AVNET ABACUS

focus

Edition 36

Medical technology: the changing landscape of modern healthcare

focus

Focus is the quarterly magazine from Avnet Abacus, featuring in-depth trend and technology reviews, new product spotlights, Avnet community news and interviews with market leaders.

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Features

Interview

Supplier technologies

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Power

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Epidemiology was the first recorded scientific method employed in identifying the source and eliminating an outbreak of Cholera in London in the mid 1800's. Since then, with the current market evolving and adapting at an unprecedented pace, technology has continued to shape public health.

Demand from manufacturers for specialist medical-grade components is rocketing, along with the wider needs of non-medical companies and institutions that must adapt their processes for social distancing, remote building access control, security and contactless monitoring.

In-home healthcare and remote monitoring are driving technological advancements in applications using the Internet of Medical Things. Medical professionals can consult and monitor people remotely, minimising the need to travel to health clinics and surgeries, particularly important for vulnerable patients. However prevention and remote care can only go so far in reducing the need for hospital treatment and within the current pandemic, the need for increased quantities of medically approved and tested critical care equipment is vital.

This edition of Focus explores some of the key technologies that are stimulating change in the medical market, in areas of diagnostics, treatment, assistance and care.

Avnet Abacus partners with the industry's leading suppliers of electronic components and solutions, offering access to expertise and guidance through every stage of the design process, helping medical technology designers and manufacturers successfully react and adapt to the ever changing healthcare environment.

We hope you enjoy reading this latest edition of Focus magazine.

Rudy Van Parijs
President, Avnet Abacus

AVNET ABACUS

Keeping the public healthy: preventative care for a well society

Marc Eichhorn

Product Marketing Manager Batteries
Avnet Abacus

'Today, the threats from diseases borne through air, water and other fluids, as well as those transmitted through direct physical contact is only too apparent.'

One of the first recorded examples of real science being used to improve public health comes from the case of Dr John Snow, who in the mid 1800s successfully identified contaminated water as the cause of cholera.

His breakthrough came from systematically tracing the cases of an epidemic to a public water pump in London's Soho district. The case is now often referred to as the Golden Square outbreak, because Dr Snow's analysis of the cases managed to put the pump, located in Broad Street, at the centre of the outbreak. Before that, the medical society's consensus was that cholera was caused by inhaling air contaminated with particles of decomposing matter.

Since Dr Snow's discovery, technology has continued to shape public healthcare. Today, the threats from diseases borne through air, water and other fluids, as well as those transmitted through direct physical contact is only too apparent. In many areas of the world, wearing a face mask and also gloves in public is common practice, even during times of low risk. More recent global events have focused public attention, as more people take greater responsibility for their own health and the health of the wider general public. So too are local and national governments, by putting in place greater measures to ensure public wellbeing.

Wellness and fitness

In a broader sense, many people are embracing technology to help manage their own fitness, using wearable devices to monitor their physical activity. This has been more about fitness and less about general health, but now there are examples of how wearables are also being used to monitor vital statistics, such as heart rate, and using this trend data to predict potential conditions that may be undiagnosed.

Using technology to support wellness in this way has much wider potential, but it is still largely restricted to those people who are proactively seeking out ways to improve their physical wellbeing. There is a greater need to deliver wellness solutions to everyone, at a national level and in a way that is essentially transparent at the point of care.

The use of contactless sensing in public spaces is already well established. Hand dryers and now also taps are almost exclusively controlled using proximity sensors. This removes the need to touch surfaces that may be contaminated. These are applications enabled by simple proximity sensors, which can be based on ultrasonic, infrared or even visible light sensing.

Keeping the public healthy: preventative care for a well society

Many of these applications are located in areas close to water and high humidity, which can add cost and complexity to the design if using an AC power source. Powering automatic soap dispensers and hand sanitisers using batteries can ease this design challenge. A soap or sanitiser dispenser typically uses a motor to push the liquid out of a nozzle; these motors present a high drain load to the battery, with high peak power requirements. It is important to take this into account when choosing the type of battery to fit as standard. For example, the Alkaline Intense Power range from Procell has been designed for exactly this kind of load, so can help minimise the service interval and cost of running.

More recently, there has been a large increase in the use of temperature sensing, which can be effective in detecting a fever. Elevated body temperature is one of the symptoms of an infectious disease and can easily be detected using relatively simple handheld infrared-based thermometers. These give near instant results, can be used at a safe distance and do not require extensive training.

'Researchers at the University of South Australia have developed a solution that can be mounted to a drone and mingle with crowds, looking for people with elevated heart and breathing rates, as well as measuring their body temperature.'

The technology used here typically employs the thermopile effect, which describes a material that can produce a voltage based on the amount of energy it is exposed to. In this case, the energy would be in the form of IR energy radiated by a part of the body. Thermopiles typically produce very low voltages, in the range of µV per °C, so the design of the sensor is critical to the efficacy of the temperature scanner.

Automated hand sanitiser.

Measuring the surface temperature of skin, or inside the ear, for medical reasons is covered by the ISO standard IEC 806019-2-59:2017, so when developing this kind of application, it is important to select a sensor that will support this requirement. An example here includes the thermometric infrared (IR) sensors from Amphenol, which integrate the thermopile, IR filter and a thermistor to provide temperature compensation, all in one, small, hermetically sealed package in a TO style can. Sensors such as these support various applications, including handheld temperature scanners, as well as scanning kiosks.

Thermopiles can also be implemented using MEMS technology, in the form of small systems-in-a-package. These devices can also integrate signal conditioning ASICs that produce a convenient I^2C output, making it even simpler to design temperature sensing devices. The D6T family from Omron is a good example of this.

Drones can be adapted to disinfect areas using ultraviolet light or alternatively monitor the health of people in public spaces.

Portable irradiation

Something that has become more important in recent times is the need to maintain higher levels of hygiene in public spaces. One innovative company addressing this need has developed an autonomous drone equipped with ultraviolet lights.

The science involved indicates that 3mJ of energy in the UVC bandwidth can provide greater than 99% disinfection to an area of 1cm by 1cm. The drone, developed by Digital Aerolus, is called the Aertos 120-UVC. Flying the drone at a height of 2m for 3 minutes will disinfect a surface area of 2m by 2m, as well as all of the air between the surface and the drone.

Drone technology is also being employed to monitor the health of people in public spaces. Researchers at the University of South Australia have developed a solution that can be mounted to a drone and mingle with crowds, looking for people with elevated heart and breathing rates, as well as measuring their body temperature. The image processing algorithms used can also identify people who may be coughing and sneezing more than average.

