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Technology guide
Soft & pliable electronics for NICU on-skin sensing devices

NICU market

The neonatal intensive care unit (NICU) is one of the most unique and challenging environments in terms of the design, function and use of monitoring equipment.

Neonatal care, particularly for premature infants, is complicated by the infants' fragility and by the need for a large number of tethered sensors to be attached to their tiny bodies.

These sensors are essential to detect complications early, and any devices developed for the NICU need to be able to provide reliable monitoring, even in an incubator with continuous humidity levels of 80-90%, at the same time ensuring the fragile patient's safety and comfort.

All materials used for patients should be designed to minimise discomfort



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Patient monitoring technology in the NICU

Current monitoring platforms require multiple hard-wired, rigid interfaces to a neonate’s underdeveloped skin to continuously monitor key vital signs like ECG, SPO2, respiration and skin temperature.

In addition to monitoring the standard vital signs, promising new sensor technologies are slowly being incorporated into routine neonatal monitoring practice like EEG monitoring to detect seizures, EIT* to monitor lung function and NIRS† to monitor tissue oxygenation.

Both existing and new on-skin sensors perform a critical function in ensuring the infant’s safety, and they are required to show a high level of comfort, safety and reliability

* Electric Impedance Tomography

† Near-Infrared Spectroscopy

Comfort

Especially skin-worn devices need to be comfortable to minimize stress.

Safety

Due to the infant’s fragility, extra care is necessary for choosing the materials for skin-worn devices to avoid damage to the skin.

Reliability

Devices used on NICU patients need to provide reliable continuous monitoring, even in a hot and humid incubator environment.

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Minimizing the risk of skin damage

In the NICU, the risk of skin damage and pressure ulcers due to medical devices is high.

According to clinical literature†:

- MDRPU* incidence rate in ICU is 6-7 times higher than in other hospital departments.
- In neonatal cases 50% of pressure ulcers are device-related - way above the average of 10-12%.

MDRPU risk factors (among others):

- Rigid materials (incl. cables)
- Sensitive skin

Medical devices used in pediatric hospitals that may cause MDRPU include:

- EEG (electroencephalogram) leads
- EKG (electrocardiogram) leads
- Oxygen saturation probes
- Temporary pacemaker/cardiac monitoring devices and cables

* MDRPU - Medical Device Related Pressure Ulcer

† Journal of Wound Care Vol. 29, No. Sup2a (International Consensus Document)



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Balancing safety & functionality

Safety precautions taken in the design of NICU sensors to avoid skin damage / pressure ulcers to neonates sacrifice functionality.

Device design considerations

Sensors attached to the infant's fragile skin are designed to minimize the risk of injury, for example by keeping any rigid or sharp-edged materials (ex: cable, connector) off the skin, reducing the adhesive strength so that it does not peel off the fragile skin, and keeping the sensor size as small as possible.

Challenge

Even with these safety considerations, it is impossible to eliminate the risk of skin injury.

In addition, the above design safety precautions combined with the hot and humid incubator environment can result in the sensors easily detaching from the skin, causing an inability to continuously monitor important bodily parameters.



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Skin-soft cable & sensor

Murata skin-soft electronics can simultaneously reduce risk of skin damage and improve adhesion to skin.

Reduce risk of skin damage

Soft and pliable substrate, tracks and encapsulation ensure that the risk of damage to skin is minimized, and both the thin cable and sensor parts conform perfectly to the skin.

Adhesion to skin

Because of the soft and pliable cable, the design restriction of keeping the rigid cable off the skin is lifted, and new options emerge to make a more robust and stable sensor attachment to the skin.

Integration with existing sensors

Due to thin and flexible interconnection method we can attach the pliable soft cable to an existing sensor as well as an existing back-end connector.

No electrode gel required

Murata is also developing dry electrodes, which make it possible to achieve very small electrode that does not need gel like conventional electrodes, improving both ease of use and safety.

UNDER DEVELOPMENT

Sensor

- Soft pliable substrate
- Mounting of sensor:
e.g. optical, temperature, electrode
(including dry electrode - small size, no gel needed)

Cable

- Soft, pliable substrate and printed tracks
- No pressure points or sharp edges
- Thin (<300um)

Thin, flexible connection

Allows soft cable connection to existing sensor and/or system.



