

SONATA¹⁰⁰

Cochlear Implant





Main Entry: sonata
Pronunciation: sə-ˈnā-tə
Function: noun
Etymology: Latin sonare, to sound
an instrumental musical composition

Contents

The Latest in Cochlear Implant Technology	3
New Generation I ¹⁰⁰ Electronics	4
Safe & Reliable Implant Design	6
In Tune with the Future	8
Comprehensive Diagnostic Toolkit	12
Advanced Electrode Design	14
SONATA _{TI} ¹⁰⁰ Technical Data	17
Hearing Technology: Visionary Company	18
MED-EL Milestones	19

The SONATA_{TI}¹⁰⁰ features MED-EL's advanced I¹⁰⁰ electronics in a new compact titanium housing



The Latest in Cochlear Implant Technology

The SONATA_{Ti}¹⁰⁰ cochlear implant is engineered for unparalleled precision and performance. It combines a small-volume, thin titanium housing with MED-EL's powerful next generation I¹⁰⁰ electronics.

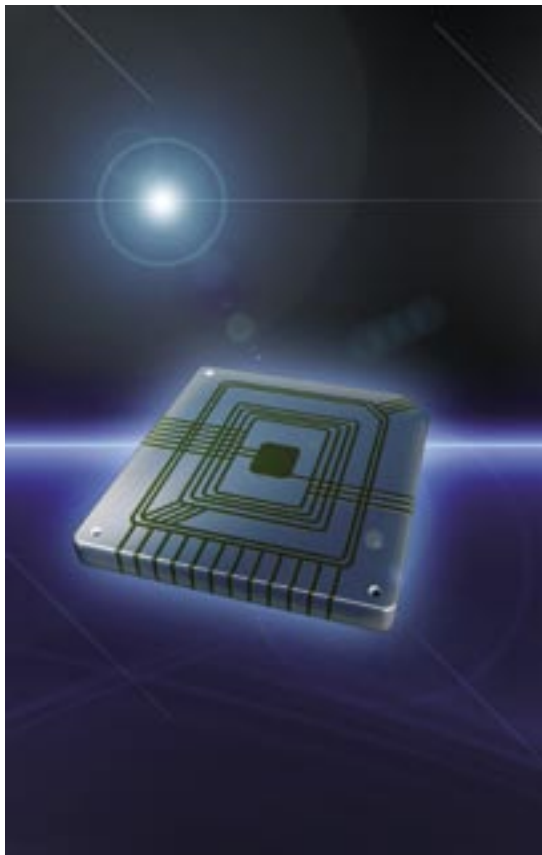
The SONATA_{Ti}¹⁰⁰ supports advanced developments offering implant users greater sound detail and clarity – particularly beneficial for music enjoyment and difficult listening situations. The SONATA_{Ti}¹⁰⁰ is also future-ready, designed to implement future upgrades and enhancements.



New Generation I¹⁰⁰ Electronics

MED-EL's highly advanced I¹⁰⁰ electronics platform provides implant users access to the fastest and most effective speech coding strategies available today. It supports FineHearing™ and Intelligent Parallel Stimulation™, the latest developments designed for greater sound detail and clarity. See p. 8 for more details.

New generation I¹⁰⁰ electronics
for unprecedented sound
detail and clarity

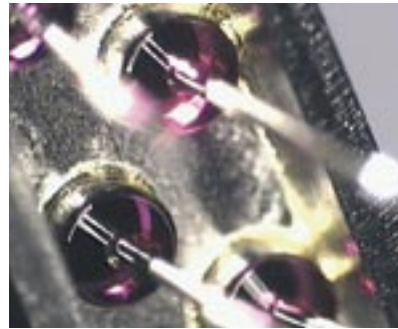


100% ON-CHIP DESIGN

The electronic components of the SONATA_{TI}¹⁰⁰ are arranged on a single custom-designed ASIC (Application Specific Integrated Circuit) microchip. The microchip allows more information to be processed while maintaining low energy requirements.

PRECISION STIMULATION

SONATA_{TI}¹⁰⁰ has 24 independent current sources for highly precise, high-rate stimulation over the entire length of the cochlea. Research shows that an optimal implant speed causes the auditory nerve to behave as in the normal hearing process. SONATA_{TI}¹⁰⁰ mimics this process (stochastic behaviour) by stimulating at rates matching the abilities of the recipient's auditory nerve.