A similar device, but one that uses AI, was developed by researchers at the University of Massachusetts Amherst. Based on a Raspberry Pi, it uses a thermal camera and microphone array to capture sounds (but not, the team points out, speech) which are processed by a deep neural network to identify coughs and sneezes.

Another example of how UVC light can be used to provide protection comes in the form of the ProtectiveAir breathing device, manufactured by UK company Medi-Immune. The ProtectiveAir device is worn by the user and comprises a belt-mounted irradiation chamber connected to a face mask. As air is drawn into the chamber the UVC light source cleans the air before it is inhaled by the user.

Keeping the public healthy: preventative care for a well society

Keep your distance

We are all familiar with the concept of social distancing, but it is difficult to predict when it may next be enforced, or for how long. Maintaining a social distance may become the norm. This is an ideal application for innovative solutions, like the SafeDistance device from Lopos, a spin-off from IMEC and Ghen University.

'Health and wellbeing is moving closer to home, through technology that allows us to take greater control over our own safety and medical care.'

The Lopos device uses ultrawideband technology to provide a resolution of around 15cm. That means that once it comes within a predefined distance of another unit (with a tolerance of 15cm), it alerts the wearer using audible and visible indicators, as well as vibrating.

One of the main design challenges involved with this kind of device isn't necessarily the way proximity is measured, but how that information is conveyed to the user. If the device is wearable – and in order to be useful yet unobtrusive, it probably needs to be – it must be small and easy to use. It doesn't need to provide a lot of information, just an alert when the proximity limits are about to be reached. In this scenario, vibrating alerts can be highly effective.

One of the simplest ways to implement a vibrating alert in a low-profile device is to use an actuator based on piezoelectric material.

This kind of user interface is generally referred to as haptic and can be implemented using various devices, such as the PiezoHapt actuator from TDK. It works by applying an alternating voltage across a ceramic substrate, sandwiched between two metal electrodes. The Piezo effect causes the substrate to flex back and forth, which in turn deforms the electrodes, leading to a vibration that alerts the user. Devices like this can react much faster than those using a rotating mass to create a vibration, taking less volume and operating at lower power, making them suitable for small, wearable applications.

Conclusion

The subject of health and wellbeing is moving closer to home, through technology that allows us to take greater control over our own safety and medical care. In addition to any regulatory medical standards that must be met, the key design requirements here are not unfamiliar; size, power efficiency, portability, reliability and, increasingly, convenience.

Key trends and technologies in Medical applications

Interview: Hafeez Najumudeen

European Distribution Manager at Omron Electronic Components Europe

Hafeez Najumudeen is the European Distribution Manager at Omron Electronic Components Europe, a position he has occupied for over three years.

He joined the company in 2015 as a Product Marketing Manager. Hafeez has extensive marketing experience, including three years in product marketing with Yokogawa, and six years with Siemens Enterprise Communications. He has an MBA gained with TiasNimbas Business School, Netherlands/University of Bradford, UK and a Bachelor in Engineering, Electronics and Communications from the University of Madras.

What are the main trends you are seeing in the healthcare/medical technology sector in EMEA?

With over half a million technologies – from sticking plasters to full body scanners – the medical sector is one of the most diverse, which makes identifying a single trend difficult. But there is evidence to show that the rate of innovation in the medical sector is very high; three out of the top ten fields of technical patent applications are related to this area; medical technology, pharmaceutical and biotechnology. Medical technology is surpassed only by patents categorised as digital communication.

In addition, Europe has a positive trade balance in medical devices in the global market, with the main trade partners being the US, China, Japan and Mexico. This indicates the medical technology sector in Europe is very healthy and continues to grow.

One trend that is apparent is the increased use of data and its collection using advanced devices. This data not only assists heath providers and patients, but also helps in the design of new devices, making them more efficient. Recent events have also shown how important it can become to reduce the development and approval cycle for these products; the insights provided by data are also helping in this respect.

What are the key technologies that are enabling new applications and enhanced functionality in healthcare equipment?

New sensor technologies are constantly being introduced and evaluated, both to enable new applications and to improve the functionality of existing medical equipment. Historically, any sensor used in medical applications would typically have been based on a mechanical principle alone, but integrated technology has enabled the manufacturers of MEMS sensors to redefine this application space.

As an example, many companies are considering how pressure sensors can now be used to augment applications such as inhalers, to automatically detect the patient's breathing. Environmental sensors are now used to monitor the patient's environment, such as temperature, humidity, pressure, VOC and air purity.

Along with advanced sensing solutions, traditional e-mech components such as MOSFET relays, signal relays, tactile switches and FPC connectors are still needed in these applications, but it is apparent that new technologies are allowing the overall dimensions of medical equipment to be reduced, while functionality continues to increase.

Key trends and technologies in Medical applications

'The overriding requirement remains patient safety, and the necessity for approvals is unlikely to be relaxed in a post-COVID world.'

Do you see a trend where functionality from medical electronics is being adopted in other areas?

Standard medical practices, such as frequent and vigorous hand washing, the use of antibacterial solutions and symptom monitoring are all becoming more common outside of a medical environment. This is where devices like light reflective sensors can be used in non-contact automated door opening and soap dispensers. Other sensors are being used in medical devices to measure body temperature without the need for physical contact; a high temperature can indicate a potential fever.

These and other sensors like them are now being used to automate processes designed to promote hygiene, such as water and soap dispensing or door opening. The same technology has already been put to good use in automatic hand sanitisers, too.

We can expect more of these types of applications moving forward, as the general public becomes more familiar with the technologies and more accepting of its benefits.

Describe the key challenges that engineers face within the health care market

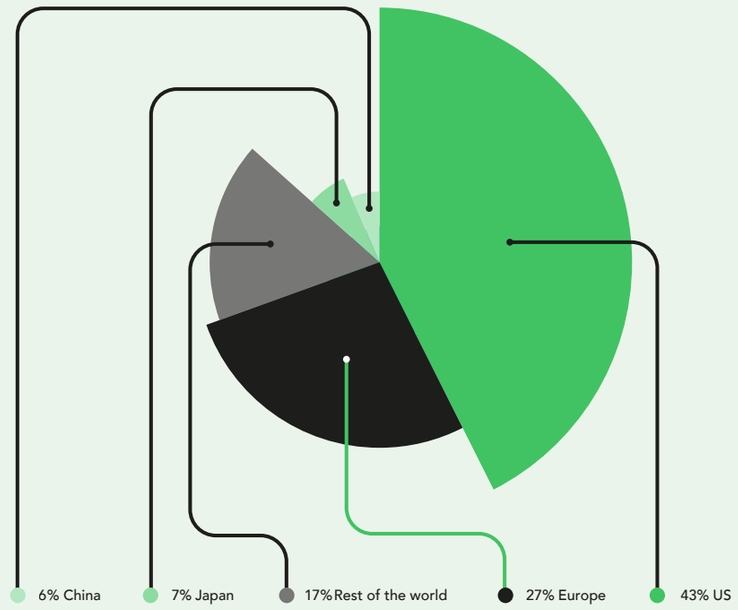
The overriding requirement remains patient safety, and the necessity for approvals is unlikely to be relaxed in a post-COVID world.

