



TT electronics

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Company registration No. 87249



High-Reliability Products for Medical Electronics



Leading in Tomorrow's Technology

**Clinical and Laboratory
Analysis Equipment**



Medication Delivery Systems

**Defibrillator and
Cardiac Care Products**



Diagnostic Equipment



**Home Healthcare
Products**

**Patient
Monitoring
Systems**



For information about other products sold by TT electronics for commercial or military applications, please contact any of the individual group companies listed for a TT electronics capabilities brochure.

Operating with precision: high-reliability technology for healthcare and medical electronics



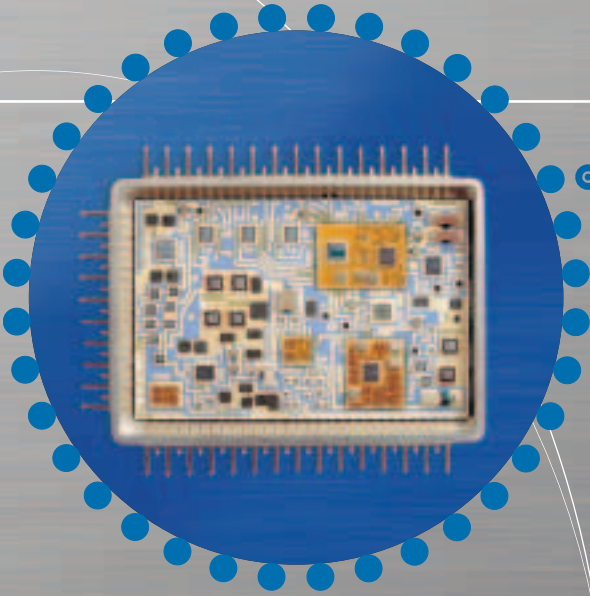
TT electronics is a global supplier of advanced electronic technologies for high-reliability medical and healthcare systems manufacturers. Through its divisions, TT electronics provides one of the industry's most comprehensive ranges of advanced application specific products, applications engineering experience, and world-class manufacturing facilities that meet the stringent requirements of medical certifications.

Throughout the world, TT electronics is a major supplier to medical electronics equipment manufacturers, and independent design firms engaged in high-reliability medical and healthcare systems design. Individual divisions specialize in standard and custom microelectronic assemblies, optoelectronics, sensors, resistors, resistor networks and precision potentiometers. As a combined company, TT electronics can serve as a single-vendor source for this wide range of medical-qualified products as well as specialized technologies needed to develop innovative custom solutions for the most demanding applications.

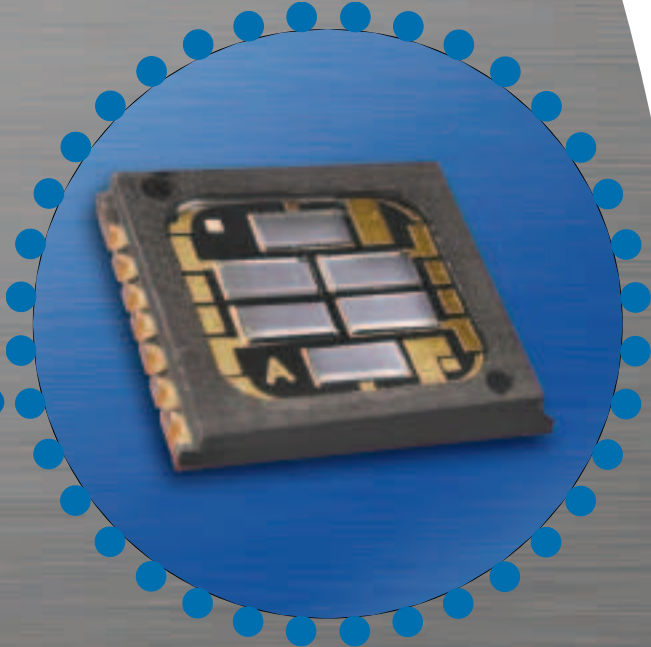
TT ELECTRONICS TECHNOLOGIES

- **Microelectronic assemblies/hybrid microcircuits**
- **Sensors (optoelectronics, Hall-effect, and others)**
- **Resistor networks**
- **Discrete resistors**
- **Potentiometers**
- **Integrated passives**
- **RTDs**

Please turn to the inside back cover of this brochure for manufacturing division contact information.