Each hair-thin platinum wire is insulated with ruby crystals for highly precise transfer of stimulation to the electrode contacts

POWER EFFICIENT

MED-EL's patented power-efficient technology makes it possible to provide all recipients the benefits of high-rate stimulation with the comfort of a behind-the-ear (BTE) speech processor. This energy efficiency also translates into long battery life, typically 3 – 5 days of use per set of batteries.

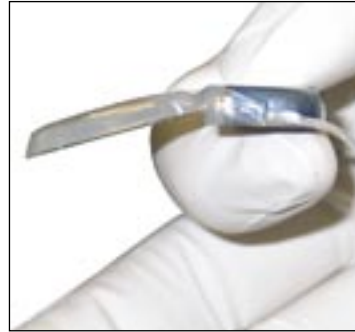
Safe & Reliable Implant Design

MED-EL cochlear implants are designed according to the highest safety standards for long-term reliability, durability and performance. Extensive research and development, highest quality materials, rigorous testing procedures and field data analysis ensure that MED-EL users receive the safest and most effective technology.



NEW TITANIUM HOUSING

The SONATA_{Ti}¹⁰⁰ is housed in a compact, lightweight package, combining robust titanium and flexible silicone. Its exceptionally small size and thinness makes it ideal for infants and toddlers as well as adults, and is also designed to allow minimally invasive surgical techniques and faster recovery. The flexible, contoured design allows the SONATA_{Ti}¹⁰⁰ to conform to the profile of the skull. Safety features include a 100% on-chip design, IRIS implant identification, comprehensive integrity checks and output capacitors.



Smallest stimulator housing, most lightweight cochlear implant available

IRIS IMPLANT IDENTIFICATION

MED-EL's unique implant identification feature, IRIS (Individual Recognition of the Implant System), prevents stimulation from occurring if the incorrect speech processor is worn. Each SONATA_{Ti}¹⁰⁰ has a unique identification pattern that is recognized and verified by the speech processor prior to stimulation. This is particularly important for children with bilateral implants and for school and group situations with numerous children using implants.

MRI SAFE WITHOUT MAGNET REMOVAL

The wide availability of MRI (Magnetic Resonance Imaging) makes MRI compatibility important when considering a cochlear implant. MED-EL cochlear implants are the only implants available that are MRI safe without requiring surgical removal of the internal magnet.



SONATA_{Ti}¹⁰⁰ is MRI safe¹ at 0.2, 1.0 and 1.5 Tesla:

- :: No surgical removal and replacement of the magnet
- :: No incision or swelling
- :: No recovery time affecting implant use or performance
- :: No additional risk
- :: No significant impact on MRI image quality

¹ Contact MED-EL prior to MRI examination for important guidelines.

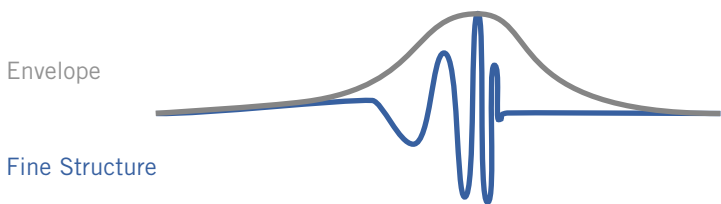
In Tune with the Future

For decades, the greatest challenges in cochlear implant performance have included music enjoyment and speech understanding in noise. The sophisticated I¹⁰⁰ electronics platform of the SONATA^{TI100} supports FineHearing™ and Intelligent Parallel Stimulation™ (IPS), technologies designed to provide greater sound detail and clarity in all listening situations. These innovations may be particularly helpful in enhancing music enjoyment and improving speech understanding in difficult listening situations.



FINEHEARING™

FineHearing technology focuses on providing implant users the fine details of sound, known as fine structure. In simplified terms, a sound signal can be separated into two parts: the envelope and the fine structure. The envelope is a general outline of a sound signal that reflects changes in loudness (amplitude) over time. The fine structure contains the detailed information that reflects the rapidly changing pitch (frequency) details.



