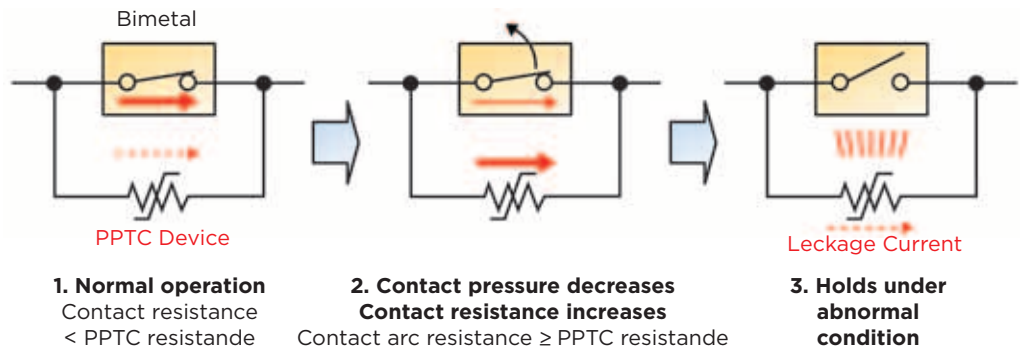

Figure 2: Activation steps of the MHP device

Figure 3 shows a circuit diagram of the bimetal protector and PPTC device in parallel.

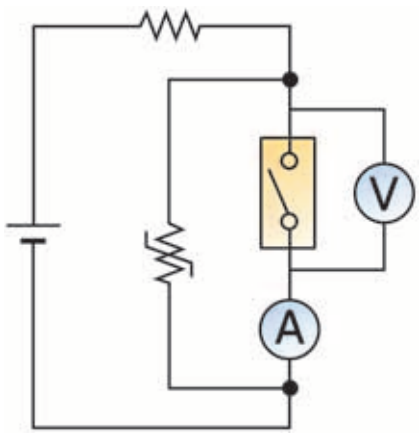

Figure 3:
PPTC device/bimetal protector parallel circuit

Smaller Contact Size and Lower Resistance

The MHP device uses a type of contact that is referred to as "double-make" or "double-break" design in order to downsize the device, as shown in Figure 4. In addition to facilitating the use of a smaller protection device, this technology offers two important advantages as compared to a typical bimetal protector. First, the MHP device exhibits very low resistance because the current path is very short and, second, heat is only generated at the contact point, which permits the use of thermal control to achieve precise thermal activation.

Impact/Shock Withstand

A typical power tool battery pack operates under severe vibration and impact conditions. The MHP device can be used in the harsh operating environments of high-current applications by providing longer cycle life and high vibration/shock withstand. Standard bimetal protectors generally did not survive more than 100 on-off cycles during overcur-

rent and often failed after only a 200 g (g-force) drop test. The MHP30-36 device is rated to survive at least 500 operation cycles and can survive a 1,500 g drop test without failure, and as many as 3 cycles at 3,000 g.

As shown in the Table the MHP30-36 device's time-to-trip at 50 A is 25 +/– 5 seconds. This value is sufficient to help protect the battery pack from an over-discharge event and is also long enough to not inconvenience the power tool operator.

The time-to-trip at 100 A is the most important parameter in terms of protecting the battery pack from any abnormal situation, such as power tool (drill) rotor lock. As such, the time-to-trip should be no longer than five seconds.

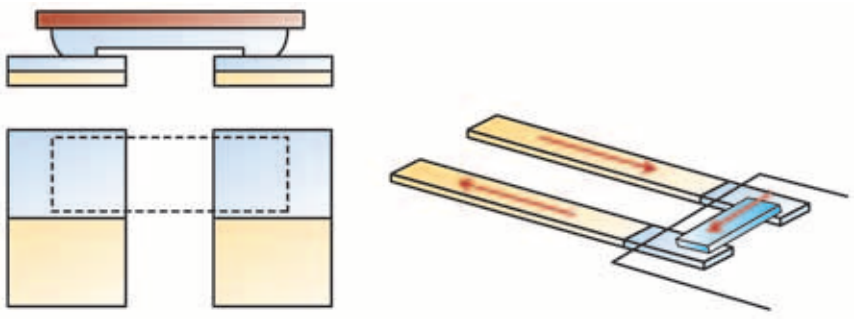

Figure 4: Double-make/double-break contact design used for the hybrid MHP device.

