HOME APPLIANCES & DEVICES

TE connectivity

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GROWTH OF THE CONNECTED HOME - THE HOME PLATFORM PERSPECTIVE

GROWTH OF THE CONNECTED HOME
The Home Platform Perspective

by Nick Langston, Connected Home, Market Development Leader

THE CONNECTED HOME IS A RAPIDLY EMERGING MARKET AND PLATFORM FOR PRODUCTS AND INNOVATIONS

Whether you call it the connected home, smart home or home automation, it is a hub of activity for connectivity and sensor solutions. While mainstream adoption may still be years away, we know this market is poised for growth. It represents an important opportunity for consumer product manufacturers from devices to appliances, security and lighting, to deliver products that are differentiated with new functionality and connectivity.

As a sensor and connectivity component company, our interest in this market is significant. We proactively identify trends and innovate new product solutions to better serve our customers. Consumer needs are rapidly changing and new features and functionalities are being created that will forever change the idea of value. No one knows what products will be central to the connected home, but we do know you need to place multiple bets. Whether it's the refrigerator, TV or thermostat, TE Connectivity (TE) will work with our partners to develop product strategies that will enable multiple outcomes.

A Consumer View

Today's market is fragmented and standards differ. The killer application does not yet exist. Vendors are competing for mindshare with their own version of walled gardens or individual platform standards. What is clear is that there is no one approach or obvious leader today. The migration towards home automation is based on do-it-yourself product solutions versus an integrated home solution. Consumers are confused and the industry is not helping the situation.

The idea of a home hub, long held by the personal computing OEMs to be the future of the home pc, is now very much up for grabs. For now, the primary control device remains the smartphone or tablet. Yet, we see new products entering the market, including digital assistants like Apple's Siri and Amazon's Alexa, as well as familiar appliances reappearing with new features enabled by sensing and connectivity. All of these products are competing for a bigger share of mind and control in the home. Samsung is promoting both the smart refrigerator and smart TV as a family hub. The company is using technology from Smart Things, which it bought in 2014, to add home automation technology across their product line. In this example, the two products represent very different strategies and demonstrate both the uncertainty of the primary device, as well as the importance of placing early bets.

We are in a period we call "exploration". We do not know what the outcome will be from a lead device or must-have functionality, but we know that the market is changing rapidly and successful companies are proactively developing and testing new solutions to bring to market.

Consumer Purchase Intent

32% of online shoppers own at least one smart home device.

22% own connected smoke detectors, which was the highest among devices included in the survey. An additional 22% of respondents intend to purchase a connected smoke detector in the future.

While only **11% currently own connected lighting products, 26% intend to purchase them in the future**. This ranked as the top smart home device consumers intended to purchase in the future.

Security was ranked as an important feature of a connected home device by 70% of the respondents, more than any other feature. 69% said price is one of the most important features, and **66% cited ease of installation**.

Source: *UPS Pulse of the Online Shopper, June 2016*

> "From coffeemakers at college hackathons to TVs at your local Best Buy, everything is smart these days."
>
> John Mannes, TechCrunch June 22, 2016

Smart connectivity is just a starting point. Connectivity enables the sharing of information and the ability to monitor and control. As artificial intelligence matures and proliferates devices will leverage complicated analysis in the cloud to deliver actionable insights back to users and systems within the connected home. Automation will eventually make routine tasks or chores easier and perhaps invisible. As new value propositions are shaped, we expect to see simplification, increased efficiencies (saving both time and money), and a level of service beyond what can be delivered today.

This will drive a virtuous cycle of increased demand for products which can be leveraged to improve data analysis. Understanding behavior and how to drive efficiencies is critical. These improved results will create a better experience for consumers who then demand more products—and the cycle continues.

Gartner predicts that by 2022, a typical family home could contain more than 500 smart devices.

Adoption and Challenges

Partnerships and touchpoints are critical as service providers, home security companies, retailers, consumer electronics and appliance OEMs bring a range of new hardware and services to market. The rapidly evolving role of mobile devices (tablets, smartphones, wearables) is adding another layer of complexity as management and control preferences are determined and new opportunities are created (such as in the healthcare monitoring space). While complexity continues to increase, the benefit will be unprecedented levels of functionality and service delivery.

Adoption in this space has been slowed down by the challenges around ease of use, installation and control. Add various and competing communication standards, and the proliferation of networking protocols, and you have an ecosystem that is fragmented and competitive. It's truly ironic that despite increased connectivity, smart devices are not connecting with each other.

Companies are beginning to offer points of collaboration. Samsung has long supported the developer community and specifically supports developers of connected home products via it's SmartThings platform. Even Apple is recognizing the importance of common technologies. For the first time at their Worldwide Developers Conference they announced two things which may help jump start smart home adoptions. First, they are releasing the Home app for iOS devices that will act as a central control point for HomeKit compatible smart home devices. Second, Apple opened up Siri to third-party developers, just as Amazon opened up its Alexa platform. This will allow app developers to have Siri act as their voice control.

In addition to technology, standards, and security concerns, it's also important to evaluate the consumer adoption mindset. Early adopters are intrigued by new products and functionalities and start purchasing, testing, and sharing information. Mainstream adoption may be years away, seeing the challenges as roadblocks threatening their desire to purchase. Yet the fact remains that people are testing the waters. Research demonstrates different interest levels and expectations. We see adoption curves differ depending on the product focus, geography and pain points. In some countries, utility companies and government regulations are driving adoption. We think the benefits of automation, remote management and servicing, and other customer friendly features will lead appliance
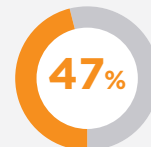
Icontrol's State of the Smart Home identifies top benefits:

70%

say they are excited about the potential cost savings from energy efficiency and monitoring
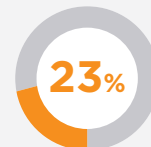
48%
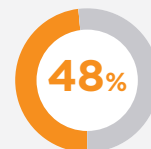
say they are excited about the potential convenience in programming home settings and maintenance

47%

say they are excited about the potential to help the environment with greater energy efficiency*

Yet they also found other levels of interest:

23%

want greater productivity and the ability to manage work-life balance

18%

look to anticipate one's needs

13%

site the ability to have more interactive features to help connect with the people in their lives

*Source: *Icontrol 2015 State of the Smart Home Report*

The inside of a modern thermostat is starting to look like the inside of a smartphone with new technology including TE's connectivity and sensor products.
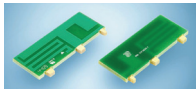
0.8mm FPC HEADER

1mm BTB STACKING CONNECTOR

DIP SWITCH

DUAL-BAND ANTENNA
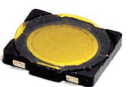
EMI SHIELDING

HUMIDITY SENSOR

IM RELAYS

IR OCCUPANCY SENSOR

PASSIVES

RTD TEMP SENSOR

SMT TACTILE SWITCHES

SPRING FINGERS

manufacturers to compete to differentiate themselves. They may be the drivers of adoption as OEMs bring products that offer new levels of functionality to the market sooner than later.

Multiple adoption points increase the complexity of the market and companies' ability to predict when the connected home hits mainstream adoption. We have seen disruptive models and products enter the market completely changing expectations. The smartphone changed expectations around playing music, and the ultrabook changed expectations around the size and weight of notebooks. From a usage model, streaming video changed the idea of entertainment and content delivery. History proves there will be a new entrant that rapidly changes expectations and jump starts adoption.

Evolving Business Models

We cannot discuss opportunities and challenges without considering the potential impact on business models. The impact, particularly on appliance manufacturers, may be significant. Who will deliver the new functionality? Will the OEMs add it to their product offering or will a new, third party service provider emerge to offer the digital version of a service contract? Will remote maintenance and preventative service alerts turn the customer data into new, value-add service offerings? How will businesses articulate the value of the new "connectivity" features?

The role of brand partnerships may be redefined. Across the connected home market we see alliances and integration across previously separate vendors. Imagine the potential partnerships that may be created across appliance, security, lighting and more. As different standards and platforms emerge, we predict the partnership landscape will continue to evolve dramatically.

TE's Approach

TE has strong relationships with the major consumer electronics, appliance and device OEMs. We also work closely with our distribution partners to serve a range of customers and start-up players. Innovation is not about company size or location, it is a mindset around exceeding or anticipating the needs of the market. Our goal is to drive the most comprehensive, highest quality connectivity solutions in the market; and be the partner of choice across the ecosystem.

TE's customer relationships extend across many home product categories such as appliances, hubs, personal assistants, occupancy sensors, HVAC equipment, thermostats and more. TE's interconnect and switching technologies play a critical role in development of home automation systems. We enable power and signals internally and externally using electrical interconnects, and routing power and signal in these devices via switching components (for example, a power relay is needed in every wireless or wire-controlled connected AC wall outlet).

Our customers' devices are found in all products and sub-systems in the connected home, including:

• Large & small appliances
• Consumer devices
• Energy management
• Entertainment
• HVAC equipment and controls
• Lighting equipment and controls
• Safety equipment and controls
• Security equipment and controls

Designing in the right connector, switch, relay, or sensor for the device and its application is key to ensuring reliability and functionality. TE has a global team of product and development engineers, application and sales engineers, account managers, and technology experts. Their goal is to help customers make these important decisions early in the product development process, where optimization of a design is most important.

TE engineers can work with customers to develop a semi-custom or custom design that meets their requirements. The process is initiated by working with one of TE's sales or field application engineers. Innovating with our customers is one of our strengths that benefit our customers with differentiated solutions.

Our engineers are agile and use the latest metal and polymer materials to develop a perfect-fit product for custom applications. TE Engineers can leverage a wide range of manufacturing technologies. High-speed progressive stamping, injection molding, a variety of plating technologies, and automated assembly all help ensure long-term production volumes with a design optimized for manufacturing and the end customer's application.

Micro-sized connectors and switches

Through TE's vast product offering, we are able to provide micro-sized connectors and switches for the smallest sensor assemblies. Micro-sizing matters: Consumers want their home automation devices to be as small and unobtrusive as possible. This means the internal components of these devices need to be proportionally small, which is further complicated by additional functionality packaged into these devices. For example, occupancy sensors may also contain ambient light level sensors, a microphone, and other sensing/monitoring elements.

High-current capability

TE provides high-current connectors, switches, and switching relays for HVAC equipment and appliances, enabling their connectivity and control in the automated home. Connected, electronic devices are inherently low voltage or low power, and they need to have relays to switch the higher voltage/higher power loads typical in the home. These loads can be anything from a coffee maker or toaster plugged into a connected wall outlet, to a boiler controller wired to a connected thermostat.

Breadth of choice for product designers

TE's product portfolio is comprehensive —allowing designers to find exactly what they need for their unique ideas and products. In almost every electronic design, connectors and sensors are needed to provide and route power and signals into or out of a circuit.

Wireless innovations

Remote and wireless communication as well as control and monitoring will be an integral part of connected home ecosystems. These connected capabilities drive value by saving time and money for consumers, and will be key to driving demand and mainstream consumer adoption.

Below is a high-level itemization of some of the TE Connectivity product families that find common use among all the sub-systems listed.

- Antennas
- Data I/O connectors
- Fine pitch & free height connectors
- Grounding & Shielding connectors
- High-performance labels
- Integration/value-add capabilities
- Point to point terminations (FASTON, PIDG, etc.)
- Rapid termination connectors
- Small format and power relays
- Passive PCB components
- Power connectors
- Switches
- Spring finger contacts
- Sensors
- Terminal blocks

The TE Advantage

TE is committed to meeting the needs of our customers. Not just delivering products for current design specifications, but also partnering to identify new opportunities.

We provide the broadest range of connectivity products available, suitable for a wide variety of applications and end products. We are uniquely positioned to help customers succeed in the connected home market.