Reduce risk
of skin damage and
improve adhesion to skin

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Soft and pliable electronics

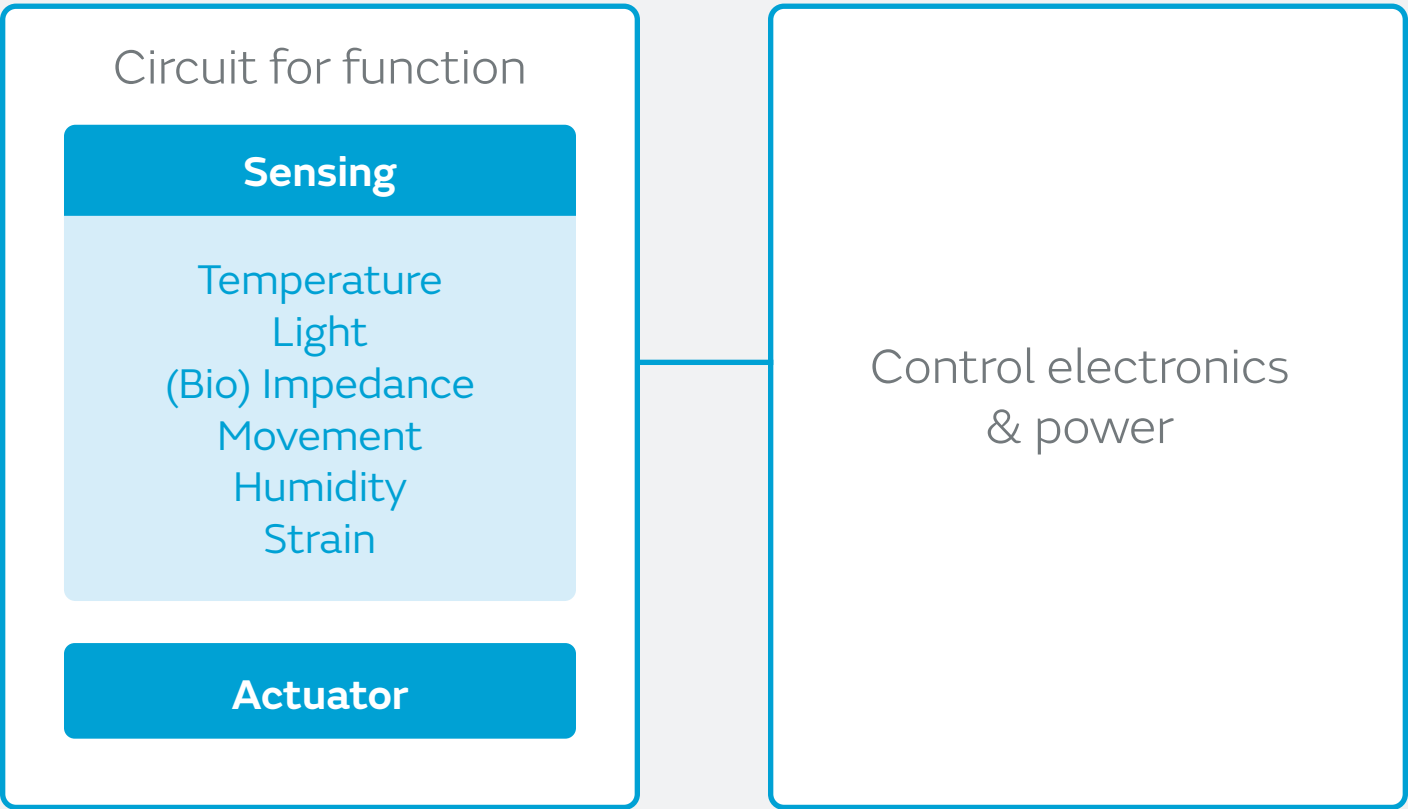
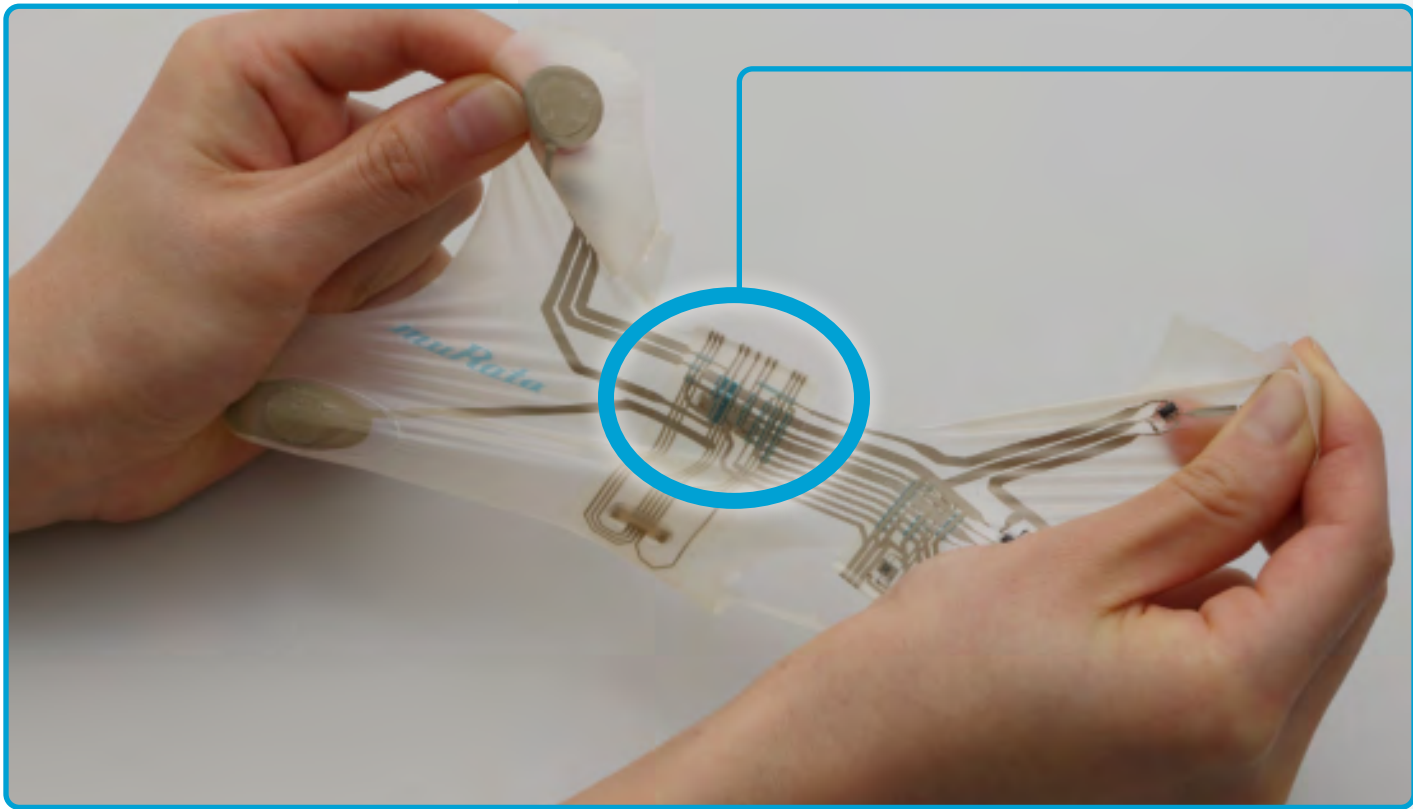