The reset time (time to return power to the tool) should be no longer than 30 seconds, a duration that also balances user convenience with time needed to keep the battery from overheating.

Planned Family Extension

The MHP device technology can be configured for various applications, and higher voltage (up to 400 V_{DC}) and hold current (60 A) devices are currently in development. Future design considerations include battery protection in Li-ion battery packs used in e-scooters and light electric vehicles (LEVs), as well as standby-power applications and non-battery applications such as electric motor protection.

Parameter	Value
Electrical Rating (Max)	36 VDC / 100 A
Hold Current @ 25°C	30 A
Initial Resistance	0.8 ~ 2.0 mΩ
TtT (60 A @ 25°C) (Time-to-Trip)	17 sec +/- 5 sec
TtT (100 A @ 25°C) (Time-to-Trip)	3.5 sec +/- 1.5 sec
Reset Time @ 25°C	15 ~ 45 sec
Shock Withstand A (Force/Cycles)	1,500 g / 1,000 times
Shock Withstand B (Force/Cycles)	3,000 g / 3 times

Table: List of MHP30-36 reference values

For more information regarding this new technology, come and see us at the Tyco Electronics booth B3.225 or contact us directly through:

www.circuitprotection.com

For more information about the new RTP devices, come and see us at Electronica in Tyco Electronics' booth B3.225 or contact Ty Bowman at *ty.bowman@te.com* or go to:

www.circuitprotection.com

The Power to Innovate: Pioneering Circuit Protection Solutions for a Connected World

Over the past 30 years, the growth of electronic content in automotive, industrial, portable electronics and telecommunications applications has been dizzying. Tyco Electronics' effort to keep pace with this evolution has allowed the company to make customized products available for the development of emerging technologies, and deliver innovative, cost-effective solutions for existing technology.

TE's material science expertise combined with technological breakthroughs and pioneering designs has also resulted in the advancement and acceptance of new circuit protection solutions.

Raising the Bar on Circuit Protection Technology

Collaboration with electronics equipment designers coupled with forward-looking research and development of advanced materials has expanded Tyco Electronics' initial breakthroughs in PPTC (polymeric positive temperature coefficient) technology into an ever-wider range of industries and applications.

Tyco Electronics has also advanced the reach of circuit protection technology by integrating polymeric materials with "traditional" products, such as metal oxide varistors and Zener diodes to provide coordinated overcurrent/overvoltage protection.

Latest Innovations

At Electronica 2010, Tyco Electronics is again advancing circuit protection with the introduction of innovative technologies that result in a Metal Hybrid PPTC (MHP) device and a Reflowable Thermal Protection (RTP) device. These two new products help protect high-power battery applications and automotive or industrial power electronics, respectively.

The portable battery market is evolving from traditional low-power portable applications to much higher power applications. This trend is seen in lithium ion (Li-ion) battery applications for power portables, such as power tools, motive power (e.g., electric bikes) or standby power (e.g., solar panels).

MHP devices utilize a technology developed specifically to address the need for a cost-effective circuit protection device that is capable of helping protect portable power applications.

Continuation on page 26

Continuation from page 25

This fall, Tyco Electronicsis releasing the new MHP30-36 device, which features 30 A+ hold currents at voltage ratings over 30 V_{DC}. Currently there are few protection solutions for high-rate-discharge battery applications at ratings above 30 V_{DC} / 30 A, and many of the conventional circuit protection techniques currently available are large, complex and/or expensive.

The MHP30-36 device is suitable for high-rate-discharge Li-ion battery applications, and yields many cost and space benefits as compared to typical circuit protection approaches. This new hybrid device connects a bimetal protector in parallel with a PPTC device. The MHP approach helps provide resettable overcurrent protection while utilizing the low resistance of the PPTC element to help prevent arcing in the bimetal protector at higher currents.

Another example of Tyco Electronics' ability to create new technologies that address specific trends in the electronics industry is the Reflowable Thermal Protection (RTP) device. The automotive power electronics market has grown quickly, with comfort and active safety features becoming more common.