That puts greater pressure on engineers to bring new products to market in a shorter timeframe, as the rate of innovation is only increasing. Competition is essential to any market, and the medical sector is no exception.

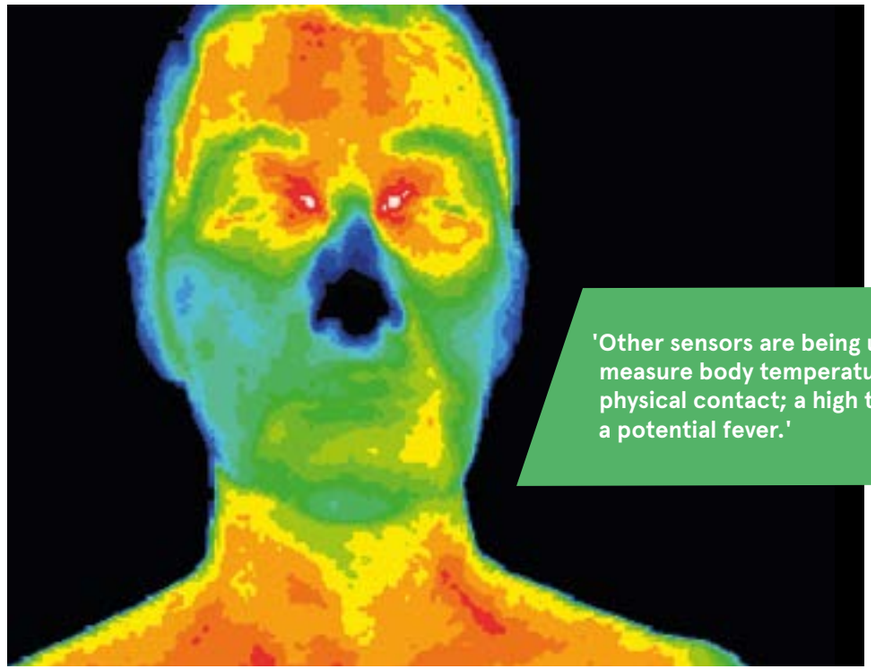
Working with suppliers who are familiar with the relevant approval processes and standards can help here. At the component level, specific medical approval is generally not required, but in Europe all medical products and equipment are classified under either Class I, Class IIA, Class IIB or Class III. At Omron, we encourage the customer to share this information so we can approve the use of our products based on this classification. We usually work with Class I and Class IIA medical products.

When it comes to Class IIB we approve the use of Omron products based on final application and if the customers can fulfil certain criteria such as adaptability of fail-safe mechanism in the design. With its long history in e-mech and sensor products, along with a strong global network, Omron can also help its customers and partners to develop new products that address the current social needs of the wider society.

Position of Europe in the global medical device market



(source: https://www.medtecheurope.org/wp-content/uploads/2020/05/The-European-Medical-Technology-Industry-in-figures-2020.pdf)



'Other sensors are being used in medical devices to measure body temperature without the need for physical contact; a high temperature can indicate a potential fever.'

Omron D6T thermal IR sensor

Omron

BUILDING GATE ACCESS CONTROL

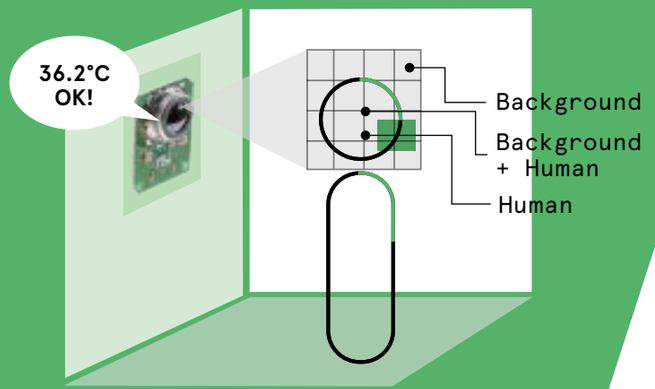
HUMAN TEMPERATURE MONITORING USING THE OMRON THERMAL IR SENSOR

The thermal IR sensor from Omron supports contactless temperature monitoring applications, such as body temperature assessment at an access gate.

With a measurement range of +5°C to +50°C in ambient temperatures of 0°C to +50°C and guaranteed accuracy of ±1.5°C, this can be customer calibrated to be accurate up to ±0.2°C.

Omron has a broad product portfolio of IR sensors of which the matrix type (4x4) is recommended for gate access control applications. The 1x1, 1x8 and 32x32 matrices can be used, for example, over varying distances, for forehead and wrist detection and with people wearing masks.

MATRIX TYPE 4X4



OMRON IR SENSOR KEY FEATURES

CONTACTLESS
EASY TO SEPARATE HUMAN AND BACKGROUND TEMPERATURE

I²C DIGITAL OUTPUT
EASY FOR CUSTOMER TO UTILISE DATA

PCB MODULE TYPE
PCB, MCU, CONNECTOR IS INCLUDED. EASY TO IMPLEMENT

OMRON IR SENSOR PRODUCT LINEUP

	D6T-1A-01	D6T-1A-02	D6T-8L-09	D6T-8L-09H	D6T-44L-06	D6T-44L-06H	D6T-32L-01A
Pixel number	1x1	1x1	1x8 (8pixel)	1x8 (8pixel)	4x4 (16pixel)	4x4 (16pixel)	32x32 (1024 pixel)
Appearance & Pixel image (*1)							
FOV (Field of view)	X: 58° Y: 58°	X: 26.5° Y:26.5°	X: 54.5° Y: 5.5°	X: 54.5° Y: 5.5°	X: 44.2° Y: 45.7°	X: 44.2° Y: 45.7°	X: 90° Y: 90°
Object temp	5 to 50°C	-40 to 80°C	5 to 50°C	5 to 200°C	5 to 50°C	5 to 200°C	0 to 200°C
Operating temp	0 to 60°C	-40 to 80°C	0 to 60°C	0 to 60°C	0 to 50°C	0 to 50°C	-10 to 70°C
Temp resolution (NETD)	0.02°C	0.06°C	0.03°C	0.03°C	0.06°C	0.06°C	0.33°C
Object temp accuracy	±1.5°C max (*2)						±3°C max (*3)
Consumption	3.5mA typ		5mA typ				19mA typ
Comm interface	I²C						
Supply voltage	4.5 to 5.5VDC						

*1 Actual output of D6T sensor is only temperature figure (not thermal image).
*2 Measurement condition (1) Tx=25°C, Ta=25°C (2) Tx=45°C, Ta=25°C (3) Tx=45°C, Ta=45°C.
*3 Measurement condition Tx=25°C, Ta=25°C central 16 pixel area

OMRON

For more information and to download the white paper on High frequency relays for high-speed differential transmission signals switching, visit avnet-abacus.eu/omron

C&K Medical switches are the skilled surgeon's interface to the active components in their advanced minimally invasive surgical tool. C&K is behind the haptics the nurse expects when using a critical diagnostic tool or patient monitoring equipment. C&K Medical switches are the feel the patient gets when using their Home Health Care equipment. Our switches create the soothing touch of the glucose monitors and drug delivery systems when testing or delivering critical medicines.

