



Equipment Guide

OPUS 2 Processor



INTRODUCTION

If you're working with a child who listens with a MED-EL hearing implant, you'll soon want assistance in how to handle the equipment, how to verify that the device is working properly, and what to do if the system isn't working properly..

This guide is designed to help you become confident in handling and assembling the parts of the OPUS 2 audio processor; understanding all of the available wearing options, and objectively verifying that the device is working properly. It will provide step-by-step instructions to help identify and solve any problems that may arise, and will assist you in understanding how to care for the system properly.

The OPUS 2 processor offers a number of innovative features. While the internal electronics are identical to those found in an OPUS 1 processor; OPUS 2 varies quite a bit from the OPUS 1 and TEMPO+ processors. OPUS 1 and OPUS 2 contain a microchip with the capability to implement newer sound coding technology (though this new technology may or may not be activated for a particular child). OPUS 2 also offers a new curved look with no buttons, switches or knobs. Using the new FineTuner remote control, OPUS 2 processor settings are easily changed without removing the child's equipment.

Although the audiologist or the child's implant center typically handles advanced troubleshooting, many classroom teachers and therapists find that minor problems can be quickly and easily managed without disrupting the day's learning plan if they are comfortable troubleshooting and handling the equipment. Please keep this guide in a handy place, and refer to it whenever problems may arise.

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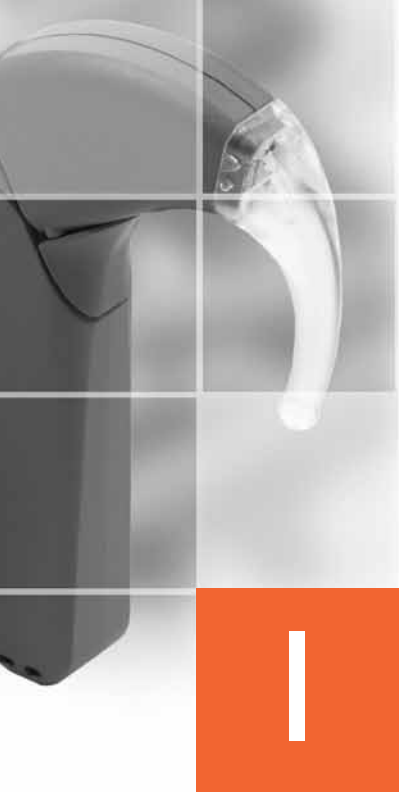
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NOTE:

This Guide deals with the OPUS 2 processors.

If you are working with a OPUS 1 or TEMPO+ processor (pictured above), please refer to the *Equipment Guide for TEMPO+ and OPUS 1*.



GETTING TO KNOW THE OPUS 2 PROCESSOR

PARTS OF THE SYSTEM

The MED-EL OPUS 2 processor consists of five main parts: a control unit, a battery pack, a coil, a coil cable and an earhook or other connecting piece. The system is modular, so the parts can be combined into different wearing configurations from day to day, depending on the needs of each child. In addition, each child receives a patient kit that contains a variety of accessories. Each wearing option will have the following parts:



Control unit

The control unit is just like a tiny computer. Inside, an electronic chip controls the entire system. It can hold several different programs (also called 'maps'), which contain the specific hearing settings for each child. Features of the control unit include:

Microphone port :: This tiny opening is where sound enters the processor. The microphone is most sensitive to sounds coming from the front, although it is able to pick up sounds from a wide area.

Locking earhook (optional) :: The OPUS 2 processor features a new earhook that can be secured to the control unit with a small pin to prevent young children from removing the earhook..

Microphone cover :: This small cover is used with the BabyBTE™ and ActiveWear configurations. It replaces the earhook for wearing options that are not worn at the ear and serves to protect the microphone.

LED indicator :: This small red light indicates a variety of status and error conditions. It should illuminate when the processor is first turned on and will indicate which position is currently active (with 1, 2, 3 or 4 quick blinks). If it begins flashing during normal use, please refer to the table on page 31 for additional details.

Integrated telecoil :: The telecoil is located in the OPUS 2 control unit and requires no additional parts or cables. Select telecoil settings using the FineTuner remote control to reduce background noise with hearing aid compatible telephones and induction loop systems.