Conventional mechanical functions are migrating to electronic applications. The first RTP device being announced at Electronica, the RTP200R120SA, features a 1.2 mOhm initial resistance and a relatively flat thermal derating, which is especially well suited for automotive applications.

In parallel, the communications market is evolving. User demand for constant-connectivity is leading to the increasing density of IT server farms and telecom centers around the world, along with higher power machines and denser PCBs.

These market trends place greater demands on power electronic systems, resulting in the potential for serious thermal issues when power components, such as power FETs, capacitors, resistors or ICs, fail due to harsh environmental environments.

In response to such market needs, Tyco Electronics has developed the RTP device. Based on a technology which enables high-reliability, surface-mount thermal protection, the RTP device helps protect power electronics. This first-of-a-kind device helps prevent thermal runaway events that can be generated by multiple factors, including power component failures or corrosion-induced heating.

The RTP device will open electrically in the event that it achieves its critical temperature set at 200°C, which has been determined to be higher than normal operating temperatures but lower than lead-free solder melting levels.

As a new passive component, the RTP device provides a robust, reflowable solution that before now was unavailable in such a robust and easy-to-use SMD package. By working closely with power electronics designers, TE has been able to develop a device with design characteristics ideally suited to address the most pressing application requirements.

Continuing the Tradition of Advancements

These new technologies demonstrate Tyco Electronics dedication to providing leading-edge solutions to electronics equipment manufacturers. They also affirm how TE's long-term investment in material research and technology and close collaboration with customers have allowed the company to push existing performance levels into new, smaller, and more convenient packages.

The products described above are the initial offerings of these new families. Product line extensions for the MHP and RTP device families are now being developed to target a broader spectrum of application requirements; such as an MHP device for 400 V/60 A applications, and a 0.6 mOhm RTP device.

Tyco Electronics consistently strives to lead the industry with groundbreaking products that outpace what conventional technologies can deliver.

Tyco Electronics' innovative circuit protection technology is powered by R&D, manufacturing, and technical sales and support offices around the world, and by over 1,700 employees who are committed to bringing a performance advantage to every technology, product and service we provide.

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www.circuitprotection.com

Unique Touchscreen Technology Enters Portable Markets

Tyco Electronics' Acoustic Pulse Recognition (APR) touch technology has the potential to soon appear in a portable electronic device near you. The engineers at Tyco Electronics touch solutions group are developing multiple touch technology solutions that will allow the integration of touch technology, including APR, into a wide spectrum of devices.

Normally associated with larger touchscreen installations in the commercial and industrial spaces, the APR technology may soon find a home in portable consumer products like mobile phones, navigation units, portable gaming, and tablet PCs, as well as in handheld industrial devices.

How APR Works

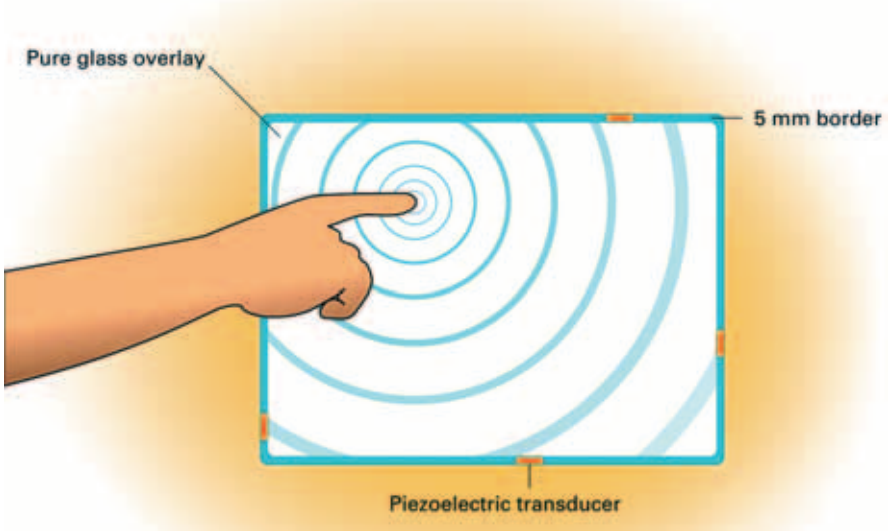
APR combines the features of existing touch technologies within a single package while offering an alternative to capacitive and resistive topologies. A basic implementation consists of a display with a glass overlay (picture 1) and a small USB control board (picture 2). An acoustic-based technology, APR matches the stylus independent sound characteristics generated when the glass is touched at any location to a preset characterization file, thereby identifying the point where the screen is touched.