The connected home represents tremendous opportunity for growth and innovation. Now is the time to get started.

HOME APPLIANCES & DEVICES

CONNECTED HOMES AND INTELLIGENT BUILDINGS -
SOLVING FOR RELIABILITY, CONVERGENCE, CONNECTIVITY

CONNECTED HOMES AND INTELLIGENT BUILDINGS:

Solving for Reliability,
Convergence, Connectivity

From Popular Culture to Reality

The concept of an automated home is not a new one: the idea has been floated since the 1930s at World's Fair venues, and in popular culture as TV shows and movies imagine home life of the future – solidifying the public's view of the benefits of home automation.

In the 1980s, modern versions of the automated home began to turn up in the marketplace. The concept of the "connected house" was first introduced by the American Association of Homebuilders, and formed the basis of what we now consider to be "home automation." The connected house presented a new way to wire, connect, and control all of the devices in the modern home. However, it proved to be too expensive, cumbersome, and difficult to construct, and became limited to the luxury homebuilder market.

Throughout the 1990s, automated home technologies stagnated – for the most part, proprietary (and costly) systems were available only for luxury homes. These proprietary technologies were often system-specific, controlling only the home's lighting or entertainment systems. Marrying these systems into a single, cohesive, easily controlled whole was a challenge tackled only by the most technologically astute systems integrators.

At the same time, a do-it-yourself ("DIY") market developed around powerline communication systems, and some early market entrants introduced wireless products for home automation. Innovators started to develop self-assembling, ad hoc wireless network protocols from which the now-prevalent ZigBee standard would emerge around the turn of the century.

In the first decade after 2000, technology innovators developed a wide variety of proprietary, open wireless and radio protocols for home automation. ZigBee, ZWave, EnOCean, C-Bus, and KNX are some of protocols that helped bring about the development of home automation applications during this period. These protocols are the "languages" of home automation, and allow devices to speak to each other. As these protocols were developed, the reality of connected equipment became apparent, as well as a demonstrated need for sensors and actuators for closed loop, learning home automation solutions.

Convergence

With technology costs decreasing, consumers becoming more interested in connected home solutions, and greater reliance on the efficiency of the cloud, solutions for home automation have free reign to become more sophisticated and accessible.

The Power of TE:
TE is uniquely positioned to help customers succeed in the connected home market. From material components such as relays and connectors, to smart components such as sensors and connectivity components such as antennas, TE offers all of the internal elements that make end products smart and connected.

The global home automation market now encompasses all controllable elements in the modern home. Connected lighting, appliances, entertainment, and access devices are all commercially available for professional and DIY installation.

Driven by safety and security concerns, energy savings potential, and convenience, the main home automation elements of lighting, safety, security, entertainment, HVAC, and energy management are now controllable using existing technologies. This convergence of market drivers and technologies has resulted in significant market growth potential, with overall market values estimated at $3.6 billion in 2012, and growing to $16.4 billion by 2019. This growth is being led by North America, with a total market share of 40.7 percent of global home automation installations[1].

Safety and security

Established security companies such as ADT[2] are leveraging the connected home trend as the foundation for expanded home automation offerings through SHaaS (Smart Home as a Service). In addition, broadband providers such as AT&T and Comcast, and energy companies such as British Gas, have also created new revenue streams through SHaaS[3]. Broadband, cable, and energy operators are uniquely positioned to succeed in this market, as they have millions of customers who rely on their services for energy management and data access.

Since these service providers seldom design their own components, a wide range of commercially available, interoperable, and easily deployed hardware – such as relays, switches, connectors, sensors, passives – is necessary and critical for growth of the SHaaS market.

Drivers of the Connected Home Market

Connected consumers

The connected consumer is a major driver for the connected home industry. Seventy-eight percent of U.S. consumers own mobile devices, and they realize the value of controlling home functions – such as heating and cooling systems – from anywhere they happen to be. Being able to adjust a home's temperature from the office or check whether a door is locked is a capability not possible even 10 years ago.

The inherent GPS tracking capabilities in mobile devices create new application options through geo-tracking, such as the ability to unlock a door and turn on the lights as a homeowner enters his or her driveway. Other capabilities are enabled by interfaces to personal wearables, such as fitness and health monitoring devices[4] that can signal a home automation system to dim lights when it senses the user is asleep, or open blinds when the user is waking.

These health-monitoring options are also creating new market spaces, such as age-in-place applications that enable real-time monitoring of the elderly and the devices in their homes – a better alternative to moving them to more costly assisted living facilities[5].

The growth of such markets and the development applications will require the hardware necessary for connectivity.

Wireless and radio protocols

Another technology driver of the connected home market is the coalescence of wireless and radio protocols. The smorgasbord of open and closed protocols and communication standards is typical in a nascent industry. ZigBee, ZWave, KNX, Thread/6LowPAN, Bluetooth LE, and Wi-Fi all are in play in this market, with some manufacturers staking their claims on one protocol, as others hedge their bets and implement two or more in their products.

Each protocol has its strengths, and although they are all different, their combined penetration in the market space is valuable since each illustrates what is possible within a home automation implementation. However, it is likely that only one or two protocols will prevail. Fortunately, the hardware required for connectivity is the same regardless of what communication chip or protocol is implemented.

TE'S Role in the Connected Home Marketplace

TE has strong relationships with the major home automation device OEMs in the connected and home and building markets, including the top 10 home automation suppliers as reported by BCC Research. Connectivity is critical to the efficient manufacturing, assembly, and installation of these devices and TE's products are designed into OEM products that are driving home automation innovation. TE's additional focus on second-tier OEMs and third-tier startups through direct sales relationships and through its distribution partners positions

TE connectivity

the company as a major component supplier for this rapidly evolving market.

TE's customer relationships extend across many home automation categories such as hubs, occupancy sensors, appliances, HVAC equipment, and thermostats. TE's interconnect and switching technologies play a critical role in development of home automation systems: For example, TE enables routing power and signals internally and sometimes externally using electrical interconnects, and routing power and signal in these devices via switching components (for example, a power relay is needed in every wireless or wire-controlled Connected AC wall outlet).

TE customers' devices are found in all major sub-systems in the automated home, including:
- Lighting equipment and controls
- Safety equipment and controls
- Security equipment and controls
- Entertainment
- Portable consumer electronics
- HVAC equipment and controls
- Energy management equipment and controls
- White goods
- Portable appliances

Selecting the right connector, switch, relay, or sensor for the device and its application is key to ensuring a long and trouble-free product life. For example, misapplication of products can be a major headache for OEMs, causing product failures that can take years to rectify. TE's global team of product and development engineers, application and sales engineers, account managers, and technology experts helps its customers make these important decisions early in the product development process, where optimization of a design is most important.

Limitations to Connected Home Adoption

The major elements are in place to drive growth in the connected home market, including:
- Established communication protocols
- Hardware that supports these protocols
- Hardware that interfaces with all main home automation systems (HVAC, Security, Safety, Entertainment, Lighting)
- Cloud-based access for mobile devices
- Cloud-based inter-protocol translation
- Improving and more reasonable price points

However, a number of roadblocks currently limit widespread adoption and are worth mentioning:

Data security
Data security is an issue for home automation and across all Internet of Things (IoT) connected devices. Whenever a new system or product is released, it becomes a new target for cyberattackers[6]. It is unlikely that an ironclad solution to attacks on connected home systems will be developed in the near future. However, today's connected consumer is accustomed to these risks and accepts them in exchange for the benefits offered by connectivity[7].

Standardization
The lack of cohesiveness and standardization across a broad group of competitors may also limit the adoption of home automation technology. Consumers have expressed concerns about committing to a specific system that is not interoperable with other devices – they do not want to commit to a product, only to discover that they cannot integrate it with other systems. These differences in protocol and communication limit economies of scale but are characteristic of any new technology revolution.

Fortunately, hardware remains the same across protocols – so the hardware currently in development by companies such as TE will help drive adoption of home automation, no matter which protocols become standard.

Consumer awareness
Though many devices for home automation are on store shelves today or available for online purchase, many consumers are confused about the value proposition. For example, a consumer who is in the market for a new refrigerator will need a knowledgeable retail sales associate and comprehensive content on the Internet to explain the benefits and value of a connected home appliance. Without front-line education during the sales cycle, a consumer could opt out, and the connected home capabilities and value would go unrealized.

The connected home market is still in the early adopter phase, and many startup companies are jockeying for position and for consumer attention. Manufacturers such as TE can help accelerate development of new and attractive home automation products by partnering in product design.

TE connectivity

TE products support home automation product development
Home automation advancements are transforming TE customers' products, and will continue to do so. Consider what thermostats looked like 30 years ago: They were mostly thermo-electro-mechanical devices that used a bimetallic element to switch heat or cooling on and off.

Fast forward to today: The inside of a modern thermostat is starting to look like the inside of a cell phone with new technology including TE's connectivity and sensor products – for example, connected thermostats often incorporate multiple printed circuit boards loaded with electronic components, passive devices, sensors, fine pitch connectors, and micro-sized wire to board connectors for tiny battery back-up packs. Switching and controlling HVAC equipment is critical, so low-profile relays are often incorporated. For user interfacing, mini tactile switches are often used for selector or reset buttons.

Another example: The ubiquitous power receptacle found on every home's walls. This technology, which spent nearly 100 years largely unchanged, is now being replaced with a connected outlet containing power relays, antennas, control circuitry and, of course, a reset button.

1. **IR Occupancy Sensor**
2. **SMT Tactile Switches**
3. **0.8mm FPC Header**
4. **EMI Shielding**
5. **IM Relays**
6. **Humidity Sensor**
7. **DIP Switch**
8. **RTD Temp Sensor**
9. **Passives** (capacitors, PTC's resistors, inductors)
10. **Dual-Band Antenna**
11. **1mm BtoB Stacking Connector**

Figure 1: Connected thermostat with TE components.

Micro-sized connectors and switches
Through TE's vast product offering, the company is able to provide micro-sized connectors and switches for the smallest sensor assemblies. Micro-sizing matters: Consumers want their home automation devices to be as small and unobtrusive as possible. This means the internal components of these devices need to be proportionally small, which is further complicated by additional functionality packaged into these devices. For example, occupancy sensors may also contain ambient light level sensors, a microphone, or other sensing/monitoring elements.

High-current capability
TE also provides high-current connectors, switches, and switching relays into HVAC equipment and appliances,

enabling their connectivity and control in the automated home. Connected, electronic devices are inherently low voltage or low power, and they need to have relays to switch the higher voltage/higher power loads typical in the home. These loads can be anything from a coffee maker or toaster plugged into a connected wall outlet, to a boiler controller wired to a connected thermostat.

Breadth of choice for product designers
TE's product portfolio is comprehensive – allowing designers to find exactly what they need for their unique ideas and products. At some point in almost every electronic design, connectors and sensors are needed to provide and route power and/or signals into or out of a circuit.

TE connectivity

Below is a high-level itemization of some of the TE Connectivity product families that find common use among all the sub-systems listed above.

- Terminal blocks
- Rapid termination connectors
- Point termination contacts (FASTON, PIDG, etc.)
- Small format relays
- Power relays
- Data I/O connectors
- Fine pitch connectors
- Passive printed circuit board components
- Switches
- Spring contacts
- Integration/value-add capabilities
- High-performance labels
- Sensors

Custom solutions

TE engineers can work with customers to develop a semi-custom or custom design that meets their requirements. The process is initiated by working with one of TE's sales or field application engineers.

TE engineers use the latest metal and polymer materials to develop a perfect-fit product for custom applications. Engineers' ability to pull from a wide range of manufacturing technologies such as high-speed progressive stamping, injection molding, a variety of plating technologies, and automated assembly helps ensure long-term production volumes with a design optimized for manufacturing and the end customer's application.

