

Imaging Deck – Script

Title Slide:

- Introduce yourself
- Welcome audience to presentation/meeting
- Introduce the Surgical & Imaging business as follows

“I represent the Surgical & Imaging/Interventional team within our Medical business. The focus of our group is on solutions for medical devices used in the OR, Imaging, Radiology and Endoscopy fields.”

- Introduce imaging capability at TE

TE is a partner to leading companies offering imaging solutions. Our business is built upon a legacy of innovation, an understanding of the core engineering challenges in imaging both today and tomorrow and a wide range of integrated technologies and design supports.

Slide 2 – TE Medical

Today, the medical business at TE:

- Comprises over 4,000 employees of whom 350 are talented and experienced design engineers – we are experts in our field
- Has scale and velocity – we estimate that 120 patients are treated every minute with a medical device containing a TE technology
- Is proven. We are partners to more than 1,500 medical device companies across the globe – from the world’s largest medical device companies to innovative emerging medical technology companies

TE’s Medical business is built upon a legacy of leading and acquired brands:

- Precision Interconnect – a specialist in fine wire and medical cable assemblies
- AMP – a leader in high end connectors, deeply rooted in imaging applications
- Raychem – an innovator in material science and medical tubing
- Creganna Medical, a world leading partner for minimally invasive and catheter based technologies
- MicroGroup, a precision engineering partner for advanced surgical tubing
- AdvancedCath, an innovative catheter design and development company
- Measurement Specialities, a leading provider of advanced sensor solutions

Together we are the medical business unit of TE.

Slide 3 – Legacy

Before we look forward we should look back. TE is synonymous with pioneering engineering solutions for step changes in imaging for over 75 years.

Some highlights on this journey of evolution include:

In 1941, AMP, a TE company, innovated a method for solderless attachment of electrical terminations to wire, known as the crimped method. This method was highly efficient in a manufacturing environment – it was simple yet revolutionary. It changed the engineering solutions landscape where space was cramped. Around this same time, Karl Dussik first used ultrasound for

medical diagnosis of the brain. Over time, AMP's revolutionary technology was incorporated in ultrasound cable assemblies, forming the basis for the ultrasound cables that we still use today.

In 1972, National Electric Cable was formed developing cables for harsh environments. In 1984, and now renamed as Precision Interconnect, a TE acquired company, engineers had developed coaxial cable nearly as thin as a human hair. This new standard in ultra-miniature coax enabled production of highly flexible 128 conductor cable assemblies, unleashing a new era in smaller size solutions and enhanced image quality.

Moving to 1987, TE Connectivity partnered with Acuson, now Siemens, to develop a cable assembly for Transesophageal Echocardiography, revolutionizing how cardiologists diagnosed structural disease of the heart.

During this time, material scientists at Raychem solutions were also innovating new conductive solutions to enable high density image transmission and polymer solutions that were robust to the rigours of clinical and sterile environments. Raychem is an acquired TE company.

In more recent times, TE has enabled advancements in imaging across a range of areas from the automation of cable processing for cost efficient products, to high density solutions for improved clinical diagnostics and improved ergonomics for users. To this day, our solutions are to be found in many hospitals throughout the world such as the highly successful Comfort Cable, the first ultrasound cable that truly addressed ergonomic & repetitive strain injury issues for sonographers. Indeed, it was TE's advancements in automation and efficient processing of core connector and cabling throughout the 80s and 90s that drove down overall device costs, contributing to the proliferation of imaging we know today.

More recently, imaging has moved beyond an "outside-in" view of the body to an "inside-out" diagnostic tool and TE are at the forefront of this next wave of imaging evolution. For example, Endoscopic ultrasound (EUS)-guided biopsies for pancreatic disorders is now a routine diagnostic tool – TE's solutions can be found in multiple medical devices employed in such procedures - from the specialist needle of up to 1.5 metres length with echogenic tip to the endoscope assembly.

TE is enabling continued advancements in imaging.