C&K is the leading provider of **Medical Device switches**. Our extensive switch portfolio is designed for quality, superior performance and long life cycles making us the first choice when you are designing mission critical medical devices. The medical switch needs to make a first impression with quality, superior electrical performance and a consistent professional feel. C&K Medical switches are designed and manufactured to make that first impression memorable and consistent with every use thereafter.

C&K switch solutions are designed with medical applications in mind. In addition to our complete product portfolio and the C&K Medical Switch concentration, C&K has been refining switch designs for the application. We are experts in **purposely built switch solutions**. C&K switch designs can detect a cap on or off, count a dosage, signal when the delivery is complete all while preserving power. We provide switches that ensure power is available in the device: after assembly, packaging, distribution and while in the hand of the patient as it is readied for use. Yes, C&K can do that. Better yet, C&K has done that. Inquire what C&K can do for you.

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C&K

Panasonic Electric Works
PhotoMOS relays

Panasonic Industry

PhotoMOS are solid state relays with MOSFET output featuring low off-state leakage current and stable on-resistance over the component lifetime. Miniature in design they save PCB space and thus are a suitable choice for a wide range of modern, light-weight and mobile medical and healthcare devices, such as endoscopes, blood pressure gauges or ultrasonic diagnostic equipment.

Longtime life-cycles through unlimited contact operations and a reliable non-aging contact resistance render the compact AQY210S and AQY280 ideal components for signal control and sensor input transmission of next-generation blood pressure gauges – respectively for I/O signal switching in diagnostic endoscope systems.


PhotoMOS SOP4 SMD

For signal control and the scanner circuit inside ultrasonic devices, the AQY22*R PhotoMOS would be the relay of choice as it ensures a continuously high operational speed and high frequency signal switching while coming in a compact housing.

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Panasonic INDUSTRY

How technology is enabling in-home healthcare and monitoring

Alessandro Mastellari

Technical Specialist
Wireless & Sensors
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'The IoMT makes use of technologies that have been around for many years, such as teleconferencing and basic internet connectivity, and adds a level of intelligence that has become synonymous with the IoT in general.'

Almost by definition, the Internet of Things doesn't differentiate, but it has reached a level of maturity that supports some partitioning.

The Internet of Industrial Things (IIoT) is one common example, but another is the Internet of Medical Things (IoMT). The term describes a shift that has been happening for some time, which is putting greater physical distance between healthcare providers and patients while at the same time and, perhaps ironically, allowing greater access to the professional care that people need.

The IoMT makes use of technologies that have been around for many years, such as teleconferencing and basic internet connectivity, and adds a level of intelligence that has become synonymous with the IoT in general. More recently, the IoMT has been one of the first vertical sectors to embrace artificial intelligence (AI) in a practical way, by using expert systems (a recognised form of AI) to augment the healthcare provider's own capabilities.

Together, these technologies allow patients to be monitored on a near-continuous basis, in the comfort of their own homes, and even be medicated remotely. As health services across the world feel the pressure of an increasing and aging population, we can expect this kind of more affordable and scalable healthcare to become a part of all our lives.

focus
Technology review

'The IoMT is also merging with the lifestyle sector, by bringing diagnostic capabilities to wearables already being used to monitor fitness, or record activity. For example, smart watches can be used to connect to a smart sensor to relay data via the cloud to a doctor for remote diagnosis.'

How technology is enabling in-home healthcare and monitoring

Bringing connectivity to healthcare

Healthcare relies on two things; access to relevant information, and the ability to synthesise that information. Professional providers and, increasingly, AI provide the synthesis, while in the IoMT it will be connected devices that provide the information; the raw data. This data will be collected using smart sensors, safely attached to the patient and securely connected to the healthcare professional.

Standards are now emerging that will help developers working in this area to create smart devices that are interoperable with a wider medical framework. For example, FHIR (pronounced FIRE), which stands for Fast Healthcare Interoperability Resources, is a standard API (Application Programming Interface) for exchanging healthcare records. It was created by the Health Level 7 International organisation, an ANSI (American National Standards Institute) accredited SDO (Standards Developing Organisation).

Microsoft has demonstrated how developers can use the FHIR standard to create IoMT devices for remote monitoring and share the data within its Azure cloud environment. To support this, Microsoft's engineers have created an open source FHIR-compliant server, as well as equipped Azure with the hooks needed to talk to remote medical devices.

Remote monitoring and national healthcare

As part of its Dynamic Purchasing System (DPS) framework, the UK's National Health Service (NHS) has already approved over 30 manufacturers as online consultation suppliers. This includes Medicspot, a company that uses internet-connected medical devices to provide remote diagnosis. The Medicspot Station is typically located within pharmacies, enabling patients to have private consultations with one of Medicspot's own doctors through a video link. The station's connected devices comprise a blood pressure monitor, thermometer, pulse oximeter, a close-up camera and a stethoscope.

Under the consulting doctor's supervision, the patient will carry out the examination by placing their finger in the oximeter, or holding the stethoscope to their chest, for example. Once a remote diagnosis has been made, the patient receives a prescription that can be filled at the pharmacy. The company claims its technology enables it to treat around 70% more conditions than those treated using other remote services, such as a video-only consultation with a GP.

The IoMT is also merging with the lifestyle sector, by bringing diagnostic capabilities to wearables already being used to monitor fitness, or record activity.

For example, smart watches can be used to connect to a smart sensor to relay data via the cloud to a doctor for remote diagnosis.