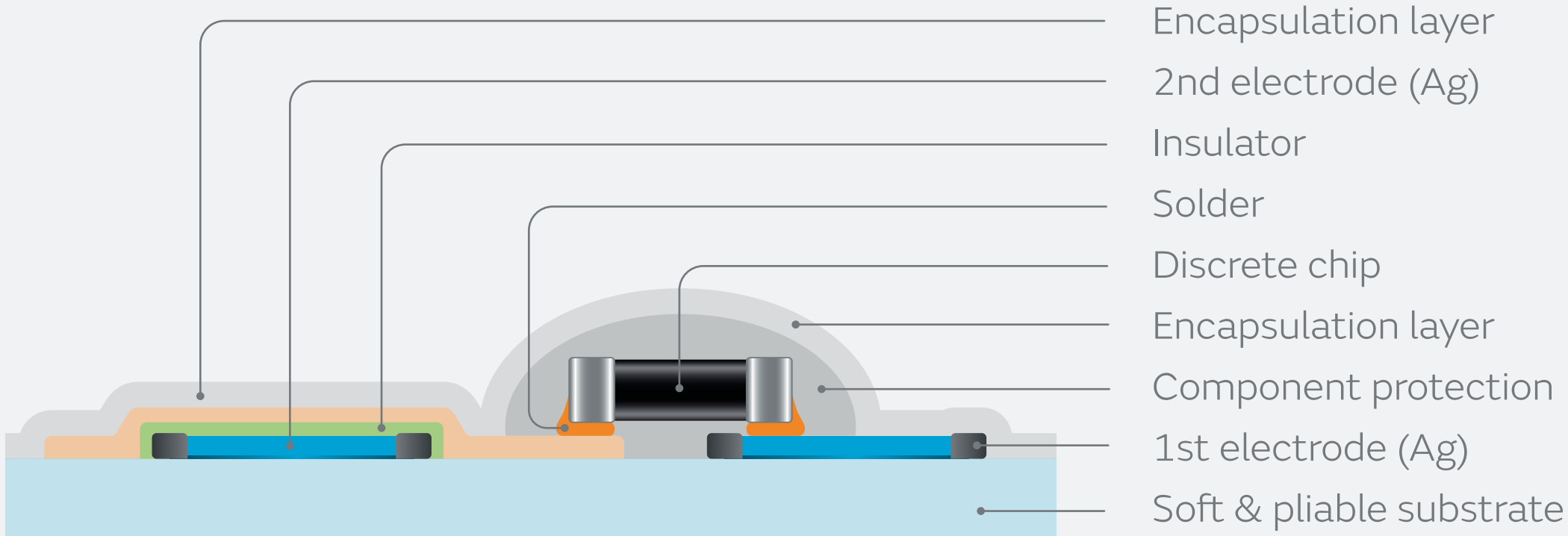
Murata state-of-the-art soft and pliable electronics integrate a wide range of materials and processes, from stretchable substrate and tracks to mounting of printed and SMD sensors and protective encapsulation.