Slide 4 – Imaging at TE, today

Today we broadly define our imaging solutions for application in 3 disciplines:

- **Sonography** – ultrasound that captures real time images of structures and movements within the body from echocardiograms to foetal monitoring
- **Endoscopy** – medical imaging via an endoscope or laparoscope where the scope device is inserted directly into the body to visualize an organ or structure
- **Intravascular** – catheter based imaging to allow physicians such as interventional cardiologists to see & model diseased vessels from inside inside the artery

Slide 5 - Enabling trends

Turning to the key trends in imaging today, we see 3 main aspects.

- When imaging, physicians want to see more to enable more accurate and precise diagnostics.
- Devices are decreasing in size, enabling great portability and POC (point of care) imaging. Improved screening and disease detection is not just happening in hospital settings but is moving to primary care settings or imaging on the front line. Portable diagnostics is a key driver of imaging in all care settings.
- Finally in the age of IoT (Internet of Things), all care givers are seeking to capture, retain and communicate more data. Advanced computational power in imaging is critical for this next wave in connected care.

TE are continuously innovating for these enabling trends. Our focus is on:

- High density imaging solutions for 4K, 8K and 3D imaging
- Miniaturization of devices – achieving the same, or enhanced outcomes with every smaller technology
- Increasing data acquisition through enhanced connectivity
- Integrating multiple functionality into the same device to transmit, power, signal – both analog and digital and/or fibre optics and interconnection with sensors in a single slim line and cost effective device

Slide 6 – the challenge ahead

Responding to these trends in imaging, there are technical challenges ahead.

- Enhancing signal performance and acquiring more data from an imaging device generally requires more wires.
- At the same time, we want device sizes to decrease in size so we now need to think about how we are going to pack these wires more densely to achieve a smaller overall solution.
- Finally, maintaining signal integrity is critical. This can only be achieved through more shielding and termination of a solution which competes with requirements for more wires that are more tightly packed.

These competing market needs and the technical solutions to realize these needs are trade-offs, they compete with each other.

As a backdrop against these competing needs are certain physical limitations. Human hands and the human eye have defined limitations in product assembly. When we approach the limits of human dexterity, cost of assembly begins to become inefficient.

Taking all of these factors together, there is a significant challenge to be addressed to realize a future of high precision, big data and increasingly smaller imaging devices. At TE, we are thinking about these challenges for our customers.

In response we have identified that it is critical now, more than ever, that medical imaging companies work with a full spectrum solutions provider from initial design to commercial manufacture. Decoupling design from manufacturing or fragmenting the supply chain across multiple vendors decreases the potential to optimize on the competing technical attributes of next wave imaging devices.

To address the limitations of human dexterity as outlined above, we continue to innovate in process technologies where advanced automation and new process techniques all have a significant impact.

Finally, we continue to innovate our technologies, offering new advancements in engineering for image quality, ergonomics and connectivity.

Slide 7 – One partner for all your needs

TE offer an extensive range of component technologies and sub-assemblies for imaging devices. Our key competences are in the engineering design & high production quality of each individual component and how we bring these components together for an overall effective design solution for your product.

Definition of each component/process technology:

Custom connectors: We work with our partners to develop custom connectors for their solutions from high density ZIF connectors and **PCB interconnects** incorporating electrodes & antennas to catheter connectors for the transmission of power, signal and data.

Cable technology: TE is acknowledged as a leading provider of cable technologies for high density, high speed and precise imaging. For example, our high density coax is pushing the boundaries for increasingly lower profile TEE. Our coax platforms enable customers to access modular designed solutions for a compressed time to market in NPI.

Materials science: materials science and engineering spans the development, processing and testing of materials. For example, we have engineered highly conductive materials to enable high density signal transmission as potential alternatives to wire constructions

MEMs (Micro-Electro-Mechanical Systems) connectivity: miniaturized mechanical, electro mechanical and sensor components for enhanced connectivity, for example, micro interconnect technology to connect directly to a sensor without the need for printed PCB solutions and where the symmetry of the wire matches the symmetry of the sensor. Our customers have the added benefits of working with our medical team in combination with our market leading sensor team to reach these optimal design solutions.