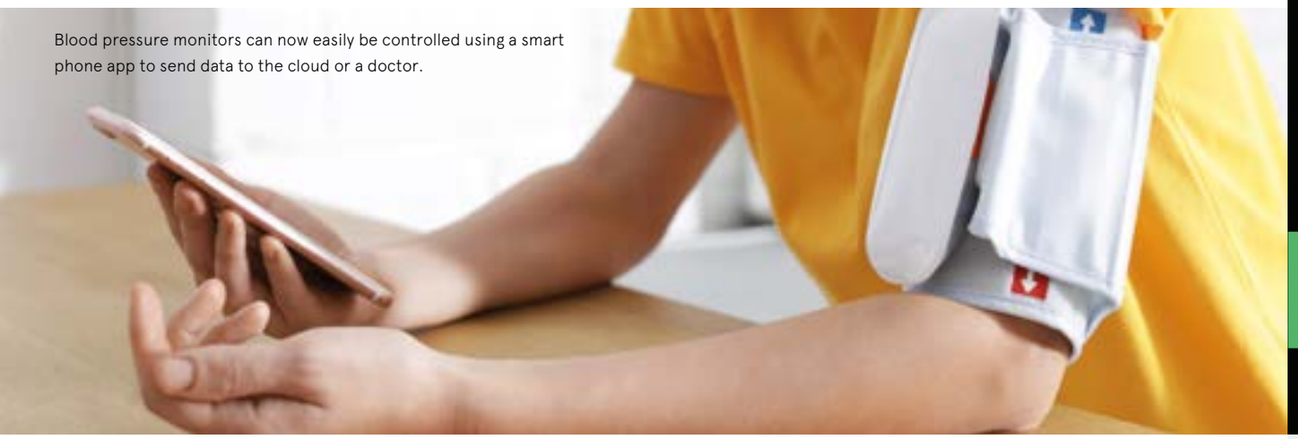
Continuous Glucose Monitors (CGMs) have been on the market for some time, but now they too are becoming 'smarter' through applications running on smart phones or smart watches. Once connected to the sensor, typically using Bluetooth, the app receives data from the CGM and displays the results to the wearer. The output may be something as simple as a good/bad indication, or more complex if the patient needs to know more. Essentially, the complex assessment of the raw data is handled by the computing power of the smart device, giving the wearer just the information needed to help manage their condition.

This is now being extended to include the automatic delivery of insulin. OpenAPS (Automatic Pancreas System) is an open source initiative created by a couple who hacked a CGM to use its data to control an insulin pump using a Raspberry Pi. Similarly, there are now examples of connected inhalers on the market aimed at asthma sufferers and people with COPD (Chronic Obstructive Pulmonary Disease). Propeller is a leading manufacturer of a connected sensor that fits to almost any manually operated inhaler to monitor the user's respiratory health. Like many smart IoMT sensors it connects to an app running on a smart phone/tablet to give the patient full access to the data and its meaning.

How technology is enabling in-home healthcare and monitoring

Adding value at every level

These applications are representative of the innovation happening in healthcare. At this forefront, where the internet meets the patient in their own home, there is a relatively high level of design freedom. Naturally, there will be requirements to meet, such as being in compliance with the Health Insurance Portability and Accountability Act (HIPAA). Generally speaking, however, almost any embedded technology can be used to enable innovative remote monitoring solutions.



Blood pressure monitors can now easily be controlled using a smart phone app to send data to the cloud or a doctor.

In the examples outlined above, the key technologies are sensors and connectivity. In some cases, the type of sensor used may be based on proprietary technology, developed by or for the manufacturer to provide a competitive edge. In many cases, however, the sensors used will be general purpose sensors. In wearable devices, those sensors may be based on MEMS technology, which offers a high level of functionality in extremely small packages.

As we all become more comfortable with being actively involved with our healthcare and not 'just' a patient, we will be willing to use a greater variety of devices providing functions that were once the remit of the professional care provider. One piece of home healthcare equipment that bridges this boundary is the blood pressure monitor. Taking an accurate blood pressure reading requires a level of competence that most non-medical people simply don't have, but that competence can now be embedded within a portable device. MEMS-based pressure sensors are a vital part of the solution here and include a number of products developed by Silicon Microstructures (a TE Connectivity company). It includes sensors that provide a 16-bit digital output only, as well as devices that provide a digital output and amplified analog output. The sensors are available in gauge, differential and asymmetric differential configurations.

A key benefit of MEMS technology is its small size, which makes it possible to integrate a large number of functions into a small outline. An example here is the SmartSense wireless multi-sensor module from Invensense (TDK). As well as its sensing capabilities, the module also includes a rechargeable battery alongside Wi-Fi and Bluetooth connectivity. This fully integrated system, including software, can measure pressure, humidity, temperature, orientation, vibration and magnetic direction. As such, it could easily form the basis for personal fall monitors, motion sensors or environmental sensing solutions for vulnerable people in their homes or care establishment.

There are many challenges to providing wider access to healthcare to a growing and ageing population, but it is also true that there are many technologies now able to address those challenges. Not all medical equipment needs to be operated by a healthcare professional, and, as we become more familiar and comfortable with having advanced technologies in our homes, we will also grow to accept how those same devices could also help us monitor and maintain our wellbeing.