Combining this with our experience with challenges like high humidity, our technology can provide comfort, safety and reliability to NICU on-skin sensors.

By leveraging flexible and thin connecting methods, it is also possible to integrate this technology with existing sensor probes and back-end electronic system connectors

Murata process and technology expertise

UNDER DEVELOPMENT



Printing

- Multilayer
- Stretchable tracks
- Stretchable & pliable substrate
- Electrodes

Design

- Stretchable electronics layout and circuitry

Mounting

- Accurate and reliable
- SMD components
- Sensors

Manufacturing

- Scalable
- High quality
- From pilot project to commercial

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About Murata

Murata is a global leader and supplier of advanced electronic materials, components, modules and sub-systems that fuel innovation in the healthcare industry.

Outstanding customer care

Since its formation in 1944, Murata has developed a reputation for putting customers and partners first, ensuring that their needs are listened to and met at every stage. As one of our valued partners, you will have the opportunity to liaise with our team and benefit from excellent customer care.

Manufacturing

From initial samples to high-volume production, Murata's facilities allow for scalable manufacturing and can provide reliable long-term supply. By partnering with Murata, you can gain access to an international network of manufacturing experts with a huge range of technical specializations - many of whom are at the top of their fields.

World-class technical tools & support

Murata partners can also benefit from access to a wide range of technical support tools like circuit model (SPICE) simulators and analysis equipment. With market leading technical tools on your side, you could vastly speed up the process of development.



The future relies on technology
...technology relies on Murata

**4 patents a day
for over 75 years**

World-leading innovation
Our thirst for innovation has driven us to register around 80,000* patents since our foundation ...an average of four per working day!

**<1.6 trillion
products per year**

Global manufacturing strength
As the world's leading electronic component manufacturer, we build and deliver more than 1,600,000,000,000 quality products in a year.

**\$15 billion
annual revenue**

A trusted partner
For decades, the world's leading technology manufacturers, across all sectors, have relied on us to deliver - again and again.

**80,000 includes expired patents.
Total currently-active global patents: 24,000.*

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Why Murata

Design support

Murata is known for being a leading innovator in the electronics space. With a wealth of experience across multiple industries and sectors, Murata engineers can collaborate with you to achieve a truly groundbreaking product with soft, pliable electronics.

Product customization & integration

For certain projects and applications, Murata can support its partners by developing fully customized products to suit their unique requirements, with the capability to integrate the hardware and software required to create a conformable electronics patch.

Along the way, Murata can draw on decades of experience and a wide-ranging portfolio of technologies that can assist in perfecting your designs.

If you would like to explore the feasibility of soft, pliable electronics for your application please contact us today

Contact us



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