Until now, cochlear implant systems have been able to transmit envelope information only. For the first time, MED-EL's FineHearing technology allows users to benefit from the subtle pitch and timing details of sound in addition to the envelope.

Research indicates that although envelope cues alone may provide enough information for speech understanding in quiet, music appreciation and speech understanding in noise depend more upon the details contained in the fine structure.

Channel Specific Stimulation (Temporal Coding)

Channel Specific Stimulation, also known as temporal coding, is used to capture rapidly changing frequency information using cues obtained from the phase (timing) of a sound wave.

Field Shaping

Field shaping is a means of controlling the electric potential distribution in the cochlea using sign-correlated stimulation. Precise determination of the location of stimulation between two electrode contacts allows pitches between frequencies to be created. This can improve both pitch perception and predictability.

Wider Frequency Range

MED-EL offers the deepest electrode placement available, providing greater access to all neural elements of the cochlea. The SONATA_{TI}¹⁰⁰ is designed to tonotopically match a frequency range of approx. 70 - 8,500 Hz. This wide range may be beneficial for music enjoyment and speech understanding, particularly for complex tonal languages.

INTELLIGENT PARALLEL STIMULATION™

In natural hearing, incoming sounds stimulate many areas of the cochlea at the same time. This type of stimulation is known as simultaneous or parallel stimulation. Until now, cochlear implants have not been able to effectively use parallel stimulation due to the occurrence of channel interaction.

What is channel interaction?

When the cochlea is stimulated by the implant, many electrical fields are created simultaneously. When these fields overlap, the sound signal is distorted, or “blurred”, and sound clarity is lost. This overlapping of sound signals is referred to as channel interaction.

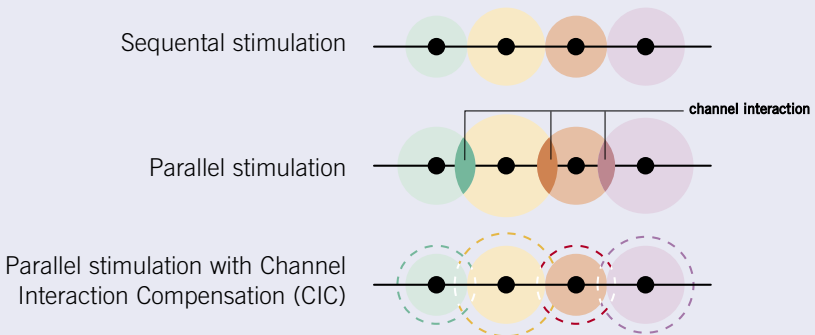
In order to provide parallel stimulation without the disadvantages of channel interaction, MED-EL’s Intelligent Parallel Stimulation* (IPS) uses sophisticated techniques, including Channel Interaction Compensation, Sign-Correlated Stimulation, and Triphasic Pulses, to control overlaps in electrical fields automatically. Research indicates that this may provide a clearer sound signal, particularly beneficial in difficult listening situations, e.g. noisy environments, and when listening to music.

Channel Interaction Compensation (CIC)

Channel Interaction Compensation mathematically calculates the spread of electrical current in real-time and automatically reduces the potential for channel interaction.

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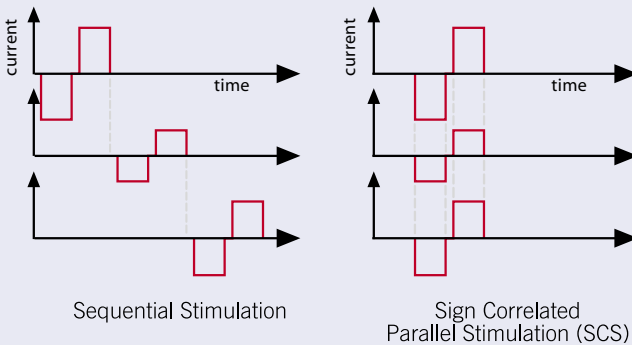
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*Feature will be enabled in an upcoming software release.