Wireless innovations

Remote and wireless communication as well as control and monitoring will be an integral part of connected home ecosystems. These connected capabilities drive value by saving time and money for consumers, and will be key to driving demand and mainstream consumer adoption.

TE is changing the way appliances are wired to enable a more connected appliance that offers the consumer and OEM many benefits. For example, TE's appliances team developed a product called ADNEXHA that eliminates the complex point-to-point wire harness assembly common in modern appliances. It does so by electronically bussing controls and power to all the devices in an appliance.

The result is connectivity that informs. Imagine consumers receiving a text message from their washing machine that the wash cycle is completed, or that the wash detergent

they use is just about gone. The ADNEXHA system makes it possible to communicate detailed information about an appliance back to the main appliance controller – if it is connected to a home's WiFi system, it can deliver status messages back to the homeowner's mobile device.

The Power of TE

TE is uniquely positioned to help customers succeed in the connected home market. From material components such as relays and connectors, to smart components such as sensors and connectivity components such as antennas, TE offers all of the internal elements that make end products smart and connected.

Intelligent Buildings: The TE Opportunity

The commercial building automation space is different from home automation in many aspects. Its growth is tied heavily to commercial building construction trends, which in this decade have been relatively slow, and tempered by the reduction in the commercial building construction pace in China. The resulting building automation space therefore sees Compound Annual Growth Rates (CAGRs) in some regions in the area of 8.5 percent, and in other regions less than 5 percent with global growth averaging around 5.5 percent[8]. The growth expectations for this particular market are far less than what is projected for home automation.

Building automation for commercial buildings started with early pneumatic controls, and has developed into a mature market. Developers of these systems have moved beyond the formerly heavily segregated, separate systems controlling HVAC, security/access, lighting control, building safety, and physical plant control. Today, through integrated system controllers, these separate systems can now talk to one another using a common language made possible by modern serial bus communications such as BACNET and KNX.

Standardization drives progress in commercial market

Cloud capabilities have brought this market a level of management and control not seen in the past, and have made possible complex heuristics that make the modern building much more intelligent than its predecessors. In today's commercial building systems, many of the bugs and issues now manifesting themselves in home automation have long since been ironed out through the standardization present in BACNET and KNX protocols. The cloud simplifies multi-building management, and serves as a data aggregator for building managers responsible for multiple buildings without the need for a large IT staff to manage a dedicated system.

While both these systems initially emerged as hard-wired, they have been extended into wireless realms to provide connectivity in less accessible conditions. A vast majority of the commercial building systems remain wired though due to the simplicity of installing, maintaining, and troubleshooting such systems.

Another factor in the steady reliability of commercial systems is that they are all professionally installed and designed in close communication among the building architect, general contractor, electrical contractor, and low voltage controls contractor. In some instances, even the building owner is involved in the decision process, since a building owner with multiple plants under its control almost always selects the same system. In this way, facility maintenance personnel have a common system to maintain, control, and troubleshoot if needed, creating a strong brand alliance in the commercial controls space.

High demand for sensors
The need for sensors is even more important in the commercial building space. Building managers need to know what is going on their buildings, including who is accessing the buildings and at what time, how much energy is being used, where the energy is used, what areas of the buildings are occupied, the temperature and how uniform environmental conditions are, and how efficiently the physical plant is being run (e.g., is a bearing going bad or a filter plugged).

In addition to the sensors, there are far more actuators in a commercial building. A centralized control system may take readings from multiple airflow sensors in a building, and dynamically adjust airflow dampers to ensure equalized airflow and comfort throughout the building. From a safety standpoint, if a smoke or flame detector indicates a fire in one part of a building, the system may completely close the air dampers on the area where the fire is detected to starve the fire of oxygen, while at the same time activating the building fire suppression system through remote actuated valves.

TE's Role in the Connected Building Market
The connected buildings industry is made up of global players such as Johnson Controls, Honeywell, Siemens, Schneider, and United Technologies. Since systems tend to be heavily wired, TE claims a market advantage because of its wide range of connector products – particularly in the terminal block arena, since this is the I/O termination method used throughout the world.

Wireless devices offer opportunities for TE products as well. All such devices have at least one switch used to reset and configure the devices, with many using multiple DIP style switches to hard-program various characteristics into the different devices.

TE's heavy focus on the physical plant and equipment manufacturing means the company offers multiple connectors and sensors within the boilers, air handlers, and AC systems in commercial buildings. TE's connectors, relays, switches, and sensors are found in the main control units, satellite controllers, various sensor devices, and the actuators offered by commercial building device OEMs.

The future will see buildings more heavily instrumented than ever before, with an increasing focus on environmental quality (including air, comfort, light) to maximize the efficiency and comfort of building inhabitants. Energy efficiency will continue to be a major market driver, as will the trend toward Zero Net Energy (ZNE) buildings. ZNE requires that a building be designed from the ground up to minimize energy use and maximize the use of renewable energy from sun, wind and other geo-sources. The features vary based on the climate zone in which the building is located, but could include placing adjustable awnings on the south side of the building to shade windows to minimize cooling loads during the summer; or more skylights and light tubes to use more natural light sources and minimize electrical use for lighting.

Similar to what is seen in home automation devices, there will be significant miniaturization and intelligence in commercial building devices. TE's years of experience and product breadth interconnecting small, consumer devices positions the company well to address this trend.

LEARN MORE ABOUT TE'S SOLUTIONS FOR THE CONNECTED HOME.

www.te.com/connectedhome

TE connectivity

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HOME APPLIANCES & DEVICES

THE CONNECTED HOME - INNOVATIVE SOLUTIONS

Browse Products: http://www.te.com/usa-en/solutions/home-appliances-and-devices.html

THE CONNECTED HOME
INNOVATIVE SOLUTIONS

OUR SOLUTIONS ENABLE YOU TO DESIGN THE HOME OF TOMORROW.

With our global network of engineers, TE Connectivity (TE) can help turn your vision for connected home applications into a reality. With a broad range of connectivity and sensor solutions for home appliances and devices, lighting, HVAC, security, and more, TE is the ideal partner to help you bring your products to market fast.

1 ENVIRONMENT SENSING

2 EQUIPMENT
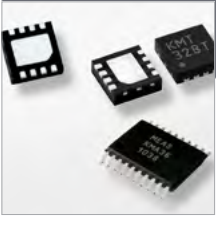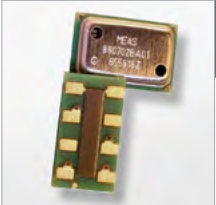
3 ACTUATORS

4 CONTROLS

FEATURED PRODUCTS

1.5mm Mini CT Connectors ② ③ ④
Product Details
Quick Reference Guide

Economy Power (EP) 2.5mm Connectors ① ② ③ ④
Product Details
Quick Reference Guide

IM Relays ② ④
Product Details
Datasheet
Definitions

P2 Relays ② ④
Product Details
Definitions

Eurostyle Terminal Blocks ② ③ ④
Product Details

Free Height Connectors, 0.5mm Pitch ② ④
Product Details
Catalog
Product Specification

T9A 30A Power PCB Relay ② ③
Product Details
Data Sheet

FSM / FSMMST Series Tactile Switches ① ② ③ ④
Product Details
Catalog

High Performance Interconnect (HPI) Connectors ① ② ③ ④
Product Details
Quick Reference Guide

Modular Screwless Terminal Blocks, 2.5/2.54/3.5/3.81mm Pitch, 1 Pc. PCB ① ② ③ ④
Product Details
Catalog
Quick Reference Guide

GDH Series DIP Switch ① ② ③ ④
Product Details
Catalog

S/SE Series Slide Switches ② ③ ④
Product Details
Catalog

Modular Screwless Terminal Blocks, 5.0mm Pitch, 1 Pc. PCB ① ② ③ ④
Product Details
Catalog
Quick Reference Guide

Power Triple Lock Connectors ② ③ ④
Product Details
Video
Quick Reference Guide

HTU21x Series Sensors ① ② ④
Product Details

Leadless Chip, 44000 Series, DO-35 Packaged Probe Sensors ① ② ④
Product Details

RAST 5 PCB Connectors ① ② ③ ④
Product Details
Flyer
Catalog

RJ45 Connectors ① ② ④
Product Details
Catalog

M-100 Minisense Vibration Sensors ① ③
Product Details

M5200, U5300, US300, MSP300 Sensors ① ②
Product Details

Signal Double Lock Connectors ① ② ③ ④
Product Details
Quick Reference Guide

Spring Fingers ① ② ③ ④
Product Details
Quick Reference Guide
White Paper

MS32, KMT32, KMA36 Linear and Rotary Sensors ① ③ ④
Product Details

MS45x5, MS5525DSO, MS5637, MS5611, MS5803 Sensors ① ② ④
Product Details

Surface Mount (SMT) Antennas ① ② ③ ④
Product Details
Quick Reference Guide
Catalog