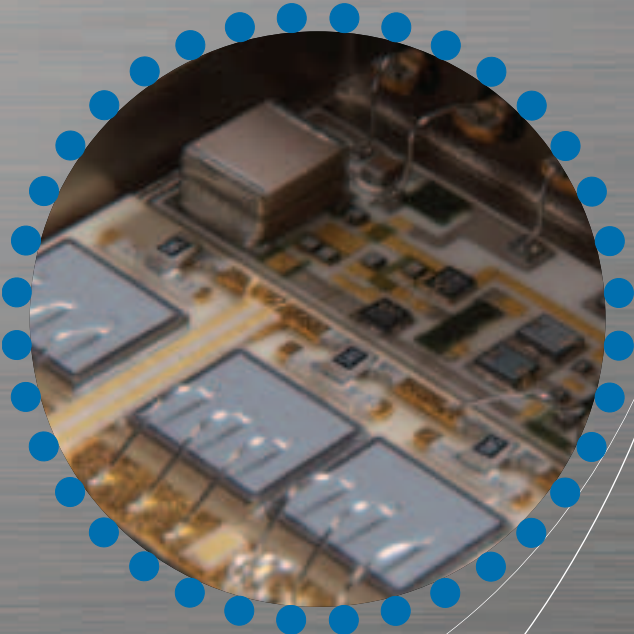


**Commercial
Microelectronic
Assemblies**



**Optoelectronic
Assemblies**

**Thick Film on
Steel Heating
Element**



**Power
Modules**



Microelectronic assemblies offer superior reliability

TT electronics' microelectronics assemblies are custom circuits designed to perform a wide range of digital and analog control functions in medical electronics applications. They offer superior reliability and weight savings over larger circuit boards, and are less costly to design than custom ICs for low-volume applications.

From basic miniaturized circuits to complex multi-function packages, TT electronics design engineers utilize substrate, interconnect and packaging technologies. These bring reduced footprints, improvements in thermal management, durability, and electrical and noise performance over competing discrete component systems.



Product highlights

- Hermetic chip & wire microelectronic assemblies
- Encapsulated chip & wire microelectronic assemblies
- Power modules for high current/high voltage applications
- Power factor correction modules
- Optoelectronic hybrid assemblies
- Thick and thin film substrates
- Printed thick film resistors on ceramic for heating elements
- Anotherm® anodized aluminum and thick film on steel cylindrical heating assemblies
- Patchwork® technology for integration of power & control on ceramic and steel substrates
- RTDs

For detailed product data or application notes, please visit company web sites located on page 11.

Technical capabilities

- Conductive systems include Au, Ag, PdAg, thick film copper (TFC®)
- Comprehensive range of printed resistors (full ohmic range, NTC, PTC, surge, shunt and high voltage resistors)
- Ceramic, beryllia, aluminum and steel substrates in a range of thicknesses
- Passive & active laser trimming
- Component assembly
- Photo defined thick films with geometries down to 1mil
- Die attach (conductive/non-conductive epoxy, eutectic, solder)
- Hermetic and local encapsulation
- Custom specific molded housing design and assembly
- Ultrasonic wirebonding up to 20 mils diameter
- Multi-site manufacturing – USA, Europe, Mexico, Malaysia, Barbados, China
- Lead-free capability
- Extended temperature operation (-55°C to +150°C)

Qualifications/certifications

- ISO/TS16949
- ISO9001:2001
- ISO14001
- BS9540
- CECC specifications
- QS9000
- VDA 6.1

APPLICATIONS IN ACTION

A medical systems supplier needed a source of instant, yet safe and controlled heat to nebulize medication for a critical respiratory inhalation unit. TT electronics engineers developed their thick-film-on-steel resistive heating technology to provide precise heat for the system's nebulizing chamber.

Optoelectronic
Components



Optoelectronic
Assemblies



Hall-Effect
Sensors

Custom Sensors



Precision Position
Sensors

Fiber Optics



Advanced sensor technology for medical electronics

TT electronics provides a wide range of sensor technologies uniquely suited to the rigorous requirements of medical and healthcare applications, including optoelectronic sensors, Hall-effect non-contact position sensors, and contacting potentiometric sensors. With the assistance of TT electronics design engineering teams, these technologies have the capability to be engineered to the high-reliability performance standards and precision tolerance demanded for life-saving medical electronics, patient monitoring systems and critical diagnosis equipment.