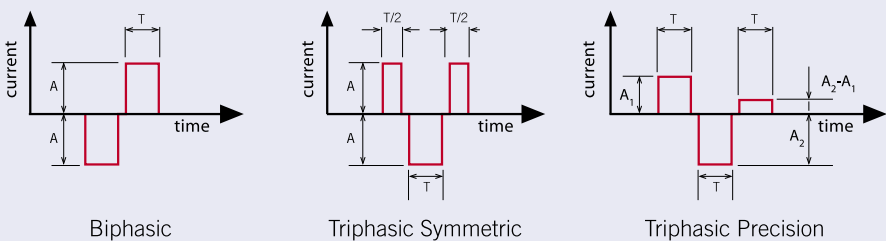
Sign-Correlated Stimulation (SCS)

In order to mimic the natural hearing process using parallel stimulation, each electrical pulse has to begin and end at the precisely same time. Until now, this precisely timed stimulation has not been possible, and the resulting mismatch in timing has caused "current tearing". MED-EL's Sign-Correlated Stimulation is designed to time-lock the onset (start) of each electrical pulse to occur at exactly the same time on multiple channels.



Triphasic Pulses

Cochlear implant systems have traditionally provided electrical stimulation using biphasic electrical pulses, resulting in a very small residual electrical field in the cochlea following each pulse. As these residual fields can contribute to channel interaction, the SONATA_{TI}¹⁰⁰ supports triphasic pulses to reduce these residual electrical fields and minimise channel interaction.

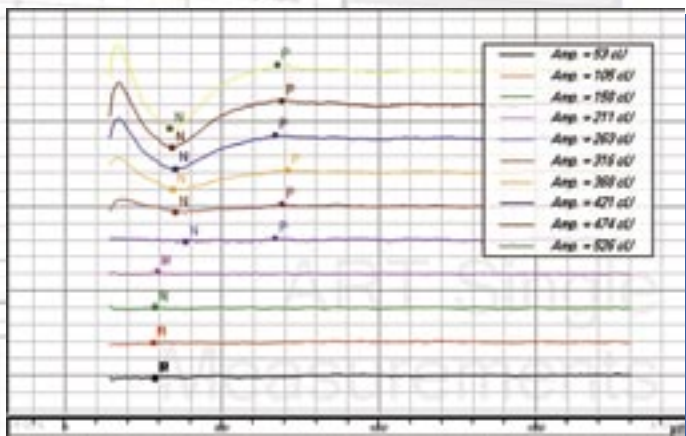


Comprehensive Diagnostic Toolkit

The SONATAT¹⁰⁰ is designed to support a wide range of telemetry and assessment functions, enabling professionals to test implant function precisely and to monitor the interaction between the implant and the auditory nerve.

The Comprehensive Diagnostic Toolkit (CDT) is a set of advanced diagnostic tools for use by cochlear implant professionals. CDT employs innovative techniques, including triphasic precision pulses and adaptive Sigma-Delta modulation, to obtain highly precise information from the implant.

- :: Impedance & Field Telemetry (IFT) – information regarding implant and electrode function.
- :: Status Telemetry* – information on the unique implant ID and certain stimulation parameters.
- :: Precision IFT* - extensive impedance and field telemetry measurements.
- :: Auditory Nerve Response Telemetry (ART)* – precise information on the physiological response of the auditory nerve to stimulation by the cochlear implant. ART employs MED-EL's patented adaptive Sigma-Delta modulation operating at 1.2 megasamples per second. This results in a higher resolution of the nerve response, reduced artefacts and better EAP predictability.



Example of an ART recording with variations in stimulation current

*Feature will be enabled in an upcoming software release.

EMMA C. :: age 3

Implanted June 2003 (left), January 2005 (right)

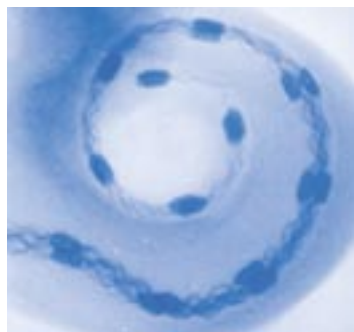


I CAN...