Tab Mount (Through Hole) Antennas ① ② ③ ④
Product Details
Data Sheet
Catalog

MS8607 Sensors ① ② ④
Product Details

TSYS01, TSYS02 Sensors ① ② ④
Product Details

INTERCONNECT

PRODUCT CATEGORY		Env. Sensing	Equipment	Actuators	Controls	Max Current Rating (A)	Max Voltage Rating (V)	Operating Temperature Range (°C)	Pitch (mm)	# of Positions	PCB Mounting Style	Mated Height (mm)	Wire Gauge	Contact Interface Plating Options	Wire-to-Wire	Wire-to-Board	Board-to-Board
COMPRESSIVE CONTACTS		①	②	③	④												
Spring Fingers	Spring Fingers	•	•	•	•	4	50 V	-40 to +85	N/A	N/A	SMT	1.0 - 4.3	N/A	Gold			•
Board-to-Board (1 pc)	Compressive Contacts	•	•	•	•	0.5	30 VAC	-55 to +85	0.7-2.0	N/A	SMT	0.7 - 3.15	N/A	Tin / Gold			•
SIGNAL CONNECTORS																	
Board-to-Board Connectors (2 pc)	Free Height Connectors, 0.5mm Pitch		•		•	0.5	50 VAC	-30 to +105	0.5	220 - 440	SMT	1.5 - 6	N/A	Gold			•
	Free Height Connectors, 0.8mm Pitch		•		•	0.5	100 VAC	-40 to +105	0.8	40 - 200	SMT	5 - 20	N/A	Gold			•
	AMPMODU Connectors, 1.27mm Pitch				•	1	133 V	-65 to +105	1.27	10 - 100	SMT / TH	N/A	N/A	Tin / Gold		•	•
	AMPMODU Connectors, 2.0mm Pitch				•	2	150 V	-55 to +105	2.0	1 - 100	SMT / TH	N/A	26 - 30	Tin / Gold		•	•
	AMPMODU Connectors, 2.54mm Pitch				•	3	250 V	-55 to +105	2.54	1 - 80	SMT / TH	N/A	20 - 32 AWG	Tin / Gold	•	•	•
Flexible Printed Circuit (FPC)	FPC Connectors, 0.25mm Pitch	•	•	•	•	0.2	50 VAC	-25 to +85	0.25	37 - 51	SMT	1.3	N/A	Gold		•	
	FPC Connectors, 0.30mm Pitch	•	•	•	•	0.2	50 VAC	-25 to +85	0.3	25 - 71	SMT	0.9 - 1.3	N/A	Gold		•	
	FPC Connectors, 0.50mm Pitch		•	•	•	0.5	50 VAC	varies	0.5	4 - 60	SMT / TH	0.9 - 4	N/A	Tin / Gold		•	
	FPC Connectors, 1.0mm Pitch		•	•	•	0.5	50 VAC	varies	1	3 - 30	SMT / TH	0.9 - 4	N/A	Tin / Gold		•	
	FPC Connectors, 1.25mm Pitch		•	•	•	0.5	50 VAC	varies	1.25	4 - 40	TH	0.9 - 4	N/A	Tin / Gold		•	
Flat Flexible Cable (FFC)	FFC Contacts, 1.27 and 2.54mm Pitch		•	•	•	0.5	50 VAC	varies	1.27 & 2.54	2 - 70	N/A	0.9 - 4	N/A	Tin / Gold	•	•	
Ribbon Cable Connectors	AMP-LATCH Ribbon Cable Connectors		•	•	•	1	50 VAC	-55 to +105	2.54	6 - 64	SMT / TH	varies	26 - 32	Tin / Gold		•	
	Micro SLP Connector, 0.8mm Pitch		•	•	•	1	30 VAC	-25 to +85	0.8	2	SMT	1.4	32	Tin / Gold		•	
Wire-to-Board Connectors	1.2mm Wire-to-Board Connectors	•				2	50 V	-25 to +85	1.2	2 - 6	SMT	1.4	28 - 30	Gold		•	
	1.5mm Mini CT Connectors		•	•	•	1 - 3	50 VAC	-30 to +105	1.5	2 - 40	SMT / TH	varies	24 - 28	Tin / Gold	•	•	
	2.0mm CT Connectors		•	•	•	1 - 4	125 VAC	-40 to +105	2.0	2 - 30	SMT / TH	varies	22 - 30	Tin / Gold	•	•	
	High Performance Interconnect (HPI) Connectors	•	•	•	•	1 - 3	50 - 250 VAC	-40 to +105	1.00 - 2.50	2 - 40	SMT / TH	varies	22 - 32	Tin / Gold		•	
	Economy Power (EP) 2.5mm Connectors	•	•	•	•	4	250 VAC	-55 to +105	2.5	2 - 40	TH	varies	20 - 26	Tin	•	•	
	Signal Double Lock Connectors	•	•	•	•	3	50 VAC/VDC	-30 to +105	2.5	2 - 13	TH	varies	20 - 26	Tin	•	•	
	MTA-100 CL (IDC) and CST II (crimp) Connectors	•	•	•	•	5	250 VAC	-55 to +105	2.54	2 - 28	SMT / TH	varies	20 - 26	Tin / Gold	•	•	
MEMORY																	
Micro Secure Digital (SD)	Micro Secure Digital (SD) Memory Card Connectors	•			•	0.5	30 VAC	-25 to +85	1.1	12	SMT / TH	1.95	N/A	Gold			•
SIM Card Connectors	SIM Connectors, 1.5mm Height				•	1	30 VAC/VDC	-30 to +85	2.5	8	SMT / TH	0.3 - 2.6	N/A	Gold			•
INPUT/OUTPUT																	
USB Connectors	Type A Receptacle	•	•		•	N/A	30 VAC	-55 to +85	multiple	4,8,9,12,16	SMT / TH	N/A	N/A	Gold			
	Type B Receptacle	•	•		•	N/A	30 VAC	-55 to +85	multiple	4	SMT / TH	N/A	N/A	Gold			
	Type C Receptacle	•	•	•	•	5	20 V	-30 to +85	0.5	14, 24	SMT	varies	N/A	Gold	•		
	Mini USB Connectors	•	•		•	1.8	N/A	-65 to +85	0.65	5	SMT	N/A	N/A	Gold		•	
	Micro USB Connectors	•	•		•	1.8	N/A	-65 to +85	multiple	5	SMT	varies	N/A	Gold			
RF Connectors	RF BNC Connectors	•	•		•	N/A	1500 VAC	-65 to +85	single	1	TH	varies	varies	Gold	•	•	
	RF SMA Connectors	•	•		•	N/A	1500 VAC	-65 to +165	single	1	TH	varies	varies	Gold	•	•	
Modular Jack	RJ45 (8 pos/8 contacts)	•	•		•	Signal App Only	150 VAC	-40 to +85	2.54	N/A	N/A	varies	N/A	Gold	•		
BATTERY																	
Battery Connectors	5A Low Profile Battery Connectors		•		•	5	30 VDC	-40 to +85	2.5	4	SMT	N/A	N/A	Gold			•
Coin Cell Holder	CR2032 Coin Cell Battery Holder	•	•	•	•	1	30-250 VAC	-55 to +105	N/A	N/A	N/A	N/A	N/A	Tin			•
TERMINAL BLOCKS																	
Eurostyle Terminal Blocks	5.0 / 5.08mm Pitch, 2 Piece Wire-to-Board		•	•	•	15	250-300	-40 to +110	5 / 5.08	2 - 24	STH	varies	varies	Tin	•	•	•
	3.5 / 3.81mm Pitch, 2 Piece Wire-to-Board		•	•	•	11	250-300	-40 to +110	3.5 / 3.81	2 - 24	STH	varies	varies	Tin		•	
	5.0 / 5.08mm Pitch, 1 Piece PCB				•	15	250-300	-40 to +110	5 / 5.08	2 - 24	STH	varies	varies	Tin		•	
	2.54 / 3.5 / 3.81mm Pitch, 1 Piece PCB		•	•	•	10-12	150	-40 to +110	2.54 / 3.5 / 3.81	2 - 24	STH	varies	varies	Tin		•	
Modular Screwless Terminal Blocks	2.5 / 2.54 / 3.5 / 3.81mm Pitch, 1 Piece PCB	•	•	•	•	6	300 VAC	-40 to +105	2.5 / 2.54 / 3.5 / 3.81	2 - 8	TH	N/A	14 - 26	Tin		•	
	5.0mm Pitch, 1 Piece PCB	•	•	•	•	8	300 VAC	-40 to +105	5.0	2 - 8	TH	N/A	16 - 20	Tin		•	
Barrier Blocks	Dual-Barrier Strips 0.250" / 0.325" / 0.375" Pitch		•			10-20	150 / 300 / 600	-40 to +105	0.250"/ 0.325"/ 0.375"/ 0.4375"	2 - 30	TH	N/A	varies	Tin			
	Tri-Barrier Strips 0.250" / 0.325" / 0.375" Pitch		•	•		10-30	300/600	-40 to +105	0.250"/ 0.325"/ 0.375"/ 0.4375"	2 - 30	TH	N/A	varies	Tin			
POWER CONNECTORS																	
RAST-Compliant Wire-to-Board	2.5mm Connectors	•	•	•	•	2/6	50V/250 VAC	-40 to +110	2.5	3 - 15	TH	varies	22 - 12	Tin / Silver	•	•	
	5mm Connectors	•	•	•	•	10/16	250 VAC	-40 to +130	5	2 - 8	TH	varies	24 - 18	Tin / Silver	•	•	
Power 2 Piece Wire-to-Wire / Wire-to-Board	Universal MATE-N-LOK Connectors		•	•	•	19	600 VAC	-55 to +125	6.35	1 - 15	TH	varies	30 - 10	Tin / Gold	•	•	
	Micro MATE-N-LOK Connectors	•	•	•	•	5	250 VAC	-40 to +105	3.0	2 - 24	TH / SMT	varies	30 - 18	Tin / Gold	•	•	
	Mini Universal MATE-N-LOK Connectors		•	•	•	9.5	600 VAC	-55 to +105	4.14	2 - 15	TH	varies	30 - 16	Tin / Gold	•	•	
	Power Double Lock Connectors		•	•	•	14	50 (3.96WTB) - 300 VAC	-30 to +105	3.96, 6.2, 7.95	1 - 12	TH	varies	26 - 18	Tin	•	•	
	Economy Power (EP) II Connectors		•		•	10	600 VAC	-55 to +105	3.96	2 - 12	TH	varies	22 - 18	Tin		•	
	VAL-U-LOK Connectors		•	•	•	9	600 VAC	-40 to +105	4.2	2 - 24	TH	varies	26 - 16	Tin	•	•	
	Universal Power Connectors		•	•	•	14	300 VAC	-30 to +105	3.96, 6.2, 7.95	1 - 18	TH	varies	26 - 16	Tin	•	•	
	Power Triple Lock Connectors		•	•	•	20	600 VAC/VDC	-55 to +105 / -55 to +150	6.0	2 - 15	TH	varies	22 - 12	Tin	•	•	
Terminals & Splices	FASTON Terminals Connectors	•	•	•	•	48	600A	-40 to +250	N/A	N/A	TH	N/A	26 - 8	Tin / Nickel		•	
	Positive Lock Receptacles	•	•	•	•	48	600A	-40 to +105	N/A	N/A	N/A	N/A	24 - 10	Tin		•	
	FASTIN FASTON Receptacles	•	•	•	•	48	600A	-40 to +105	N/A	1 - 8	N/A	N/A	24 - 10	Tin	•	•	
	Ultra-Fast Receptacles	•	•	•	•	48	600A	-40 to +105	N/A	N/A	N/A	N/A	26 - 10	Tin	•	•	
	Open Barrel Rings / Spades	•	•	•	•	N/A	N/A	-40 to +250	N/A	N/A	N/A	N/A	26 - 6	Tin / Nickel		•	
Magnet Wire Terminations	MAG-MATE Terminals		•	•		varies	varies	-65 to +150	N/A	N/A	N/A	N/A	52 - 12	Tin	•	•	
	AMPLIVAR Splices		•	•		varies	varies	-65 to +150	N/A	N/A	N/A	N/A	24 - 6.5	Tin / Gold	•	•	
	Cluster Block Terminals		•			varies	varies	-65 to +150	N/A	N/A	N/A	N/A	18 - 12	N/A	•		
	Cluster Block Housing		•			varies	varies	-65 to +150	N/A	N/A	N/A	N/A	18 - 12	Tin		•	
	Siameze Terminals		•	•		varies	varies	-65 to +150	N/A	N/A	N/A	N/A	36 - 12	Tin / Silver	•	•	

APPLICATIONS

ANTENNAS

PRODUCT CATEGORY		Env. Sensing (1)	Equipment (2)	Actuators (3)	Controls (4)	Application	Frequency Band	Connection Type	Mounting Style	Bands	Antenna Type	Packaging
Antennas	Surface Mount (SMT) Antennas	•	•	•	•	Bluetooth | WLAN | ZigBee | Wi-Fi | LTE | ISM | GSM | CDMA 850 | GSM 900 | GSM 1800 | CDMA 1900 | UMTS | IoT	169 | 700 | 868 | 800 | 850 | 900 | 914 | 1575 | 1800 | 1900 | 2100 | 2300 | 2400 | 2700 | 5000 | 2,4GHz | 5GHz	SMT	SMT	Single | Dual | Triple | Quad | Penta | Allband	Stamped | PCB | FPC | Chip | Enclosure	Tape & Reel
	Tab Mount (Through Hole) Antennas	•	•	•	•	Bluetooth | WLAN | ZigBee | Wi-Fi | LTE | ISM | GSM | CDMA 850 | GSM 900 | GSM 1800 | CDMA 1900 | UMTS | IoT	169 | 700 | 868 | 800 | 850 | 900 | 914 | 1575 | 1800 | 1900 | 2100 | 2300 | 2400 | 2700 | 5000 | 2,4GHz | 5GHz	Tab	Tab	Single | Dual | Triple | Quad | Penta | Allband	PCB	Bulk | Tray
	Cabled Antennas	•	•	•	•	Bluetooth | WLAN | ZigBee | Wi-Fi | LTE | ISM | GSM | CDMA 850 | GSM 900 | GSM 1800 | CDMA 1900 | UMTS | IoT	169 | 700 | 868 | 800 | 850 | 900 | 914 | 1575 | 1800 | 1900 | 2100 | 2300 | 2400 | 2700 | 5000 | 2,4GHz | 5GHz	IPEX | MCIS | u.fl | MHF | MHF4 | MHF4L | SMA | SMA-RP	Panel | Chassis | Adhesive | Clip	Single | Dual | Triple | Quad | Penta | Allband	Stamped | PCB | FPC | Enclosure	Bulk | Tray
	External Antennas	•		•	•	Bluetooth | WLAN | ZigBee | Wi-Fi | IoT	2400 | 5000 | 2,4GHz | 5GHz	IPEX | MCIS | u.fl | MHF | MHF4 | MHF4L | SMA | SMA-RP	Chassis | Panel | SMA | SMA-RP	Single | Dual	Enclosure	Bulk