Product highlights

- Infrared LED and VCSEL sensors and assemblies
- Surface mount or through hole packages
- Hall-effect sensors and assemblies
- Fiber optic components and transceivers
- Sensor "pill packs"
- Precision potentiometric sensors
- Linear position sensors
- Platinum temperature sensors

Technical capabilities

- Infrared LED and VCSEL, 850nm to 940nm wavelengths
- Silicon and III-V design capability
- Reflective and interruptive optical sensing designs
- Hall-effect magnetic sensing (bipolar & magnetoresistive)
- Comprehensive in-house testing and failure analysis lab (with SEM)
- 100% parametric test capabilities
- Class 100 clean room

Qualifications/ certifications

- ISO9000
- QS9000
- ISO9001
- ISO 16949
- TS16949
- VDA 6.1
- IEC751
- DIN43760

APPLICATIONS IN ACTION

A leading medical equipment manufacturer needed a non-contacting method of detecting the presence of different fluids in clear medical-grade tubing. Applications engineers at TT electronics developed an optoelectronic assembly that paired an infrared LED and a silicon photodetector in an opaque housing designed to accommodate the insertion of a clear plastic tube up to 0.25". The changes in the optical signal as it passes through the fluid-filled tube are used to monitor the presence or absence of fluid, detect different types of fluid or bubbles, as well as detect a missing tube.

Precision resistor networks in a range of technologies

TT electronics offers the industry's most comprehensive range of precision resistive element technologies for networked resistor applications. Ultra-reliable TaNFilm®, precision Nichrome and ultra-high value Chromaxx™ resistive elements are available on ceramic or silicon substrates in a wide variety of approved surface mount, leaded or ball grid array packages as well as bare silicon die for use in custom microelectronic assemblies.

Product highlights

- Surface mount precision TaNFilm networks on ceramic or silicon
- Leaded precision TaNFilm networks in DIP and SIP ceramic packages
- Chromaxx™ high-resistance value resistor divider networks
- High-frequency resistor networks and substrates to 40GHz
- Surface-mount precision Nichrome networks on ceramic or silicon
- Precision voltage divider chip networks
- Ball grid array (BGA) precision networks
- TaNSil wire bondable resistor networks on silicon die
- High voltage divider networks

For detailed product data or application notes, please visit company web sites located on page 11.

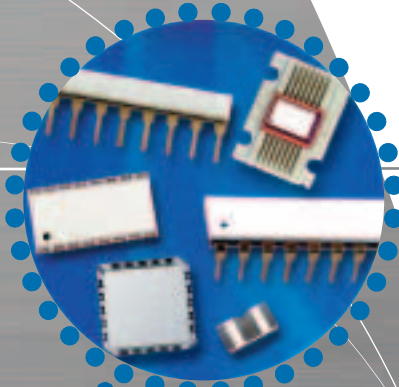
Discrete resistors with proven reliability

With one of the industry's most extensive range of high-reliability discrete resistor technologies, TT electronics can offer virtually any custom or standard rating or form factor needed for medical or healthcare resistor applications. As a major supplier to medical equipment manufacturers, TT electronics has been at the forefront of developing new products to meet the most demanding customer requirements.

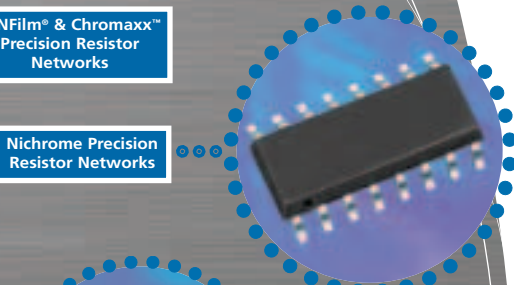
Product highlights

- Surface mount precision TaNFilm chip resistors
- High-frequency chip resistors and attenuators
- High-reliability precision wirewound leaded resistors
- High-surge precision wirewound resistors
- Surface mount cylindrical high power resistors
- High-reliability metal film leaded resistors
- Ultra high and ultra low resistance value resistors
- Specialized precision fusing resistors
- Current sense resistors
- High-reliability precision metal film leaded resistors
- High voltage thick film chip resistors
- High energy pulse performance resistors

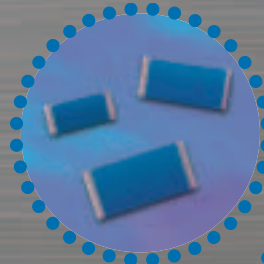
For detailed product data or application notes, please visit company web sites located on page 11.