- Tell Emma jokes in the car
- Teach her new songs and watch her dance
- Talk to her from the next room
- Read her stories when she's on my lap
- Listen as she talks with her friends
- Feel pride in her age-appropriate language skills
- Understand exactly what she's saying
- Marvel at her abilities in the classroom
- Whisper "I love you" to her
- Believe she can do and be anything she wants

Advanced Electrode Design

MED-EL leads the cochlear implant industry in providing soft and flexible electrode arrays for deep insertion with maximum protection of the delicate inner ear structures. A wide variety of electrode options ensures an ideal match with each person's cochlea, including solutions for cochlear ossification and for candidates with residual hearing.



MED-EL deep insertion electrodes allow all areas of the cochlea to be stimulated (X-ray microcopy by Prof. Karl-Bernd Hüttenbrink)

STANDARD ELECTRODE ARRAY

The Standard Electrode Array offers the deepest insertion (approx. 31 mm) and widest contact spacing (2.4 mm) available today. It features 12 pairs of electrode contacts and is designed to provide stimulation of the complete frequency range of the cochlea.



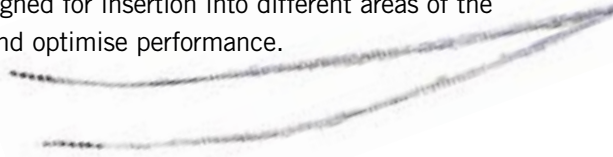
COMPRESSED ELECTRODE ARRAY

Specifically designed for candidates with partial ossification or malformation of the cochlea, the Compressed Electrode Array features 12 pairs of equally spaced contacts over a shorter distance to maximise the number of available channels.



SPLIT ELECTRODE ARRAY

Used for cases of severe cochlear ossification, the Split Electrode consists of two separate electrode branches, one with five pairs and one with seven pairs of contacts. The arrays are designed for insertion into different areas of the cochlea to maximise coverage and optimise performance.



MEDIUM ELECTRODE ARRAY

The Medium Electrode Array features 12 electrode pairs with moderate contact spacing, ideal when deep insertion is not desired or not possible due to anatomic restrictions.



FLEX^{soft} ELECTRODE ARRAY

The FLEX^{soft} Electrode Array features the same contact arrangement as the Standard Electrode Array and allows deep insertion into the apical region of the cochlea. The high mechanical flexibility of the leading section reduces insertion force.



FLEX^{eas} ELECTRODE ARRAY

The FLEX^{eas} Electrode Array is designed for short insertion into the basal cochlear turn. The high mechanical flexibility of the leading section reduces insertion force.



AUDITORY BRAINSTEM IMPLANT (ABI)

The Auditory Brainstem Implant (ABI) is designed for individuals with non-functional auditory nerves, typically due to Neurofibromatosis Type II (NF2). The electrode array features 12 contacts arranged on a soft, pre-shaped silicone paddle. MED-EL's comprehensive ABI electrode positioning system ensures optimal surgical placement.



For additional information on electrode arrays, contact your local CI centre or MED-EL office.

SONATA_{TI}¹⁰⁰ Technical Specifications



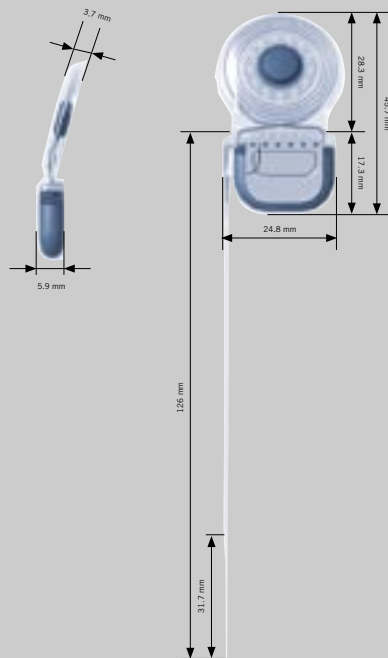
MECHANICAL DESIGN

Stimulator Housing

Length:	17.3 mm
Width:	24.8 mm
Thickness:	5.9 mm

Overall Implant Dimensions

Length:	45.7 mm
Width at coil:	29.0 mm
Width at stimulator:	24.8 mm
Thickness at coil:	3.7 mm
Thickness at stimulator:	5.9 mm
Weight:	8.6 g