RELAYS

PRODUCT CATEGORY		Env. Sensing (1)	Equipment (2)	Actuators (3)	Controls (4)	Contact Form	Number of Poles	Current Capability	Terminal Type	Coil Voltage	Coil Options	Size	Switching Power Rating	Endurance (cycles)
Low Power PCB	Power PCB Relay RT1 Inrush Power	•	•	•	•	A	1	16A	THT	5 - 110 VDC	Mono / Bistable 1 or 2 coils	29.1 x 12.7 x 15.7 / 16mm + special	4000VA	100K
	Power PCB Relay RT1 Inrush	•	•			A, C	1	16A	THT	5 - 60 VDC	Mono / Bistable 1 or 2 coils	29 x 12.7 x 15.7mm	4000VA	Form A 50K
	RZ AgSnO Power PCB Relay	•	•			A, C	1	16A	THT	3 - 48 VDC	Monostable	29 x 12.7 x 15.7mm	4000VA	Form A 30K
	RT1 Power PCB Relay		•	•	•	A, C	1	12/16A	THT / THR (DC&AC)	5 - 100 VDC / 24 - 230 VAC	Mono / Bistable 1 or 2 coils	29 x 12.7 x 15.7mm	3000 / 4000VA	Form A 30K
	PE Power PCB Relay	•	•	•	•	A, C	1	5A	THT	2.2 - 48 VDC	Mono / Bistable 1 coil	20 x 10 x 10	1250 VA	100K
	RYII Power PCB Relay	•	•		•	A, B, C	1	8A	THT / THR	5 - 60 VDC	230mW Monostable	28.5 x 10.1 x 12.3	2000 VA	Form A 100K
	PCJ Miniature PCB Relay	•	•		•	A	1	3A/5A (WG)	THT	5 - 24 VDC	200mW	20 x 4.7 x 15mm	750AV / 1250 VA (WG)	100K
	SNR Miniature PCB Relay	•	•		•	A, C	1	6A	THT	5 - 48 VDC	170mW Monostable	28 x 5 x 15mm	1500 VA	Form AC 5K
	RE Power PCB Relay	•	•		•	A	1	6A	THT	5 - 48 VDC	2000mW Monostable	20 x 10 x 10.6mm	1500 VA	100K
	RTX Power PCB Relay	•	•	•	•	A	1	16A	THT	5 - 48 VDC	Bistable 1 or 2 coils	29.1x12.7x16mm	4000 VA	30K
	SSR Relay		•			A, 2A, 4A	1, 2, 4	125A Max.	Screw / THT / Socket	N/A	N/A	varies	125A / 660 VAC Max.	1,000K
	OJ Miniature PCB Relay	•	•	•	•	A	1	3, 5, 8, 10A	THT	3 - 48 VDC	450mW, 200mW Mono	18.2 x 10.2 x 14.7mm	720 - 2500 VA/ 90 - 240 W	100K
	OJE Miniature PCB Relay	•	•	•	•	A	1	3, 5, 8, 10A	THT	3 - 48 VDC	450mW, 200mW Mono	18.2 x 10.2 x 14.7mm	720 - 2500 VA/ 90 - 240 W	100K
	OMIH 16 Amp Mini PCB Relay	•	•		•	A, C	1	10A/16A	THT	5 - 48 VDC	540mW (sensitive), 720mW	29.2 x 12.8 x 20.6mm	2500 VA/300W 4000VA/480W	100K
	RF-FASTON Power PCB Relay	•	•	•	•	A, B	1	16A	THT/QC^2	5 - 60 VDC	400mW	40.5 x 12.7 x 16mm	4000 VA	100-250K (load dependant)
High Power PCB	Power Latching Relay EW80		•	•		A	1	80A	THT/LUG	5 - 24 VDC	Bistable, 1W	36.8 x 17.2 x 30.4mm	20000 VA	25K
	Miniature Relay PCF		•		•	A	1	25A	THT/QC^2 (#250)	6 - 24 VDC	900mW, 1W	30.4 x 16 x 26.5mm	6370 VA	100K
	T9A 30A Power PCB Relay		•	•		A, B, C	1	30A	THT/QC^2	5 - 110 VDC	900mW, 1W	32.5 x 27.4 x 20.4mm (THT)	7500 VA	100K
Signal Relay	P2 Relay		•		•	C	2	2A	THT, SMT	2.4 - 24 VDC	70 - 200mW	14.5 x 72 x 10.4mm, stand. 14.5 x 72 x 9.9mm, overm.	60W / 62.5 VA	Mechanical 10_6 operations
	IM Relay		•		•	C	2	2/5A	THT, SMT	1.5 - 24 VDC	50 - 200mW	10 x 6 x 5.65mm	60W / 62.5 VA	Mechanical 10_6 operations

SWITCHES

PRODUCT CATEGORY	Env. Sensing (1)	Equipment (2)	Actuators (3)	Controls (4)	Number of Positions	Terminal Style	Actuation Force (gf)	Voltage (DC)	Actuator Length	Current Rating (A)	Packaging	Size	Sealed
APPLICATIONS													
Tactile Switch — FSM / FSMMST Series Tactile Switch	•	•	•	•	1	THT | SMT	100 | 160 | 260	24	3.4 - 18.6mm	0.05	Tube | Tape & Reel	6x6mm	Yes | No
DIP Switch — GDH Series DIP Switch	•	•	•	•	2 - 10	SMT	600	50	Flush	0.1	Tube | Tape & Reel	2.54mm spacing	Yes
DIP Switch — ADE Series DIP Switch	•	•	•	•	2 - 12	THT | SMT	800	24	1mm	1	Tube | Tape & Reel	2.54mm spacing	Yes
DIP Switch — DIP Shunt	•		•		2 - 12	THT | SMT	N/A	24	Flush	1	Tube | Tape & Reel	2.54mm spacing	No
Slide Switch — S / SE Series Slide Switch		•	•	•	2 - 3	THT	70 - 500	48	2.8mm	0.05	Tray	9.5mm	Yes
Slide Switch — MLL Series Slide Switch	•			•	2 - 3	SMT	175	20	1.5mm	0.3	Tube | Tape & Reel	9.7mm	No

PASSIVES

PRODUCT CATEGORY	Env. Sensing (1)	Equipment (2)	Actuators (3)	Controls (4)	Size	Inductance | Impedence | Resistance	Tolerance	Current Rating | DCR | TCR	Packaging	Power Rating
APPLICATIONS										
High Frequency Inductor — Thin Film - 3640 Inductor	•	•	•	•	0201 - 0402	INDUCTANCE 0.1nH - 33nH	0.1-0.3nH / 1 - 5%	CURRENT RATING 75mA - 800mA	Tape & Reel	--
High Frequency Inductor — Wirewound - 3650 Inductor	•	•	•	•	0402 - 1008	1.0nH - 15,000nH	0.2nH - 0.5nH / 2% - 10%	100mA - 2300mA	Tape & Reel	--
High Frequency Inductor — Multilayer - 3671 Inductor	•	•	•	•	0201 - 0805	1.0nH - 470nH	0.3nH, 5%, 10%	50mA - 1000mA	Tape & Reel	--
Ferrite Chip Beads — Multilayer Ferrite Beads - Type BMB Series	•	•	•	•	0402 - 1206	IMPEDENCE 10Ω - 2700Ω	25%	DCR 0.01 - 1.5Ω	Tape & Reel	--
Power Chip Resistor — Thick Film Resistor - 3520 Series	•	•	•	•	2512	RESISTANCE 1R0 - 1M0	5%	TCR 350PPM, 200PPM	Tape & Reel	1W
Power Chip Resistor — Thick Film Resistor - 3521 Series	•	•	•	•	2512	1R0 - 1M0	1%	100PPM, 200PPM	Tape & Reel	2W
Power Chip Resistor — Thick Film Resistor - 3522 Series	•	•	•	•	2512	10R - 10M	1% 5%	100PPM, 200PPM	Tape & Reel	3W

SENSORS

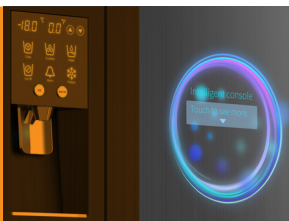| PRODUCT CATEGORY	Env. Sensing (1)	Equipment (2)	Actuators (3)	Controls (4)	Accuracy	Range	Operating Temperature Range	Stability	Time Response	SMD	Pressure Type	Output Type
APPLICATIONS													
TEMPERATURE													
NTC Thermistor — Leadless Chip, 44000 Series, DO-35, Packaged Probe Sensors	•	•		•	±1.0°C	-40 to +250°C	-40 to +250°C	1 to 10 Sec	•	N/A	N/A	R
RTD Temperature Sensor — Wirewound - 3650, Thickfilm - 12552, Packaged Probe Sensors	•	•		•	±0.2°C	-40 to +800°C	-40 to +800°C	1 to 10 Sec	•	N/A	N/A	R
Thermocouple — 202-M Plug & Play, 600 Series Micro, 211 Series Probe Sensors		•		•	±2.0°C	-40 to +1800°C	-40 to +1800°C	1 to 10 Sec		N/A	N/A	V
Non-contact Thermopile — TS105/318 Component, TSEV Series Module Sensors	•	•		•	±3.0°C	-40 to +2000°C	-40 to +2000°C	5 mSec		N/A	N/A	V
Digital Temperature Sensor — TSYS01, TSYS02 Sensors	•	•		•	±1.0°C	-40 to +125°C	-40 to +125°C	1 to 10 Sec	•	N/A	N/A	D
HUMIDITY													
Humidity Component | Module — HS1101LF Sensors	•	•		•	±3%	0 to 100%	-60 to +140°C	10 Sec	•	±0.5% RH/yr	N/A	C
Digital Humidity Sensor — HTU21x Series Sensors	•	•		•	±3%	0 to 100%	-40 to +125°C	10 Sec	•	±0.5% RH/yr	N/A	D
PRESSURE													
Board Level Pressure — MS45x5, MS5525DSO, MS5637, MS5611, MS5803 Sensors	•	•		•	±2%	0.07 to 300psi	-40 to +125°C	1 mSec	•	±1%FS/yr	G, A, D, C, V	R, A, D
Transducer | Transmitter — M5200, U5300, US300, MSP300 Sensors	•	•			±1%	50 to 30,000psi	-40 to +125°C	1 mSec		±1%FS/yr	G, D	R, A, D
Pressure Capsule — Model 82, 85, 86, 89, 154 Sensors		•	•		±1%	1 to 300psi	-40 to +125°C	1 mSec		±1%FS/yr	G, A, S, V	M, R, V, D
POSITION													
Magneto Resistive Sensor — MS32, KMT32, KMA36 Linear and Rotary Sensors	•		•	•	±0.3°C	0 to +360°	-40 to +150°C	1 mSec	•	N/A	N/A	M, V, D
Liquid Level Sensor — LS, VS, OS Series Sensors			•	•	±3%	Binary On | Off	-30 to +130°C	Instant		Infinite	N/A	S
Proximity Switch — PS1, PS2, PS4, PS5 Series Sensors	•				±2%	Binary On | Off	-30 to +130°C	Instant		Infinite	N/A	S
VIBRATION													
Piezoelectric Film — M-100 Minisense Vibration Sensors	•		•		±10%	0 to 40 Hz	-40 to +60°C	100 mSec		±1%/yr	N/A	V
COMBINATION													
Pressure | Temperature | Humidity — MS8607 Sensors	•	•		•	±1%	10 to 2000mBar 0 to 100% RH	-40 to +85°C	1 Sec	•	N/A	A	D
FORCE													
Load Cell — FX1901, FS20, FC22, FC23 Sensors		•			±2%	2.0 to 2000lbf	-40 to +85°C	1 mSec		±1%/yr	N/A	M, A, D
FLOW													
Reed Switch and Magnet — FS, FCS Series Sensors		•			±3%	Binary On | Off	-30 to +130°C	Instant		Infinite	N/A	S

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HOME APPLIANCES & DEVICES

LOW POWER AND SIGNAL APPLICATION GUIDE

LOW POWER
AND SIGNAL
APPLICATION GUIDE

MORE SOLUTIONS

TE Connectivity's (TE) extensive connector and sensor solutions provide the essential connectivity you need for your daily interactions at home and in the workplace. Whether you are looking to design next generation display panels and internal LED lighting or you're designing-in for the latest door alarms and pressure sensors, TE has the essential products you need for always-on connectivity.