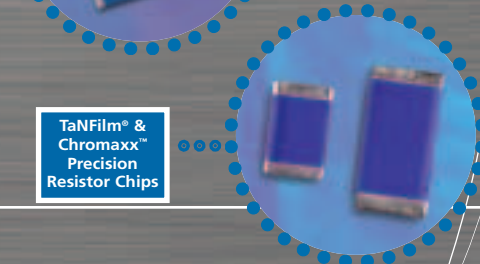
TaNFilm® & Chromaxx™ Precision Resistor Networks



Nichrome Precision Resistor Networks



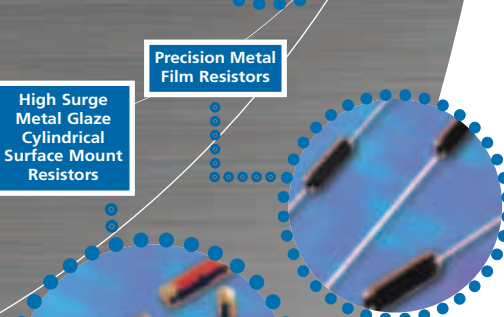
High Voltage Chip Resistors



TaNFilm® & Chromaxx™ Precision Resistor Chips

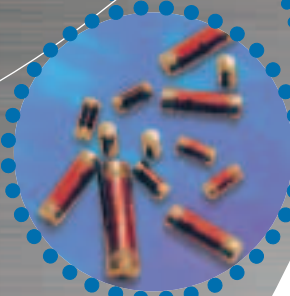


Current Sense Resistors



Precision Metal Film Resistors

High Surge Metal Glaze Cylindrical Surface Mount Resistors

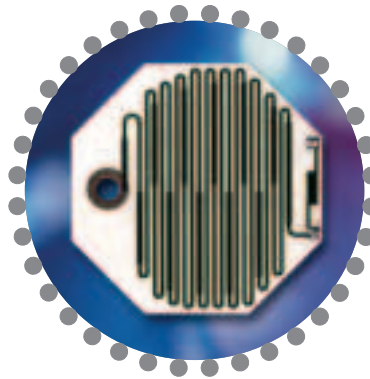


Technical capabilities

- Precision tolerances to $\pm 0.02\%$ absolute; $\pm 0.005\%$ ratios
- TCRs to $\pm 10\text{ppm}/^\circ\text{C}$ absolute; $\pm 2\text{ppm}/^\circ\text{C}$ tracking
- Resistance range from 0.0002Ω to $20\text{M}\Omega$
- Class 100, 1,000 and 10,000 clean room manufacturing
- Ceramic, silicon and metallized substrates
- Resistive films include platinum, tantalum nitride, titanium, aluminum, copper, palladium, nickel, gold, titanium tungsten and nichrome
- Precision photolithography to 2-micron line widths
- Plasma chemical vapor deposition/ silicon dioxide & silicon nitride (PECVD) and low pressure chemical vapor silicon nitride (LPCVD) processes
- Gold, nickel, copper and tin/lead electroplating processes

Qualifications/certifications

- ISO/TS16949
- VDA 6.1
- ISO9001
- QS9000
- ISO9000
- CECC



Custom Resistor Networks

APPLICATIONS IN ACTION

A designer of dental imaging systems required a custom high voltage resistive divider when developing a new ultra-compact X-ray head. For a solution they turned to TT electronics engineers, who devised an optimum thick film network. The result balanced the conflicting demands for high operating voltage and minimum size in a custom yet cost effective component.