The application of technology in the connected hospital

Andrew Hutton

European Product Marketing Manager
Power & Batteries
Avnet Abacus

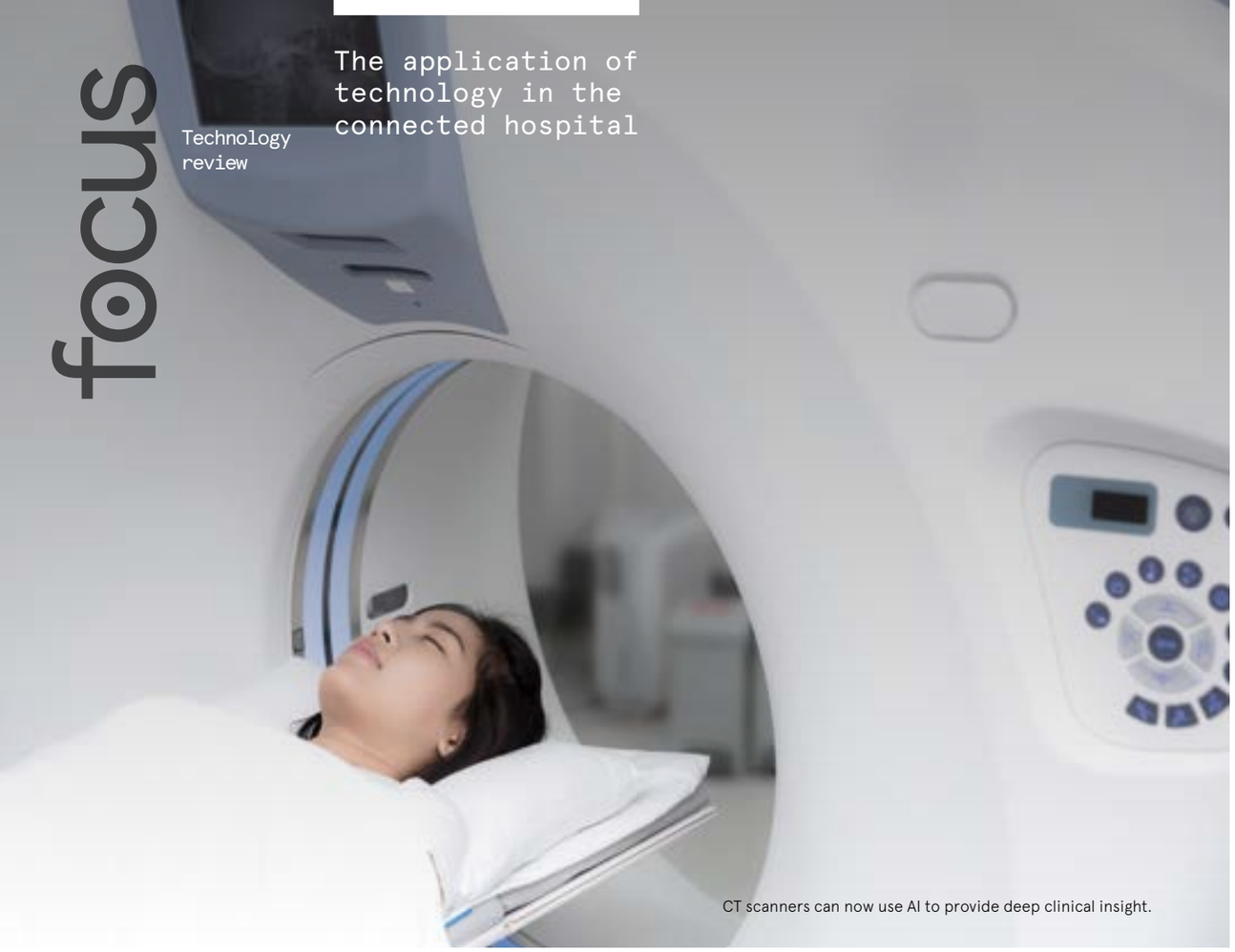
Professional healthcare has always relied heavily on technology. Medicine went through something of a revolution around 2000 years ago, when observational science started to predominate the way patients were treated. The science of medicine has been developing ever since and, as it has, clinicians have applied technology to help with their treatments. Today, the medical equipment used in hospitals, clinics and even ambulances is highly advanced, often largely autonomous and, now, likely to be connected to the Internet of Medical Things (IoMT).

As we continue to develop our understanding of human physiology, innovators are able to apply technology to augment and complement the clinician's own skills and experience. Recently, artificial intelligence (AI) has been enrolled in the diagnosis of diseases such as cancer, by using image sensors to examine scans and X-Rays in much the same way as a doctor would. This not only helps speed up the diagnostic process, but also gives doctors a 'second opinion'; one that gets better with experience but never suffers from fatigue.

This is just one example of how healthcare in hospitals is evolving, but clearly there is innovation happening at every level. The use of robotics is increasing rapidly, allowing experts to perform operations remotely.

'Innovators are able to apply technology to augment and complement the clinician's own skills and experience.'

The application of technology in the connected hospital



CT scanners can now use AI to provide deep clinical insight.

As well as revolutionising the operating theatre, new technologies are now implicitly linked to the diagnosis of chronic diseases, the analysis of cells and the general application of healthcare.

Medical imaging technology

Before any care can be administered, the healthcare professionals need to understand the condition they are treating. Often, the cause is much less obvious than the symptoms and this is one area where imaging equipment makes a real difference. Imaging encompasses techniques that cover almost the entire RF spectrum, from X-ray to visible, to ultrasound.

Medical imaging is a good example of how automation is changing the way patients interact with medical equipment. Repeated exposure to the forms of radiation used can be harmful to clinicians, so it is becoming more common for imaging machines to be semi-autonomous or remotely controlled. In some cases, the patients themselves may be given some level of control over the imaging equipment, allowing them to direct the sensing element to exactly the right area on their body.

The use of robotics is increasing in medical imaging, often in conjunction with greater integration of the imaging modality.

This may mean that a single piece of equipment performing one pass can carry out multiple scans using complementary imaging technologies, such as fluoroscopy, angiography and radiography. This kind of technological breakthrough is giving clinicians access to more realistic 3D images, delivered in real-time, using live X-ray imaging that doesn't require the images to be developed or processed offline before they can be analysed.

Medical analysis technologies for diagnostics

As well as imaging, the extent to which cellular analysis is now used to help diagnose conditions is considerable. Many of these techniques involve the analysis of blood, including tolerance tests. Other cells taken from the body can also provide deep insights. The condition of vital organs can be tested in this way, for example.

These assays of cell samples have traditionally been carried out by clinicians using microscopes to physically observe the individual cells. Now, this is an area where high performance image sensors and advanced algorithms (such as AI) are making a massive contribution. The development of cellular health assays using advanced medical imaging and analysis equipment is set to be a vital area of research and development in the near future.

Using technology for care delivery

One of the most critical elements in the provision of care is the administration of drugs. For in-patients, this is often carried out using a device known as a syringe pump. Essentially, these devices regulate the delivery of a drug, via a syringe, over a predetermined period. Since the introduction of schemes such as the Drug Error Reduction System (DERS), which was launched across Europe in 2002, much effort has gone into improving the way these devices operate. As a result, syringe pumps have become 'smarter', using technology to improve the automation of drug delivery.

This can help bring down the error rates associated with the prescribing, transcribing and administration of drugs through infusion pumps.

Smart infusion pumps have been around for well over 10 years now, but like everything else in the medical sector, they are evolving. While the working life of an infusion pump (or most other types of medical equipment) may be considerably longer than anything we may find in the consumer sector, the technologies used are remarkably similar, so the opportunity for feature upgrades is definitely present. These smart devices can be designed to allow hardware maintenance and software upgrades, so it is conceivable that smart infusion pumps will be designed in a more modular way, to support a long service without sacrificing in-service upgrades. Of course, they will still be subject to the standards and regulations in place to protect patients and clinicians, but it is technically possible to extend the value of medical equipment through in-service upgrades. This approach will be even more applicable to home health equipment.

Transferable technologies to support the IoMT

The majority of devices intended for use in a medical capacity will need to comply with a number of national and international standards before they can be put into service. It is worth remembering, however, that most of the components used are not, themselves, subject to certification. This means that many of the technologies developed for one sector are equally applicable to the medical market.

In terms of drug delivery, digital motors provide the artificial muscle needed by smart infusion pumps, while sensors form the key component in the closed-loop feedback path that allows the pump to deliver just the right dosage. The same design methodology applies to other types of medical equipment, such as ventilators.