User Interface

Lighting

Safety

Sensing & Wi-Fi

THE PRODUCTS YOU NEED FOR
ALWAYS-ON CONNECTIVITY
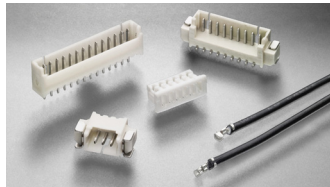
RELIABLE PRODUCTS

Common Termination (CT)
AMP CT connectors have broad industry usage and feature both crimp and IDC style interconnect on 2mm centerline spacing, with many header options.
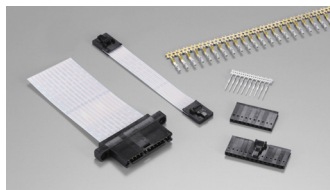
Mini Common Termination (Mini CT)
AMP mini CT connectors include all of the features of AMP CT connectors in a more compact (1.5mm) design.

High Performance Interconnect (HPI)
High performance interconnects (HPI) are standards based square-peg technology in single- and dual-row post headers available in various pitches and colors.

Flexible Printed Circuit (FPC)
Our flexible printed circuit (FPC) products offer a low profile height and light-weight solution that's available in centerline spacing from 0.25mm through 1.25mm.
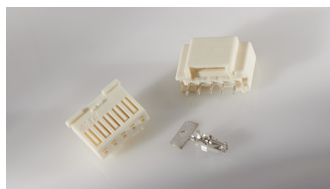
Flat Flex Cable (FFC)
Our broad portfolio of flat flexible cable (FFC) covers almost any combination of requirements for high density cable-to-board, and cable-to-cable connector solutions.

Economy Power 2.5
TE's economy power 2.5 connector system offers a compact and true locking latch feature, which prevents the plug housing and header from vibrating apart. These connectors improve efficiency and are available in multiple materials and color offerings.

Grace Inertia 2.5
The Grace Inertia 2.5 connector offers advanced design in a 2.5mm pitch providing a more reliable connection. This design can also be used in HVAC and consumer products.

Grace Inertia 3.3
The Grace Inertia power connector prevents defective products caused by half mating and helps prevent connectors from being disconnected during movement or transportation. This ergonomic design and lanceless contacts improves safety and efficiently during operation.

Micro MATE-N-LOK
Requiring only 4.7mm of vertical height, low profile micro MATE-N-LOK connectors excel in small appliance and consumer applications. Offering a 3mm centerline, this wire-to-wire and wire-to-board connector system provides positive latching to prevent mis-mating.

Signal Double Lock
TE's power double lock connector system offering a small centerline of 2.5mm is a smooth and compact design, which provides better locking strength and prevents snagging when matted. Our broad portfolio offers a solution for commercial and residential needs

CoolSplice
CoolSplice connectors were designed to connect a pair of discrete wires or a twin cord cable in line to a pair of discrete wires or twin cord cables. The connectors help eliminate the need to pre-strip insulation from wire conductors and provide a visually controlled termination.

SlimSeal
Low profile and single row SlimSeal solid state lighting (SSL) connectors were developed for indoor and outdoor LED lighting applications, and well suited for any application where low power (5A – 300V), sealing, and UV resistant connections are required.
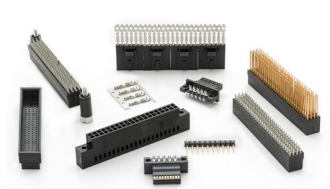
Releasable Poke In Connectors
Surface mount, low profile releasable poke-in connectors were developed to accommodate a variety of design requirements. The surface mount releasable poke-in connectors are ideal for LED lighting applications.

Mini Hermaphroditic Connectors
The low profile, surface mount miniature hermaphroditic board-to-board connectors and the miniature wire-to-board connectors are an ideal fit in tight spaces. The vacuum pick and place design features make it suitable for high volume automated manufacturing.
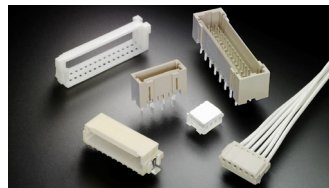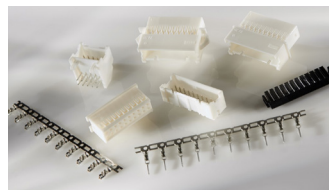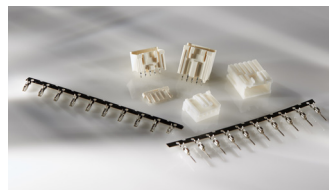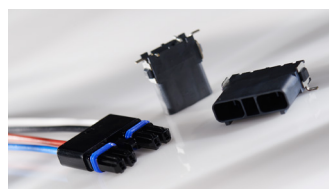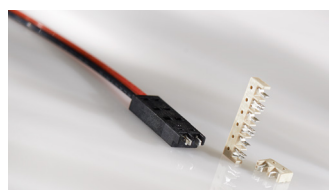
AMPMODU 50/50 Grid
Featuring a .050 x .050 (1,27mm x 1,27mm) pitch AMPMODU 50/50 grid connector family includes a variety of high density board-to-board and wire-to-board connectors. The connectors are well suited for applications subject to severe shock and vibration.

AMPMODU System 50
The AMPMODU system 50 connector family includes a variety of high density board-to-board and wire-to-board connectors. The connectors are well suited for applications subject to severe shock/vibration.
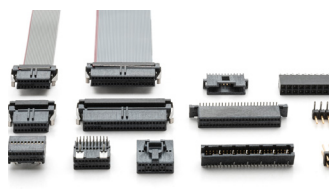
TOUCH & SEE WITH USER INTERFACE

Don't let function override form. Our broad portfolio of reliable and consistent connectivity solutions – for everything from a sensitive touch screen or membrane switch to bold indicators in a harsh environment – allows you to focus on delivering a more intuitive overall design for your critical user interface experience.

APPLICATIONS

- Touch Screens
- Visual Indicators
- Display Panels
- Audio Indicators
- Clocks/Timers
- Ice & Water Controls

Product Family	Centerline	Mating Style	Term. Method	Wire Size (AWG)	Position Size Range	Current Rating	Features	Touch Screens	Display Panels	Clock/ Timer	Visual Indicators	Audio Indicators	Ice & Water Controls
Common Termination (CT)	2.0	WTB	CRIMP & IDC	30-22	2 - 30	Up to 4A	Full portfolio of standard options World class application tooling UL & CSA		●	●	●	●	
Mini Common Termination (Mini CT)	1.5	WTB	CRIMP & IDC	28-24	2 - 40	Up to 3A	Full portfolio of standard options World class application tooling UL & CSA		●	●	●	●	
High Performance Interconnect (HPI)	0.8 - 2.5	WTB	CRIMP	30-24	2 - 30	Up to 3A	Wide range of CL options, Multiple Color Variations Latching Options		●	●	●	●	
Flexible Printed Circuit (FPC)	0.25 - 1.25	FTB	ZIF & NON-ZIF	N/A	2 - 75	0.5A	Slant insertion option	●	●	●	●	●	
Flat Flex Cable (FFC)	0.050" & 0.100"	FTB	CRIMP	N/A	2 - 70	0.5A	Industry best contact design application tooling Many housing & header options	●	●			●	
Economy Power 2.5	2.5mm	WTW WTB	CRIMP	26-22	2-20 single 8-40 double	4.5A	TPA External robust locking latch, Low insertion force and lubricated terminal colors available	●	●				●
Grace Inertia 2.5	2.5mm	WTB	CRIMP	22-28	2, 3, 5, 6, 8	3A	TPA, Four Colors, Lock prevents half mating, & Half mating easily detect design	●	●				●
Grace Inertia 3.3	3.3mm	WTB (TPA)	CRIMP	20-24	4, 6, 8, 10, 12	4A	TPA, Four Colors, Lock prevents half mating, & Half mating easily detect design		●	●	●	●	●
Micro MATE-N-LOK	3mm	WTW WTB	CRIMP	20-30	2-12 single 2-24 double	5A	Low profile design, Dual beam receptacle contact design, PCB mount pin header assemblies	●	●	●	●	●	●
Signal Double Lock	2.5mm	WTW WTB	CRIMP	26-20	2-13 WTB 2-10 WTW	3A	TPA, board-mounted headers, multiple colors, Polarizing ribs on plug housing	●	●				●
CoolSplice		WTW	IDC	18-20/22	1-2	5A/3.5A	Sealed and unsealed versions						
SlimSeal	Varies	WTB WTW	CRIMP	18-20/ 22-24	1-4	5A/3.5A							
Releasable Poke In Connectors	4mm	WTB	Poke-in	18-22	1-3	5A		●	●	●	●	●	●
Mini Hermaphroditic Connectors	3mm	BTB			1,2,4,6	3A							
AMPMODU System 50	0.50" x.100"	BTB WTB	IDC	30-32	4-50 8-100	.5A/3A	FFC amd ribbon cable versions	●					
AMPMODU 50 / 50 Grid	.05"	BTB WTB	IDC	28,30	10-100	.5A	Ribbon cable	●					

ILLUMINATE DESIGNS WITH LIGHTING

From outdoor luminaires to commercial refrigeration, innovation in lighting is taking advantage of broad-based technological progress. TE is your lighting solutions provider for electromechanical and electronic components that seamlessly integrate controls and transmit power and data across multiple building systems.