IRIS safety feature :: The Individual Recognition of the Implant System (IRIS) is compatible with PULSARCI¹⁰⁰ and SONATATI¹⁰⁰ cochlear implants. This safety feature prevents unwanted stimulation to the child if the wrong processor is placed on the head. If an OPUS 1 or OPUS 2 processor doesn't transmit the correct internal serial number, then the implant will not stimulate. This is especially useful for bilaterally implanted children.



NOTE: Because the audio processor settings are specific to one child only, **never** switch processors between two different implant users or between ears for a bilateral user. No two ears have the same program settings!

The use of a processor belonging to another user could result in overstimulation.

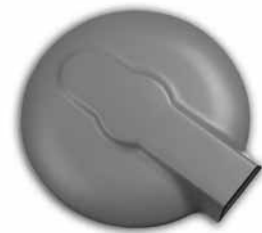
Battery packs

Each battery pack contains the batteries, an ON/OFF switch, and (for three of the battery packs) an option for input from assistive listening devices. The battery packs are separate from the control unit. The different wearing options are created by connecting a given battery pack with the control unit. Five different battery packs support six different wearing options. Each wearing option and corresponding battery pack is described in detail in the next section. For information on changing the batteries, see the “Batteries” section on page 7.

Coil

The coil is a round disk about the size of two stacked quarters. It is responsible for sending the electronic code across the skin to the implanted device. The coil contains some electronics, as well as a magnetic disk. This magnetic disk is attracted to the magnet in the implanted portion and, thus, holds the coil against the skin in the appropriate position. The magnetic strength inside the disk can be adjusted by the implant center if necessary. If you notice any signs of skin irritation in the area of the coil, contact the child’s parents or implant center. When the coil is placed over the implant site, you should be able to feel the magnetic attraction to the internal device. The coil will only ‘stick’ in the correct place so that the transmitter and receiver align properly – there is no way to put it in the wrong location.

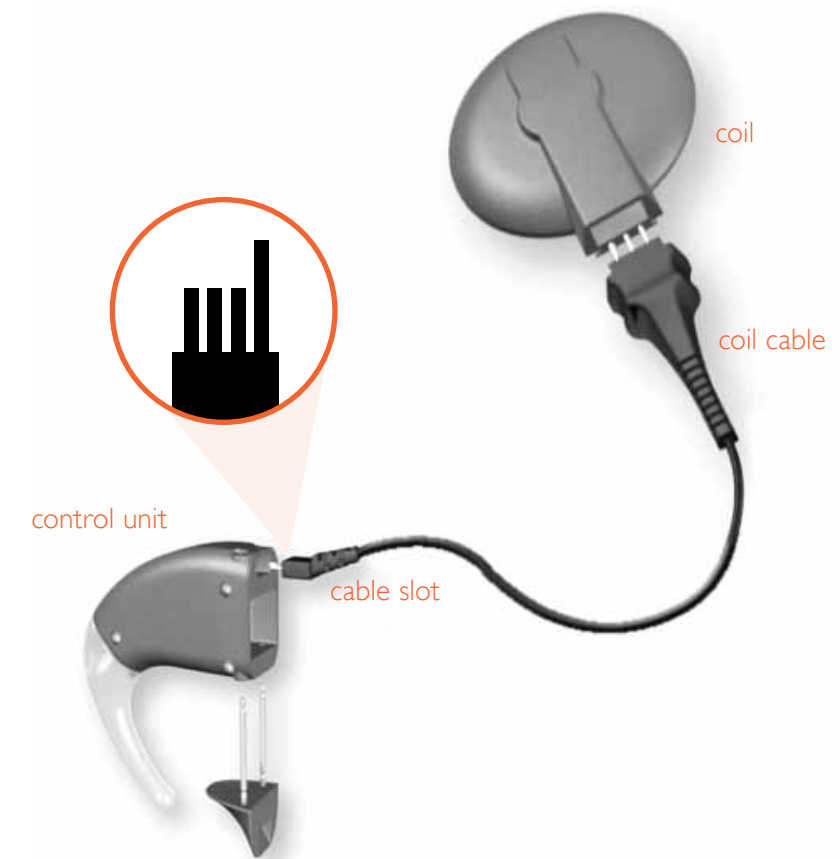
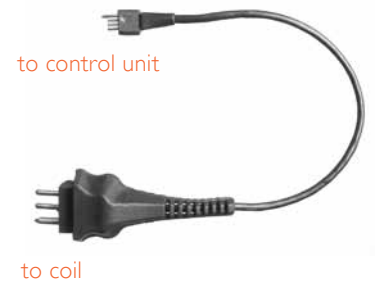
Several types of coils are available to meet individual needs – some have stronger magnets. Do not switch coil types between children without direction from the cochlear implant center. The implant audiologist can easily adjust the magnetic strength of the coil.