The critical role of power

When a piece of medical equipment is quite literally responsible for monitoring or maintaining a patient's life, its power supply needs to be beyond reliable. Battery packs are often used now to provide the primary or secondary source of power. Suppliers such as RRC offer sealed battery solutions designed for medical applications, including defibrillators, infusion pumps and patient monitors.

'The development of cellular health assays using advanced medical imaging and analysis equipment is set to be a vital area of research and development in the near future.'

Technology review
focus

The application of technology in the connected hospital

When the power source is AC, a dedicated power supply solution will be needed. This is where fanless, intelligent modular power supplies like the CoolX 1000 series from Advanced Energy are positioned. Because it is fanless it creates no noise or vibration, as it only uses natural convection. In addition, it doesn't require a baseplate, making design-in simpler. With a 1000W output, it is ideal for a number of medical applications, including diagnostic equipment, medical lasers, dialysis machines and radiology imaging.

Providing the human (interface) touch

Medical equipment puts an even greater emphasis on the need for good, functional human-machine interface. Popular technologies here include encoders, pushbuttons and joysticks, all of which can be made to comply with the demands made by medical devices and are available from suppliers such as Grayhill. As a leader in this field, Grayhill has also developed a gesture recognition system that also includes a multi-touch surface, which it has named Instinct Touch Technology. The system's software tracks touches and interprets them as gestures.

These gestures can then be used to manipulate 2D or 3D images, for example. Grayhill's solutions are currently used in a number of medical applications, including front-panels for ventilators and portable defibrillators, as well as in bedside keypads and patient monitoring equipment.

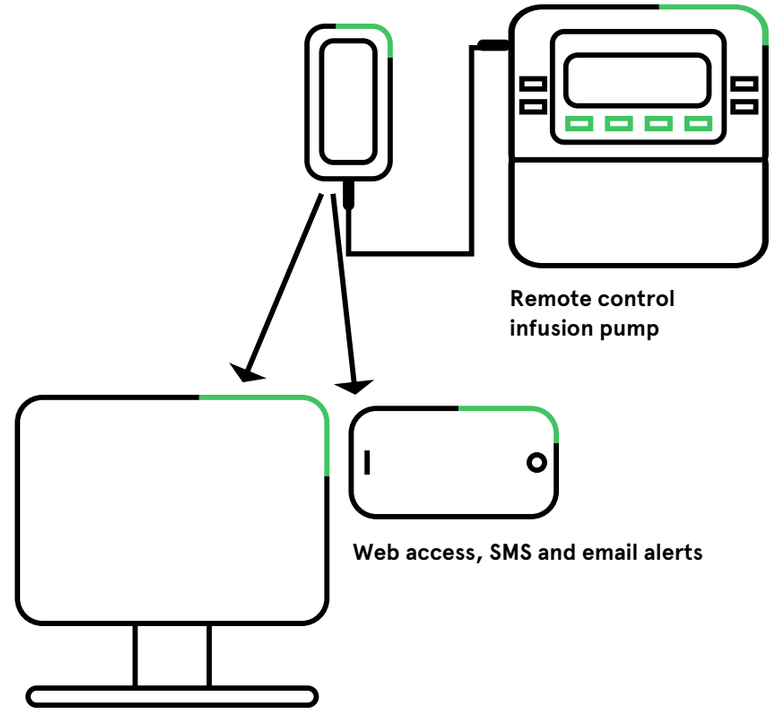
'Ingression protection requirements are likely to reach IP68. Of course, other industry-wide demands in the form of EMI/EMC will also need to be observed.'

Connectivity for the IoMT

The benefits of connectivity are not restricted to any single vertical sector, but the needs of the medical market are perhaps unique. The quality requirements are covered by the standard ISO 13485, so any solution used needs to support compliance to this standard. Often the application will need to support extensive cleaning regimes, so ingression protection requirements are likely to reach IP68. Of course, other industry-wide demands in the form of EMI/EMC will also need to be observed.

For convenience, many new designs will feature wireless connectivity and, here, Wi-Fi is as popular a choice as it is in other markets. Implementing a wireless local area network in a hospital environment, particularly for patient monitoring through bedside equipment. Monitoring equipment is typically portable or mobile, as it will be used when and wherever the patient needs it, so choosing wireless connectivity has clear and inherent benefits. Manufacturers targeting this application space include Panasonic with its dual band (2.4GHz and 5GHz), dual mode (Wi-Fi and Bluetooth) modules.

REMOTE CONTROL SYSTEM FOR HOME INFUSION THERAPIES



Infusion pumps are now part of the IoMT to provide continuous monitoring and control through web services (source: http://www.micrelmed.com/index.aspx?productid=5)

'The benefits of connectivity are not restricted to any single vertical sector, but the needs of the medical market are perhaps unique.'

Conclusion

Familiar technologies, such as touch-sensitive interfaces and wireless connectivity, are already used extensively in medical devices, but we can expect emerging technologies such as AI to have an important role to play here.

The demand for medical equipment remains strong and is an area that welcomes innovation. This presents significant market opportunities for manufacturers who are experienced in development medical devices, but it can also offer an attractive proposition for new market entrants.

Molex: Making the right connection in medical applications

Molex

The ultimate goal for medical devices is to optimise patient outcomes, and better technology often results in better healthcare. Manufacturers of such medical devices require increasingly complex circuitry to bring the latest medical design trends to life, and deliver real-time connections between medical professionals and their patients. As the demand for on-body devices continues to grow, the expectation is for devices to deliver increased functionality whilst providing low-profile, light, flexible, and comfortable end products. Some of the latest trends in these applications include:

- **Maximum power in a smaller package:** feature-rich devices now require more power in the same, or an even smaller space. These space savings are driving demand away from wire-to-board or flex-to-board connectors, and toward low-profile microminiature connectivity products
- **Real-time information requires faster connections:** reliability is critical in medical applications, and devices are required to share data faster than ever before. Sensors process and interpret more information at higher processing speeds, which requires higher signal integrity (SI). Plus, higher resolution displays demand increased EMI and SI performance
- **Space constraints require profile flexibility:** as the inside profile of medical devices becomes more space constrained, increased modularity limits the space from the connector and other components. This trends towards the design-in of micro connector ranges with multiple profile and orientation options.

BUT WHAT ARE THE MANUFACTURERS AT THE HEART OF THE GROWTH IN THERAPEUTIC, DIAGNOSTIC AND MONITORING APPLICATIONS DOING TO ACHIEVE THIS?

At Molex, engineers are developing cutting-edge solutions for the medical industry's most challenging problems. By leveraging innovations originally created for other markets, Molex is developing real-world solutions to help ensure optimal health monitoring.