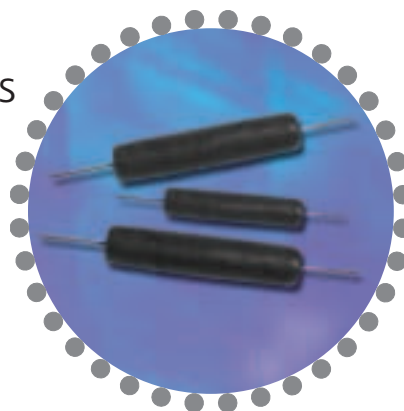
Technical capabilities

- Resistive tolerances to $\pm 0.005\%$
- TCRs from $\pm 2\text{ppm}/^\circ\text{C}$ to $+6000\text{ppm}/^\circ\text{C}$
- Resistance range from 0.005Ω to $50\text{G}\Omega$
- Power ratings from 0.125W to $>375\text{W}$
- Voltage ratings to 3kV
- Wirewound, metal film or metal element resistor technologies
- Surface mount chips and cylindrical resistors
- Axial and radial leaded resistors
- Comprehensive testing facilities in-house

Qualifications/certifications

- ISO/TS16949
- QS9000
- VDA 6.1
- ISO9000
- ISO9001
- ISO14001
- CECC
- UL1412
- BS9450

High Surge Wirewound Resistors



APPLICATIONS IN ACTION

A manufacturer of portable defibrillation equipment needed to precisely limit current delivered to patients undergoing cardiac defibrillation. The resistor needed to withstand energy pulses up to 1000V during operation, as well as repeated pulses that occur when the unit undergoes two to three daily self-test diagnostic cycles. TT electronics engineers developed a double-wound non-inductive resistor using a heavy-gauge wire element capable of withstanding these power surges with reliable long term performance.

Precision potentiometers provide reliable position sensing

TT electronics has been a leading industry innovator in developing standard and custom precision potentiometers and trimmers for specific applications within many types of medical and diagnostic equipment for manufacturers around the world. In many cases, TT electronics applications engineers have taken an existing high-reliability product design and adapted it to meet the demanding requirements of medical and healthcare applications.



Precision Potentiometers

Product highlights

- Conductive plastic potentiometers
- Wirewound potentiometers
- Hybrid potentiometers
- Single and multi-turn potentiometers
- Spring return linear potentiometers
- Surface mount cermet trimmers
- Through hole cermet trimmers
- Single and multi-turn trimmers
- Miniature SPDT switches

APPLICATIONS IN ACTION

A manufacturer of patient dye injection systems needed an ultra-reliable precision potentiometer to monitor the amount of dye injected into patients undergoing MRI, cardiovascular and CT scanning procedures. TT electronics engineers developed a long-life rotor & contact design for their wirewound precision potentiometers and was the only one of six competitors that was able to exceed the manufacturer's extended life test requirements.

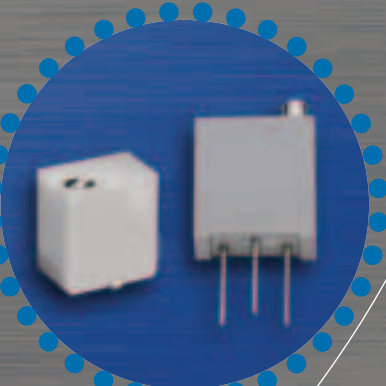
Technical capabilities

- Extensive range of models and pin configurations
- Rotational life up to 25 million revolutions
- Linearity to $\pm 0.02\%$
- Operating temperature range: -65°C to $+150^{\circ}\text{C}$
- Miniature sizes down to 3mm case size

Qualifications/ certifications

- QS9000
- ISO9000

For detailed product data or application notes, please visit company web sites located on page 11.



Precision Trimming Potentiometers

IRC - Advanced Film Division

Company Profile

IRC-AFD is a state of the art manufacturer of a variety of resistive products utilizing thin and thick film technologies.

IRC-AFD offers tantalum nitride chip resistors and networks manufactured on ceramic or silicon substrates. This technology provides the industry with the only self-passivating resistors, impervious to moisture contamination. The thin film networks are offered in standard JEDEC or BGA packages. IRC-AFD also offers thin film platinum temperature sensors used where temperature compensation is critical. High frequency thin film products are also available in various packages.

IRC-AFD is certified to ISO9001 and QS9000.