The coil cable

The coil and the control unit are connected by the coil cable, which carries information between the two components. The coil cable is available in different lengths, from 7.5 cm up to 28 cm (used for the BabyBTE™ configuration or to place the processor on the opposite ear from the implanted ear). There is only one correct way to insert the cable into the control unit and the coil (see right). The coil end of the cable has a particular shape that only fits one way into the coil – note the shape of the plug on the cable and the shape of the plug receptacle on the coil. On the control unit, special care should be taken to be sure that the cable is inserted properly, so that the longer pin is inserted into the proper side of the plug.

TIP: One of the coil pins is somewhat longer than the other three. When looking at the top of the control unit with the earhook/microphone cover pointing away from you, the cable should plug in so that the longest pin is on the right side.



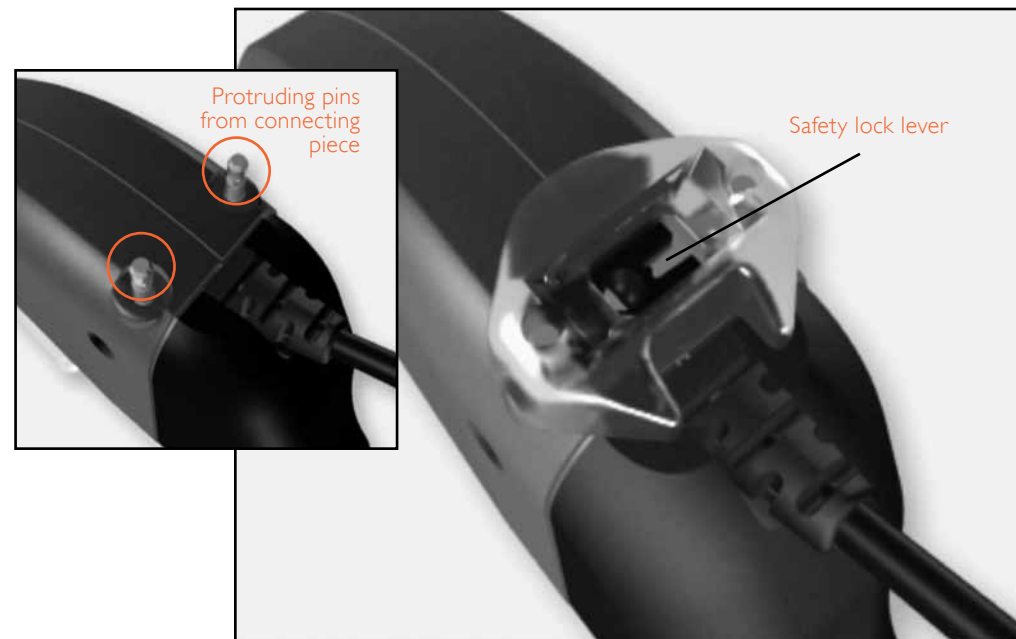
Connecting piece



Connection accessory

For all wearing options, the battery pack (or battery pack cable) is connected to the control unit by a small connecting piece. The **connecting piece** has two long metal pins that slide through two tiny holes in the control unit and battery pack. These holes line up when the control unit, coil cable, and battery pack are assembled.

Connecting pieces are also available in a 'locking' configuration that prevents active toddlers from taking the control unit and battery pack apart. When inserted into the control unit/battery pack assembly, the connecting piece pins protrude slightly from the other side of the processor. A **safety lock** can then be placed over the protruding pins. A small black lever inside the safety lock can be engaged using a pointed object (a paper clip works nicely). Simply slide the lever as shown in the photo (below) to engage or disengage the safety lock. Batteries can still be changed without removing the safety lock and/or connecting piece from its secure position.



Fixation bar (optional)

For some wearing options, an additional fixation bar or fixation clip is used to attach a part of the processor to the child's clothing. Two of the battery packs (straight and children's battery packs) have two tiny threaded sleeves on the side of the battery pack, near the labeling. The fixation bar or fixation clip can be attached to these battery packs using a small screwdriver.