One of the heroes amongst Molex's armoury is the SlimStack FSB5 floating 0.4mm pitch board-to-board connector. With medical devices ever decreasing in size, and the challenge to provide a low-profile without compromising on power, the SlimStack FSB5 series

Image courtesy of Molex

can support up to 10.0A of power supply. SlimStack also features a dual-contact terminal design for signal assurance through high shock and vibration, plus a wrap-around nail design for additional mechanical robustness – which is particularly important for on-body medical devices.

PRODUCT FEATURES:

- +/- 0.5mm of floating range in any direction for ease of mating and superior performance in high shock and vibration environments
- 125°C operating temperature
- High speed supports up to 6Gbps
- Offered in multiple mating heights

SlimStack

Additional Molex components suitable for medical applications include:

PICO-LOCK WIRE-TO-BOARD CONNECTORS

- Side positive locking system for high retention force and maximum space savings
- Ultra-low-profile right-angle design
- Up to 3.5A per circuit design

PICO-CLASP WIRE-TO-BOARD CONNECTORS

- Design flexibility with multiple pitches, mating orientations, dual-and single-row options
- Robust low-profile mechanical locking system for optimal retention force

EASY-ON 0.5MM-PITCH FFC/FPC CONNECTORS

- Multiple orientations, including vertical and right angle
- Large range of actuator styles for design flexibility and robustness
- Multiple profile options for maximum space savings

For more information visit avnet-abacus.eu/molex

Amphenol ICC BergStak HS™ 0.8mm board-to-board connector

Amphenol ICC

The FCI Basics BergStak HS™ connector family is the flexible solution for high speed applications requiring fast data transmission, high signal quality, and time-proven reliability under extended periods of application. With high-speed data rates that support up to PCIe® Gen.5 32Gbps and UL94V-0 high temperature LCP material, making it ideal for various harsh environments including medical applications.

FEATURES

- 120 positions from 40-140
- Stack height: 5mm
- GND: single and double
- Scoop proof housing
- RoHS compliant
- Easy manual assembly

APPLICATIONS

- Medical
- Data
- Industrial automation

For more information visit avnet-abacus.eu/amphenol-icc

Hirose FX10 series

Hirose

FunctionMAX

Hirose's FX10 series meets the high demand for connectors that require up to 15+Gbps high-speed transmission capability. The series is designed for applications that need multiple stacking connectors on the same board and is part of the FunctionMAX product family, consisting of board-to-board connectors designed to meet the requirements of the industrial market with maximum functionality.

BENEFITS

- Number of contacts
  - Signal/ground: 80/8, 100/10, 120/12, 140/14 (with ground plate)
  - Signal: 96/120/144/168 (without ground plate)
  - 3-piece interposer: 120/144/168
- Contact pitch: 0.5mm
- Rated current: 0.3A
- Transfer speed (Gbps): 10 (2 piece), 15 (3 piece)
- Solder technology: SMT
- Mated height: 4-13mm
- Rated voltage: AC 50V
- Temperature: -55°C to +85°C
- Mating cycles: 50

For more information visit avnet-abacus.eu/hirose

Harwin EMC shield clips and cans

Harwin

Protecting lifesaving medical devices from electromagnetic interference is key to ensuring around the clock functionality. Medical monitors and equipment operate in an environment flooded with transmission signals, whether out in an ambulance or in a hospital. Even mobile phones are no longer banned from many hospitals. Some equipment, such as point-of-care ultrasound machines, generate their own signals from which the rest of the equipment needs to be shielded.

With electromagnetic interference (EMI) a real risk to medical equipment operation, internal shielding of critical PCB functions is essential. To meet electromagnetic compatibility (EMC) requirements, board-level shielding is important within all products.

Harwin's EMC shield clips and cans simplify the process of shielding sensitive components and circuits from RFI/EMI interference. Manufacturing time and costs are saved by eliminating secondary soldering operations of through-hole shield cans. Clips are ready for automated placement and shield cans are pushed into position.

This process removes grounding plane interference and heat damage to critical circuits is avoided. The can is easily removed, allowing easy access for rework or cleaning. The compact design has a small PCB footprint which is ideal for medical devices that have space and weight limitations. The clip and can combination ensure critical PCB devices are shielded and operate correctly.

Confidence in quality is important in the 'must not fail' medical industry. When one piece of vital electronic equipment can mean the difference between life and death, specifying Harwin EMC shielding products is a smart choice. Harwin is certified to EN9100D/AS9100D and has a proven history of success in the medical sector.

For more information visit avnet-abacus.eu/harwin

HARWiN

Avnet Abacus wins TDK European Distribution Award for third consecutive year

In June 2020, Avnet Abacus scored highly across four categories to be awarded TDK's European Distribution Silver Award in the international volume distribution category. This marks the third year in a row that Avnet Abacus has been recognised by TDK, a leading global manufacturer of electronic components, modules, systems and devices.

`Senten Manten' is a Japanese term that means `the perfect result, or full marks. TDK uses the Senten Manten system to assess distributors on their levels of performance and collaboration with the manufacturer across four categories: business performance; inventory management; contractual terms; and operational excellence.

'In a challenging market environment, it is a particular honour to win the TDK Silver Award,' said Hagen Götze, Senior Director Marketing at Avnet Abacus. 'We have again demonstrated our capacity for continued excellence in customer service and business development across the TDK product range and achieving a high score for three consecutive years brings extra merit. TDK's complementary portfolio and high-quality products provide us with the means to continue this success.'

Dietmar Jaeger, Head of TDK Global Sales Distribution, said: Avnet Abacus has firmly established itself as a top performer in its support for TDK over the past three years and is a worthy recipient of the Silver Award for international volume distributors. Consistently high levels of proficiency by Avnet Abacus' technical and commercial specialists continue to inspire customer confidence and contribute to sustained growth across the TDK portfolio.'

Avnet Abacus is an authorised TDK distributor throughout Europe and offers TDK's broad range of passive electronic components, including multilayer ceramic capacitors as well as aluminium electrolytic and film capacitors, ferrites and inductors, high-frequency components and modules, piezo and protection devices and sensors.

AVNET ABACUS

Avnet Abacus - a vital component in your success

Avnet Abacus specialises in interconnect, passive, electromechanical, power supply, energy storage, wireless and sensor products from the world's leading manufacturers, providing in-depth technical expertise and unrivalled supply chain and logistics support.

We're the smart connection between customers and suppliers, guiding your projects from idea to product, from product to market, and every step in between.

Wherever you are in your technology lifecycle, collaborating with Avnet Abacus can help you reach further. Find out more at **avnet-abacus.eu**