APPLICATIONS

- Internal LED Lighting
- Ambient Lighting
- Appliances
- Retail
- Accent

PRODUCT SELECTOR ↗ — Lighting

Product Family	Centerline	Mating Style	Term. Method	Wire Size (AWG)	Position Size Range	Current Rating	Features	Internal LED Lighting	Ambient Lighting
Common Termination (CT)	2.0	WTB	CRIMP & IDC	30-22	2 - 30	Up to 4A	Full portfolio of standard options World class application tooling UL & CSA	●	●
Mini Common Termination (Mini CT)	1.5	WTB	CRIMP & IDC	28-24	2 - 40	Up to 3A	Full portfolio of standard options World class application tooling UL & CSA	●	●
High Performance Interconnect (HPI)	0.8 - 2.5	WTB	CRIMP	30-24	2 - 30	Up to 3A	Wide range of CL options, Multiple Color Variations Latching Options	●	●
Flexible Printed Circuit (FPC)	0.25 - 1.25	FTB	ZIF & NON-ZIF	N/A	2 - 75	0.5A	Slant insertion option		
Flat Flex Cable (FFC)	0.050" & 0.100"	FTB	CRIMP	N/A	2 - 70	0.5A	Industry best contact design application tooling Many housing & header options		
Economy Power 2.5	2.5mm	WTW WTB	CRIMP	26-22	2-20 single 8-40 double	4.5A	TPA External robust locking latch, Low insertion force and lubricated terminal colors available	●	
Grace Inertia 2.5	2.5mm	WTB	CRIMP	22-28	2, 3, 5, 6, 8	3A	TPA, Four Colors, Lock prevents half mating, & Half mating easily detect design	●	
Grace Inertia 3.3	3.3mm	WTB (TPA)	CRIMP	20-24	4, 6, 8, 10, 12	4A	TPA, Four Colors, Lock prevents half mating, & Half mating easily detect design	●	●
Micro MATE-N-LOK	3mm	WTW WTB	CRIMP	20-30	2-12 single 2-24 double	5A	Low profile design, Dual beam receptacle contact design, PCB mount pin header assemblies	●	●
Signal Double Lock	2.5mm	WTW WTB	CRIMP	26-20	2-13 WTB 2-10 WTW	3A	TPA, board-mounted headers, multiple colors, Polarizing ribs on plug housing	●	
CoolSplice		WTW	IDC	18-20/22	1-2	5A/3.5A	Sealed and unsealed versions	●	●
SlimSeal	Varies	WTB WTW	CRIMP	18-20/ 22-24	1-4	5A/3.5A		●	●
Releasable Poke In Connectors	4mm	WTB	Poke-in	18-22	1-3	5A		●	●
Mini Hermaphroditic Connectors	3mm	BTB			1,2,4,6	3A		●	●
AMPMODU System 50	0.50" x.100"	BTB WTB	IDC	30-32	4-50 8-100	.5A/3A	FFC amd ribbon cable versions		
AMPMODU 50 / 50 Grid	.05"	BTB WTB	IDC	28,30	10-100	.5A	Ribbon cable		

CREATE PEACE OF MIND WITH SAFETY

Safety is the number one priority when it comes to human-machine interactions in your home and commercial buildings. Whether it's an alarm, temperature control, security system or other small applications - reliable and consistent connectivity is key. Our broad portfolio of low power and signal connectivity products help ensure consumer safety, performance reliability, and are designed to address challenges in small spaces.

APPLICATIONS

- Door Alarm
- Door Switch
- Door Lock
- Harnesses
- Heater
- Stepping Motor/DC Motor

PRODUCT SELECTOR ↗								Safety		
Product Family	Centerline	Mating Style	Term. Method	Wire Size (AWG)	Position Size Range	Current Rating	Features	Door Alarm	Door Switch	Door Lock
Common Termination (CT)	2.0	WTB	CRIMP & IDC	30-22	2 - 30	Up to 4A	Full portfolio of standard options World class application tooling UL & CSA	●	●	●
Mini Common Termination (Mini CT)	1.5	WTB	CRIMP & IDC	28-24	2 - 40	Up to 3A	Full portfolio of standard options World class application tooling UL & CSA	●	●	●
High Performance Interconnect (HPI)	0.8 - 2.5	WTB	CRIMP	30-24	2 - 30	Up to 3A	Wide range of CL options, Multiple Color Variations Latching Options	●	●	●
Flexible Printed Circuit (FPC)	0.25 - 1.25	FTB	ZIF & NON-ZIF	N/A	2 - 75	0.5A	Slant insertion option			
Flat Flex Cable (FFC)	0.050" & 0.100"	FTB	CRIMP	N/A	2 - 70	0.5A	Industry best contact design application tooling Many housing & header options			
Economy Power 2.5	2.5mm	WTW WTB	CRIMP	26-22	2-20 single 8-40 double	4.5A	TPA External robust locking latch, Low insertion force and lubricated terminal colors available			
Grace Inertia 2.5	2.5mm	WTB	CRIMP	22-28	2, 3, 5, 6, 8	3A	TPA, Four Colors, Lock prevents half mating, & Half mating easily detect design			
Grace Inertia 3.3	3.3mm	WTB (TPA)	CRIMP	20-24	4, 6, 8, 10, 12	4A	TPA, Four Colors, Lock prevents half mating, & Half mating easily detect design	●	●	●
Micro MATE-N-LOK	3mm	WTW WTB	CRIMP	20-30	2-12 single 2-24 double	5A	Low profile design, Dual beam receptacle contact design, PCB mount pin header assemblies	●	●	●
Signal Double Lock	2.5mm	WTW WTB	CRIMP	26-20	2-13 WTB 2-10 WTW	3A	TPA, board-mounted headers, multiple colors, Polarizing ribs on plug housing			
CoolSplice		WTW	IDC	18-20/22	1-2	5A/3.5A	Sealed and unsealed versions			
SlimSeal	Varies	WTB WTW	CRIMP	18-20/ 22-24	1-4	5A/3.5A				
Releasable Poke In Connectors	4mm	WTB	Poke-in	18-22	1-3	5A		●	●	●
Mini Hermaphroditic Connectors	3mm	BTB			1,2,4,6	3A				
AMPMODU System 50	0.50" x.100"	BTB WTB	IDC	30-32	4-50 8-100	.5A/3A	FFC amd ribbon cable versions			
AMPMODU 50 / 50 Grid	.05"	BTB WTB	IDC	28,30	10-100	.5A	Ribbon cable			

STAY ALWAYS ON WITH SENSING & WIFI

TE's sensor solutions improve the ability to observe what's happening inside of an application. Meeting a wide range of application needs, humidity, temperature, pressure, thermal, and position sensors monitor themselves and make adjustments as needed to always provide a secure, reliable, an innovative connection.

APPLICATIONS

- Pressure Sensors
- Humidity Sensors
- Thermal Sensors
- Temperature Sensors
- Wi-Fi

PRODUCT SELECTOR ↗								Sensing & Wi-Fi	
Product Family	Centerline	Mating Style	Term. Method	Wire Size (AWG)	Position Size Range	Current Rating	Features	Sensors (Pressure, Humidity, Thermal, Temperature, etc.)	Wi-Fi Connectivity
Common Termination (CT)	2.0	WTB	CRIMP & IDC	30-22	2 - 30	Up to 4A	Full portfolio of standard options World class application tooling UL & CSA	●	●
Mini Common Termination (Mini CT)	1.5	WTB	CRIMP & IDC	28-24	2 - 40	Up to 3A	Full portfolio of standard options World class application tooling UL & CSA	●	●
High Performance Interconnect (HPI)	0.8 - 2.5	WTB	CRIMP	30-24	2 - 30	Up to 3A	Wide range of CL options, Multiple Color Variations Latching Options	●	●
Flexible Printed Circuit (FPC)	0.25 - 1.25	FTB	ZIF & NON-ZIF	N/A	2 - 75	0.5A	Slant insertion option		●
Flat Flex Cable (FFC)	0.050" & 0.100"	FTB	CRIMP	N/A	2 - 70	0.5A	Industry best contact design application tooling Many housing & header options		●
Economy Power 2.5	2.5mm	WTW WTB	CRIMP	26-22	2-20 single 8-40 double	4.5A	TPA External robust locking latch, Low insertion force and lubricated terminal colors available	●	●
Grace Inertia 2.5	2.5mm	WTB	CRIMP	22-28	2, 3, 5, 6, 8	3A	TPA, Four Colors, Lock prevents half mating, & Half mating easily detect design	●	●
Grace Inertia 3.3	3.3mm	WTB (TPA)	CRIMP	20-24	4, 6, 8, 10, 12	4A	TPA, Four Colors, Lock prevents half mating, & Half mating easily detect design	●	●
Micro MATE-N-LOK	3mm	WTW WTB	CRIMP	20-30	2-12 single 2-24 double	5A	Low profile design, Dual beam receptacle contact design, PCB mount pin header assemblies	●	●
Signal Double Lock	2.5mm	WTW WTB	CRIMP	26-20	2-13 WTB 2-10 WTW	3A	TPA, board-mounted headers, multiple colors, Polarizing ribs on plug housing	●	●
CoolSplice		WTW	IDC	18-20/22	1-2	5A/3.5A	Sealed and unsealed versions		
SlimSeal	Varies	WTB WTW	CRIMP	18-20/ 22-24	1-4	5A/3.5A		●	
Releasable Poke In Connectors	4mm	WTB	Poke-in	18-22	1-3	5A		●	●
Mini Hermaphroditic Connectors	3mm	BTB			1,2,4,6	3A			●
AMPMODU System 50	0.50" x.100"	BTB WTB	IDC	30-32	4-50 8-100	.5A/3A	FFC amd ribbon cable versions		●
AMPMODU 50 / 50 Grid	.05"	BTB WTB	IDC	28,30	10-100	.5A	Ribbon cable		●

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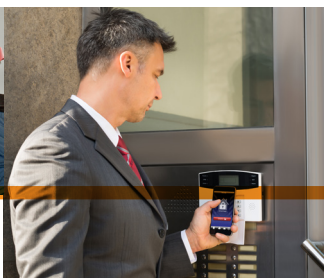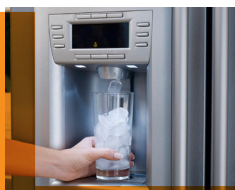
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HOME APPLIANCES & DEVICES

SMALL HOME APPLIANCES - SOLUTIONS FOR THE CONNECTED HOME

TE connectivity

SMALL HOME APPLIANCES
SOLUTIONS FOR THE CONNECTED HOME

SMART INNOVATIONS FOR SMALL HOME APPLIANCES

Small appliances are becoming more connected to each other, to the cloud and to you. Our extensive portfolio of connectors, sensors, tubing, relays and switches boast the efficiency and reliability you can count on.

This, along with our global engineering expertise and manufacturing capabilities, makes us an ideal partner to help bring your next connected appliance to market, fast.

FIND OUT MORE
te.com/connectedhome >

TERMINALS, PROTECTION, RELAYS & SWITCHES

Customer satisfaction and product reliability depend on proven components you can trust.

Eurostyle Terminal Blocks
Feature a rising cage clamp which promotes numerous reliable connections and disconnections at field installations.

DIP Switches
From miniature printed circuit board mounted DIP switches to tactile switches for use in household appliances, lighting, building systems, solar, HVAC, and an array of safety-critical applications.
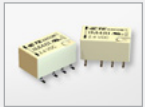
IM Relay
Provide 2A-5A current ratings with 50 to 300 mQ coil. They are available with monostable or bistable latching options, and in THT and SMT versions.

Board Level Shielding (BLS)
Custom EMI shields that minimize crosstalk in tightly designed systems.

S/SE Series Slide Switches
Compact slide switches are available in sealed and unsealed versions.

Magnet Wire Terminals
We offer a broad range of terminals specifically designed to terminate magnet wire whether copper, aluminum, or a combination of both.

SWFR Tubing
Insulates and mechanically protects components, electrical connections, terminations and more.

Positive Lock Terminals
Extensive offering of ergonomically-friendly receptacles enable fast, safe, and reliable connections for a host of applications.

BOARD-TO-BOARD, FLEX & WIRE-TO-BOARD

Big power in small packages. Address today's miniaturization requirements.

Free Height Connectors
These versatile connectors are useful for downsizing applications that require parallel stacked circuit boards.

Spring Fingers
Tiny, scalable, surface mountable contacts allow designers to fit grounding solutions almost anywhere.

Flat Flexible Cable (FFC)
Crimp style flex connection for FFC and FPC cable. Our reliable designs offer many housing options and leading application tooling.