Catheters: Coupled with our leadership in interventional catheter technologies, TE have been innovating catheter based imaging methodologies for volumetric measurement for over 10 years. Together, both our interventional and S&I businesses are collaborating for the future in catheter based imaging including IVUS, ICE and OCT.

- IVUS – intravascular ultrasound imaging – ultrasound inside the artery via transducer on catheter tip, using sound waves to create an image of inside the blood vessel. Intravascular ultrasound (IVUS) has a typical resolution of 100-120 microns.
- ICE – Intra cardiac echocardiography – using Doppler imaging to visualize heart structures (heart chambers.) ICE can image, diagnose and aid the navigation of treatment catheters such as the guidance of electrophysiology ablation and valve delivery catheter
- OCT – Optical coherence tomography - a more advanced form of imaging for inside arteries, OCT has a typical resolution of 10 microns, enabling more precise and detailed diagnostics. As a comparator, it is 10 times more precise the IVUS. OCT is a very fast imaging modality, typically acquiring detailed images within 3 seconds¹. Unlike IVUS, an optical technology is utilized to generate images. This produces near-infrared light which is

¹ CathLab Digest <https://www.cathlabdigest.com/articles/Use-Optical-Coherence-Tomography-OCT>

absorbed by surrounding structures within the vessel e.g. lipids/proteins to produce detailed imaging of existing stent struts, lipid cores and restenosis or measurements of inner layers including intimal thickness.

Along with our design capability for imaging catheters, we are also vertically integrated for core technologies used in the construction of such catheters, for example **braided shafts** that are synonymous with intravascular imaging. These shafts are constructed from polymer & wire reinforced layers. We are experts in building such shafts to optimize for flexibility & actuation, shielding along the catheter wall and multiple internal channels while keeping overall catheter profile low.

Molding: With extensive molding operations globally, we have the capability to mold and overmold for a high volume assemblies. TE is vertically integrated for design, stamping, plating and molding of components with the support of a full test lab to verify product design effectiveness.

Fine wire: We efficiently design and manufacture, in large volume, for imaging solutions incorporating fine and conductive wire as small as 1/10th the diameter of a human hair. ² We consider TE to be an expert in this technology.

HS tubing: Our heat shrink tubing can be found in a vast array of imaging solutions from the finishing and shielding of endoscopic and laparoscopic shafts to the protection and insulation of devices.

Endoscopic assembly: Along with the assembly of system cables and connector, hand piece design and assembly we also specialize in endoscope assembly incorporating multiple functions. Some of our latest innovations (baby scope) combine fibre, imaging and fluid handling functionality.

Metal tubing: – We are specialists in large bore metal tubing offering a broad range of solutions for surgical, endoscopic and interventional procedures. For quick turn prototyping, we stock over 7M feet of stainless steel tubing from our *MicroGroup* team. We offer an online store with immediate shipment on certain standard sizes, getting our metal tubing into your hands within 1 working week. We can also custom engineer our metal tubing adding new micro components to deliver functionality such as articulation, irrigation, biopsy, infusion, guide channels etc.

Specialty needles: – TE are the premier partner to global leaders in the Endoscopic Ultrasound biopsy needle market. We offer a complete needle solution from handle to tip, incorporating custom and advanced materials, visualization features on the distal tip and solutions for exceptional navigation of the overall needle assembly both through and past the scope elevator. Our custom material science solutions are proven for superior physician handling, accurate and predictable navigation to the biopsy site, easier biopsy penetration and retention of needle efficacy during multiple deployment passes.

Single use videoscope: – We offer a single use video scope solution, designed and fully assembled by TE Connectivity.

² Average diameter of a human hair (Europe, US & Asia) is 1.0mm. 52 AWG wire (our smallest) is 0.01987mm in diameter.