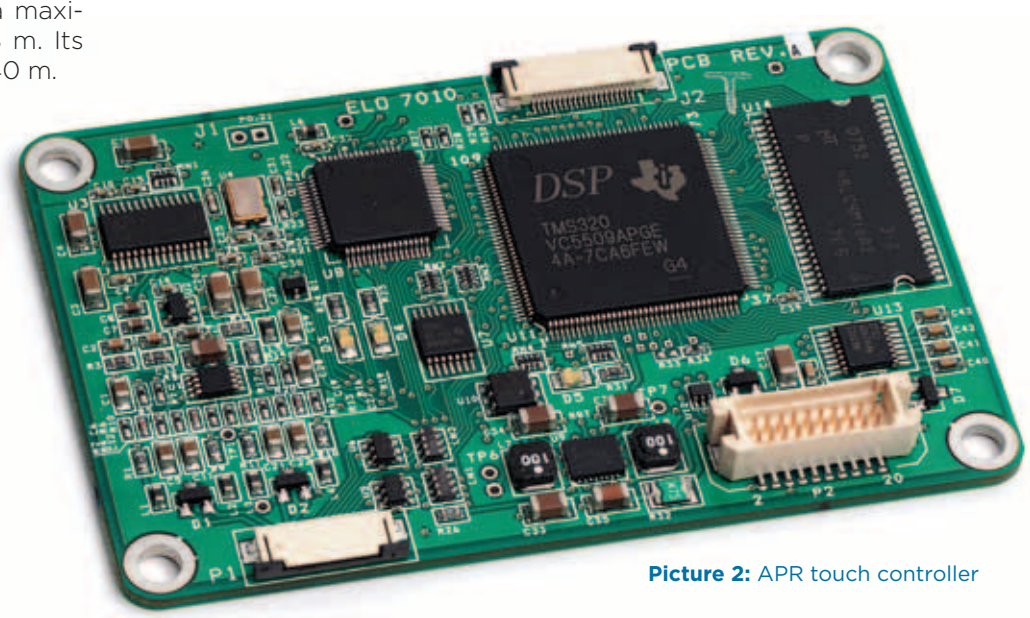
This audio approach enables touch input via finger, fingernail, gloved hand, or stylus. The technology also includes palm rejection functionality. The screen is scaleable in size from that of a mobile phone up to a 52-in. diagonal. The glass overlay offers durability in its resistance to liquids and other contaminants, including chemicals that do not affect glass such as acetone, toluene, methyl ethyl ketone, isopropyl alcohol, methyl alcohol, ethyl acetate, ammonia-based glass cleaners, gasoline, kerosene, and vinegar.

APR touch activation force is unlike typical touchscreens in that it responds to a very light tap or drag to activate the touch with a maximum positional accuracy of 1%.

Touch-point density is currently limited by the controller output resolution of 4,096 x 4,096, the industry standard. Being pure glass, APR features alight transmission 92% ±2%. Operating temperature ranges from –20°C to 60°C, with a storage temperature range from –40°C to 71°C.

Other environmental operating limits include a relative humidity of 90% maximum at a maximum of 50°C for 240 hours non-condensing and a maximum operating altitude of 3,048 m. Its storage and transport limit is 15,240 m.





Picture 2: APR touch controller

Picture 1: APR touch screen

The technology provides electrostatic-discharge protection as per EN 61000-4-2, 1995 and meets Level 4 based on 15 kV air and 8 kV contact discharges. It also carries UL, cUL, TUV, CE, and FCC Class A approvals and is sealable to meet NEMA 4 and 12 and IP 65 standards.

APR's surface durability, specified as that of pure glass, offers a hardness rating of 7. As the technology relies on no moving parts, coatings, or layers, life expectancy exceeds 50 million touches in a single location using either a finger or stylus.

For certain applications, impact resistance can meet UL-60950 and CSA 22.2 No. 60950 ball-drop test requirements, which entails dropping a 0.5-kg/50-mm diameter ball from a height of 1.3 m on the design.

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