CT & Mini CT Connectors
With broad industry usage these handy connectors feature both crimp and IDC style interconnects, with many header options.

SENSORS

Compact, reliable sensors can help monitor and protect your smart devices.

Thermopile Infrared Sensors
Measure temperature from a distance by detecting an object's infrared (IR) energy.

Humidity Sensors
Protect your products with sensors that can warn of high humidity.

Pressure Sensors
Includes a portfolio of media isolated and non-media isolated pressure sensor solutions.

Force Sensor Elements
Allows design tension, compression, or both into one simple, inexpensive construction.

Platinum RTD Sensors
Temperature sensors measure liquid and heating element temperatures in your small appliances.

ANTENNAS

Standard and custom high-performance antennas for operation on most networks in regional or international markets.

Embedded Antennas
A range of products supporting low profile wireless connectivity for GPS, Wi-Fi, and more.

Custom Antennas
TE is a leading developer and manufacturer of custom antennas for Wi-Fi, Bluetooth, Z-Wave, Zigbee and multiband applications.

POWER CONENCTORS

TE keeps your power flowing with a broad selection of internal and external power connectors.

Power Key Connectors
Power key connectors provide wire-to-board (WTB) connections consisting of plug housings for wire, compact PCB header assemblies, and Terminal Position Assistance (TPA) devices.

Grace Inertia 2.5 Connectors
TE's GRACE INERTIA connector series mates to simultaneously complete the circuit and lock the connector.

SMALL HOME APPLIANCES: te.com/connectedhome

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HOME APPLIANCES & DEVICES

ELECTRONIC COMPONENTS -
THE CRITICAL CONNECTIONS THAT ENABLE THE SMART HOME

ELECTRONIC COMPONENTS:
The Critical Connections That Enable The Smart Home

by: Terry Murphy, Director of Strategy & Business Development

In our increasingly connected world, quality, reliability and consistency matter a great deal, particularly in the context of the smart home ecosystem. The antennas, connectors, relays, sensors, switches, terminals and tubing inside these devices play critical roles in the product's ultimate functionality. If you don't focus on the right components or choose the wrong or incompatible ones, then device reliability becomes an issue. With a faltering or failing device, the user loses trust in your products and may slow their adoption of more smart devices in general. The challenge is to know which components are crucial to your design and how to best minimize any failures.

Whether it's a washing machine, thermostat, home security system, coffee maker or other home appliance, users expect seamless operation from the connected and smart devices in their homes. If devices don't function as advertised, users will slow adoption of new smart home devices. Because the smart connected home is just now beginning to expand from the early adopter phase to a larger share of the market, inconsistent performance or a poor experience in one device category can have negative repercussions for the adoption of these devices overall.

Continued growth of the connected home market hinges on consumer buy-in and trust. Gaining trust starts with providing reliable products with components that enable the device and the technology to perform as the user expects.

### Product reliability: The importance of the componentry

As appliances and other home devices become more connected and smart, the electronic components and the interconnect products inside become more critical to overall function and relevance for the user. Accordingly, you need to strengthen the importance of components in your designs for these devices. Antennas, connectors, relays, sensors, switches, terminals and tubing have a variety of tasks and functions to facilitate the operation of any smart home device or appliance, including:

- Supporting data transmission, analysis and response
- Receiving and executing remote user commands
- Enabling user interface control at the device or appliance
- Providing power supply
- Allowing a level of autonomy in device operation through sensors and sensor inputs

A failure in any one of these functions can lead to an overall failure of the product. Are you giving components and interconnect products adequate attention in terms of application requirements, including function, specifications and design elements?

Antennas, connectors, relays, sensors, switches, terminals and tubing can be points of failure if not properly designed into the device system and tested based on specifications and requirements. Consider that if there is a failure with one component, the device won't work as designed. If you aren't already thinking carefully about these critical components, you may need to change the way you think about your design in order to ensure full product functionality and reliability.

For example, if a relay does not perform to specifications, then the motor might not turn on or off, which could result in operational failure. If a power connector does not meet specifications for a particular application, there may be no power for the system which is problematic. If an antenna is not placed at the right position in any given system, then the connectivity could be limited. Again, system failures, especially in the eyes of a user who is trying to decide how, when and whether these connected devices can make their lives better will spoil their experience and slow adoption of future devices.
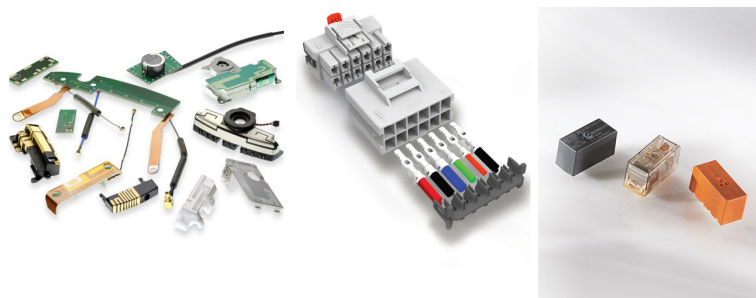
Antennas   Power Connectors   Relays

Component needs for connected home devices

How can you maximize the performance and reliability of smart home and other connected devices? Design in high quality components and at an earlier point in your design cycle. When choosing components for a smart device, you must consider the consequences of each decision. High quality components and integrated component solutions can help fulfill the promise of the smart home— and help prevent a host of problems.

Nearly all connected devices for applications in our homes now feature touch screens, voice activation capability, sensing technology and remote wireless communication functionality. These features can delight users and entice them toward greater smart device adoption if executed well:

Always-on connectivity: Consumers expect devices to work as designed, including motors to run, heaters to operate, and power to drive the connectivity throughout the device. It is important to select the right component that is designed for the intended application. These components must be high quality, reliable and meet industry and regulatory requirements. Selecting components with color or physical keying options, as well as ones that are ergonomically designed can aid in error-proofing the assembly process.

Touch screens: Most consumers are used to touch screens because of today's smart phones, and they expect every smart device to respond to their touch or swipe and act

Antenna Solutions
TE Connectivity's (TE) antennas offer endless possibilities for you to create wireless and smart devices, with several combinations of features in a variety of shapes and sizes. These solutions support high-clarity transmissions across a wide variety of technologies and frequencies including Bluetooth, Wi-Fi, LTE, ZigBee and more.

Heat Shrink Tubing
Our Raychem heat shrink tubing provides electrical insulation, mechanical protection, sealing, strain relief and wire management to help ensure reliability within appliances and devices. Available in various types, materials, heat-shrink ratios, and can withhold extreme temperatures, TE's heat shrink tubing is a great solution for your smart device needs.

Interconnect Solutions
With an expansive portfolio of power, data, and signal connectors, TE offers the right solution to enable reliable, consistent connectivity. Across a range of centerline spacing and position sizes, they come in multiple colors and materials – including glow wire and hot wire types. Terminal position assurance devices, connector position assurance devices, polarization and keying options help to provide reliable connections.

Relays
Cost-effective and reliable, TE relays are used throughout applications in the home. In nearly any design for access control systems, large and small appliances, lighting, HVAC, and an array of security applications, TE's relays offer a range of mounting and enclosure types, contact ratings and coil options to provide the design flexibility and performance you need.

Sensors
An expanding range of sensor technologies in small and large appliances and devices contribute to new levels of convenience and productivity for the home. TE's sensors help create smart appliances that respond to human touch, sense vibration, adjust to loads, detect temperature and humidity, and operate more efficiently.

Switches
TE's comprehensive line of reliable and cost-effective switches can be used in small and large appliances to ensure reliable and consistent inputs. From tactile switches to push buttons, slide switches, rotary types, rockers, and more, they offer a range of contact ratings, configurations, and mounting options. With comprehensive product data and trained technical specialists we can help you discover the best solution.

Terminals & Splices
From basic ring and FASTON terminals, to splices for various wire types and sizes, TE offers a broad portfolio of terminals and splices for home applications. Terminals such as Positive Lock receptacles have low insertion force, but high retention force to help ensure connections are properly made and stay that way. Tested electrically and mechanically by international agencies, they perform in extreme conditions for always-on connections.

accordingly. However, if the component hardware behind the touch screen begins to fail, so does the value of the device. At this point, the device can cause frustration and may cease to be useful to the user. Starting with high quality components could prevent a faulty touch screen from cropping up in the first place.

Voice recognition: Voice activation capabilities are starting to gain traction with consumers, but several factors can affect accuracy. Because the program needs to "hear" the words spoken clearly, any extra noise will interfere. Low-quality sound cards, which provide the input for the microphone to send the signal to the computer, require adequate shielding from electrical signals produced by other components in the system. They can introduce hum or hiss into the signal, thus hindering the device's performance. In addition, if the microphone or associated circuit malfunctions, it may not understand the command sent to the device.

Selecting the best components can prevent many of these problems. Another option is to use spring fingers. Spring fingers—single contact, surface mountable internal connectors with multiple functions on a printed circuit board—can be used for grounding to prevent EMI noise and static caused by a speaker, microphone or other vibration.

Sensing technology: Sensors are important to the connected home as a central input component in device and system operation. Using the wrong or inappropriate sensor in a heating and cooling system or application can adversely impact the overall efficiency of the system. That sensor could turn on the HVAC system and the compressor or motor when not needed, or cause the system to not operate when it should. A properly functioning sensor enables the system to run as intended.

Likewise with a security system, if the system fails because of communication issues or the sensors, this doesn't bode well for the security system, the user, or the smart home in general.

Remote wireless communication and control: Device-to-device communication and autonomous operation via sensor inputs are at the heart of the smart connected home. Connectivity issues between the device itself and its hub or control platform can and do occur. An engineer's job is to minimize the chance of this occurring through solid design and componentry choice. For example, choosing the right antenna based on application needs can help deliver seamless, uninterrupted service. High quality antennas provide high-clarity transmissions in wireless devices in a wide variety of frequencies such as Bluetooth, Wi-Fi, LTE and Zigbee, among others.

Choose a partner in design with expertise in the connected home

Many of these components may be invisible to the customer, but they are vital to the user experience. The success and functionality of each device are paramount to the continued adoption of the smart connected home. Together, we need to think, not just in terms of the device you are designing, but also in terms of the big picture—see how their device will fit into the home and potentially complement other connected devices.

TE Connectivity (TE) engineers have been innovating and integrating smaller, lighter technology that connects and responds to persistent data, making homes and communities safer, smarter and more sustainable. For customers who aim to push the limits of connectivity and data capability to invent the future, we are advancing connectivity—from multifunction sensors to contactless power and data, interconnect solutions and more—to enable tomorrow's smart products and systems that are entirely reliant on data and power delivery to operate every day.

TE's customer relationships and expertise extend across many home product categories such as appliances, hubs, personal assistants, occupancy sensors, HVAC equipment, thermostats and more. We provide the broadest range of connectivity products available, suitable for a wide variety of applications and end products. We are uniquely positioned to deliver the most comprehensive, highest quality connectivity solutions and help customers succeed in the connected home market

Partnering with TE can help any designer, manufacturer and, ultimately, the user gain more from their smart home devices. Choosing the best, most reliable components is easier with experts like those found at TE, who can advise on high quality standard and customized components, as well as integrated solutions that will help enable better performance, consistency and quality in your product, and thus a better experience overall.

TE Connectivity Ltd., is a $13 billion global technology and manufacturing leader creating a safer, sustainable, productive, and connected future. For more than 75 years, our connectivity and sensor solutions, proven in the harshest environments, have enabled advancements in transportation, industrial applications, medical technology, energy, data communications, and the home. With 78,000 employees, including more than 7,000 engineers, working alongside customers in nearly 150 countries, TE ensures that EVERY CONNECTION COUNTS. Learn more at www.te.com and on LinkedIn, Facebook, WeChat and Twitter.

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