STANDARD ELECTRODE ARRAY

Contacts

24 electrodes arranged as 12 twin surfaces
Geometric surface per channel: 0.14 mm*

Dimensions

Distance between electrodes: 2.4 mm*
Electrode diameter at apical end: 0.5 mm*
Electrode diameter at basal end: 1.3 mm*

I¹⁰⁰ ELECTRONICS

Pulse Shapes

Biphasic, symmetric triphasic and triphasic precision pulses

Stimulation Features

Sequential and parallel stimulation
Maximum pulse rate: 50,704 pulses per second
Pulse width per phase: 2.08 - 425.0 μ s/ph
Time resolution (nominal values): 1.67 μ s
Overall amplitude range: 0 - 1200 cu*

Comprehensive Diagnostic Toolkit

Impedance and field telemetry (IFT)
Precision IFT based on Sigma-Delta modulation
Status Telemetry
Auditory Nerve Response Telemetry (ART)

*typical value

Hearing Technology Visionary Company

Since MED-EL's founders developed one of the world's first cochlear implants in 1975, a strong research tradition has continued to fuel the development of technologically advanced hearing solutions. MED-EL offers implantable solutions across the hearing loss spectrum, including cochlear and middle ear implants, combined electric-acoustic stimulation and brainstem implants.



MED-EL hearing implants are used by thousands of children and adults in over 70 countries worldwide

MED-EL MILESTONES

- 2006** MED-EL launches the OPUS family of speech processors, containing new microchip technology for greater sound detail and clarity. The SONATA¹⁰⁰ cochlear implant is introduced, combining MED-EL's sophisticated I¹⁰⁰ platform with a new small titanium housing.
- 2005** Introduction of the MED-EL DUET, the first hearing system worldwide to integrate cochlear implant speech processing and hearing aid technology in one compact device.
- 2004** MED-EL launches the PULSAR^{ci100} cochlear implant, providing future-ready electronics in an optimized ceramic housing. MED-EL cochlear implants used in over 70 countries worldwide.
- 2003** Unparalleled speech understanding scores achieved by MED-EL users: 92.7% sentence comprehension and 70% monosyllable word recognition two years post-implantation. Acquisition of the Vibrant Soundbridge®, the first implantable middle ear hearing device for mild-to-severe sensorineural hearing loss.
- 2002** The TEMPO+ is the most widely used high-rate BTE speech processor and the most regularly recommended BTE for small children. MED-EL cochlear implant systems used in over 60 countries worldwide.
- 2001** U.S. FDA approval for the COMBI 40+ cochlear implant system. MED-EL cochlear implants used in over 50 countries worldwide.
- 2000** Superior results with the TEMPO+ BTE speech processor are shown in a multi-centre European study. TEMPO+ users excel in speech understanding and music enjoyment. MED-EL founders celebrate 25 years of cochlear implant research and development.
- 1999** Launch of the TEMPO+ behind-the-ear (BTE) speech processor, combining a highly flexible, modular design with advanced speech processing capabilities. MED-EL celebrates 10-year anniversary, opens new state-of-the-art manufacturing facilities.
- 1997** The COMBI 40+ Split Electrode (GB) is introduced for cases of cochlear ossification, making cochlear implantation available to persons previously not accepted as candidates.
- 1996** Introduction of the COMBI 40+, the thinnest cochlear implant available. First MED-EL patient implanted bilaterally with two COMBI 40 implants.
- 1995** The CIS LINK system is introduced to provide users of the Ineraid cochlear implant high-rate CIS stimulation.
- 1994** Introduction of the COMBI 40, the world's first multi-channel high-rate cochlear implant.
- 1991** MED-EL launches the world's first BTE (behind-the-ear) speech processor.
- 1989** MED-EL is founded in Innsbruck, Austria. Introduction of the COMFORT cochlear implant, containing both the antenna and the electronics in a robust ceramic case.
- 1977** Implantation in Vienna of the world's first hybrid multi-channel cochlear implant, developed by MED-EL's founders.
- 1975** Cochlear implant development started by MED-EL founders Ingeborg and Erwin Hochmair.

WORLDWIDE LEADER IN HEARING IMPLANTS

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