Product Range

- SMT Precision Chips and Networks
- SMT Current Sense Chip Resistors
- SMT Voltage Dividers
- SMT Military Chips
- Leaded Precision Networks
- SMT Resistor-Capacitor Networks
- SMT Temperature Sensors
- SMT Wire-bondable chips and networks
- SMT Igniters
- SMT Low Pass Filters
- Hybrid Substrates
- SMT Ball Grid Arrays

Contact Details

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www.irctt.com

IRC - Wire and Film Technologies Division

Company Profile

IRC-WAFT offers a wide range of wirewound and metal film components as well as an advanced thick film on steel technology line of products. Its resistive offering is available in many market-driven formats and packages including surface mount, axial, radial and custom packages. IRC-WAFT also offers metal glaze, metal film, metal oxide and thick film technology resistors in a wide variety of tolerances, power and voltage ratings.

IRC-WAFT's new products include innovative resistor module solutions, surface mount technology and thick film integration with steel.

IRC-WAFT is certified to ISO9001 and QS9000.

Product Range

- Complete family of leaded wirewound products
- Complete family of leaded metal film products
- Many custom resistive options are available
- Full complement of surface mountable film and wirewound products
- Custom thick film on steel technology products

Contact Details

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www.irctt.com

Welwyn Components

Company Profile

Welwyn provides leading edge technology in resistive components and custom microelectronic assemblies.

Welwyn offers local production combined with application, engineering design and technical sales assistance to help identify technology synergy and provide time-to-market solutions for your designs.

A skilled workforce and a significant investment in high volume automated production has created partnerships with major customers that position Welwyn as the market leader in Europe.

Welwyn is certified to ISO9001: 2000 & TS16949

Comprehensive range of CECC approved resistor products available

Product Range

- Thick film substrates and microelectronic assemblies
- Integration of power and control circuits for industrial applications
- Photo image circuits on ceramic for high-density/high-frequency applications
- Chip and wire assemblies in hermetically sealed packages
- Thick film resistors in surface mount technology
- Thin film axial resistor technology
- Wirewound resistors for power handling applications
- Precision resistors for instrumentation and medical

Contact Details

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AB Mikroelektronik

Company Profile

AB Mikroelektronik offers technology development and manufacturing services for custom specific microelectronic assemblies on ceramic and alternative substrates.

AB's power modules and thick film circuits are used in applications such as electronic motor control, heating units, optical sensors or hand tool speed control.

AB is certified to ISO/TS16949, ISO9001 and QS9000/VDA 6.1.

Product Range

AB Mikroelektronik offers a full range of custom specific microelectronic assemblies

- Thick film hybrids and thick film sensors on various substrates
- Printed thick film resistors on ceramic for heating elements
- Chip and wire assemblies
- Power modules for high current/high voltage applications
- Patchwork® hybrids integrating power and control on one substrate
- Optical sensors
- Ytronic® modules
- Thick film strain gauges
- Thick film resistor networks

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OPTEK Technology

Company Profile

OPTEK Technology is a leading supplier of optoelectronics and sensing technology, providing products for office equipment, industrial, medical, automotive, hi-reliability and data communications industries. Custom designs and innovative solutions are OPTEK's core competencies.

OPTEK is certified to ISO9000 and ISO/TS 16949 (QS9000)

Product Range

- Optoelectronic components: LED, VCSEL, photodiodes, phototransistors, photologic
- Optoelectronic switches: slotted and reflective
- Fiber optic components: LED, VCSEL, photodiodes, receivers, transceivers
- Magnetic components: Hall-effect, uni-polar, bi-polar, magneto-resistive

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www.optekinc.com

BI Technologies

Company Profile

BI Technologies has been an innovator and leader in electronic components for more than 50 years manufacturing products for communication, computer, industrial and automotive applications.

BI Technologies serves a global customer base with manufacturing locations in the United States, Mexico, Scotland, Japan, China and Malaysia.

Product Range

- Trimming and precision potentiometers
- Position sensors
- Chip resistor arrays
- Resistor networks
- Integrated passive networks
- Inductors
- Transformers
- Turns counting dials
- Hybrid microelectronics and custom integration products
- Comprehensive range of magnetic products
- BGA packages

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