Slide 8 – Product Solutions

For ultrasound and sonography, TE is your single partner for lightweight cables, high density wire termination for transducers and zero insertion force connectors.

We also provide a range of solution for endoscopic and laparoscopic devices including system cables & connectors, hand piece design and scope assembly. TE support product solutions for endotherapies administered via scope including specialty needles for Endoscopic Ultrasound guided fine needle aspiration.

For intravascular catheter applications we can design and build your complete device integrating solutions from across TE to include imaging technologies in the distal tip, steerable shafts with precise actuation and complex actuation handles and connector to system modules and power generators.

Slide 9 – Core Capabilities

We combine our core capabilities in discrete component technologies with our advanced assembly capabilities to deliver product solutions for probes, cables, connector, scopes and catheters.

Slide 10 – Integrated solutions

This slide provides a visual representation of TE technologies within our Surgical and Imaging business.

{Note to staff – the image will build from the cable assemblies on the bottom right to the device tips on the top right. The image builds in an anti-clockwise direction. Voice over the image as it builds.}

- Our solutions enable power, data and signal to generate, transmit and feedback along a range of devices.
- Our cable assemblies are custom built to terminate with companion connectors of varying degrees of complexity.
- Our fine wire assemblies integrated seamlessly to our deployment handle technologies – these can range from a handle for a simple mechanical surgical set, to an endoscope's light source connector or a cartridge module in a high end stapling device.
- Along the device shaft we provide highly engineered metal and heat shrink tubing solutions which terminate out to a range of device technologies at the distal tip. For example, fine wire termination on an ultrasound probe, the optical tip of an ICE catheter or simple surgical jaw.

Along this full continuum of device solutions from cable to tip we design, we manufacture and we assemble for the world's leading brands.

{Note to staff. For slides 8 – 13, please use as appropriate when presenting depending on your audience. There is repetition in here so it may not always be appropriate to bring the audience through every single slide. Golden rule applies – know your audience!}

Slide 11 – Innovating for tomorrow

We are co-creating technologies for the future and advancement of imaging. Here are some platform technologies in our current technology roadmap, including:

VERSIO is a connector for high density signal & power transmission in a low profile catheter. VERSIO is TE's innovation in response to an evolving market where medical devices offer more technical features and greater connectivity.

VERSIO features:

Technical features & benefits:

- Transmission of power & signal – catheter of the future
- High density signal – enables future imaging and data modalities
- 272 contact positions, 1" diameter – low profile, ergonomic, no loss of performance
- Integrated & shielded connector sub-system - shielding of signal to maintain integrity, shielding is integrated into a signal connector system – most existing systems feature multiple or larger connectors to maintain signal shielding
- High cycle capability – low insertion forces (easy fit connector) increases mating cycles and reduces overall cost
- Modular design – a platform solution, easily configurable for the individual customer's requirements/product application

Comfort NX is the next generation of our successful Comfort series cables which have become a standard solution for ultrasound. The Comfort cable series combine a light, flexible, durable cable with highly-reliable ZIF connectors and precision wire terminations. In addition, this lightweight cable is a leader in ergonomic design facilitating a low torque, easily maneuverable device in the hands of the sonographer.

Our latest in this series, Comfort Nx is a more compact design but with superior image resolution. The image to the right illustrates comparative testing of the ultrasound cable for a carotid artery.

Finally, we are also innovating a high speed imaging cable for next generation laparoscopic visualization of 4K and above. Moving towards an age of portability, the cable is compatible with USB-C connections and optimized for high speed transmission of detailed images. Its modular design means that TE engineers can partner to deliver a rapid design solution, driving overall product development efficiencies.

Slide 12 – Advanced Catheters

TE is a leader in enabling capability for advanced catheters. This image depicts how TE works with customers to integrate a range of discrete technologies for advanced applications.

TE's core expertise is in catheter design and development. We can work with our customer to integrate their advanced technologies such as sensor, fibre or RF ablation, providing an overall integrated solution. Connector solutions such as VERSIO bridge the link between the catheter and the system element of the overall solution.