ON/OFF switch

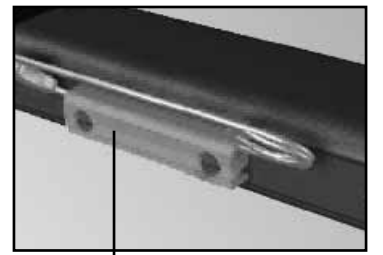
The power switch is located in the following places:

Standard, FM and DaCapo battery packs: The battery pack lock functions as the on/off switch. When the battery pack lock is in the down position (closed), the processor is on. When the battery pack lock is up (open), the processor is off.

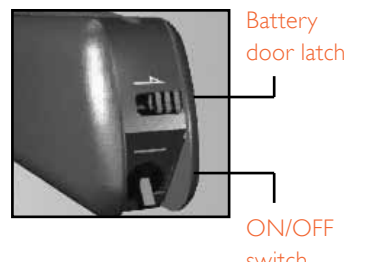
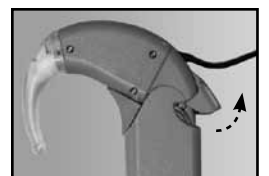
Straight and children's battery packs: At the tip of the battery pack, next to the latch that opens the battery door. It is labeled "I" for ON and "O" for OFF. Keep in mind that the children's battery pack is attached to the end of its own cable.



Remote battery pack: On the base of the battery pack labeled "ON/OFF."



The **fixation bar** can be used to secure a safety pin so that the processor can be attached to a child's clothing.



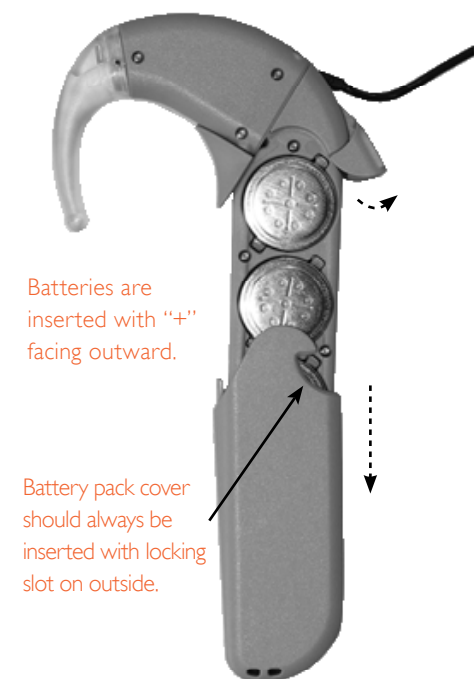
Battery pack covers

All battery pack options have a cover over the battery compartment, and some are designed to discourage children from tampering with the batteries. To open the battery compartment:

Standard, FM and DaCapo battery packs:

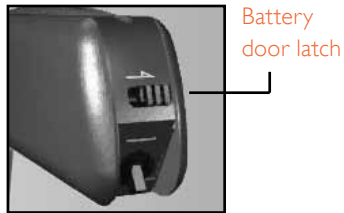
The battery pack cover on the standard and DaCapo battery packs is built like a sleeve. The FM battery pack cover also includes input for assistive listening devices. The battery pack lock functions as the on/off switch. Flip the battery pack lock up (this turns the processor off), and slide the entire battery pack cover off the battery pack.

NOTE: Be sure that the battery pack cover is inserted correctly. (See image at right.)



Batteries are inserted with "+" facing outward.

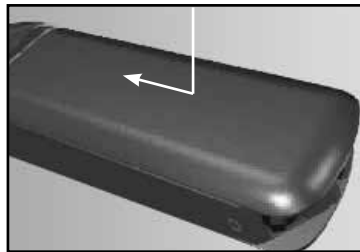
Battery pack cover should always be inserted with locking slot on outside.



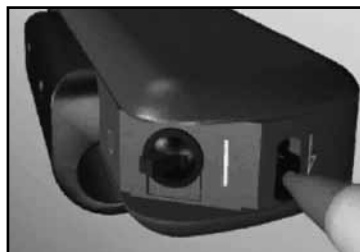
Battery door latch

Straight and children's battery packs:

A small latch at the end of the battery compartment slides to disengage the battery door. With the thumb of one hand, slide the latch in the direction of the arrow to release it, and hold it in the open position. Holding the battery pack between the thumb and index finger of the opposite hand, slide the battery door towards the end with the latch. The cover should release and open just a few millimeters. Lift the battery cover completely off.



Place the battery door directly over the batteries, as if it were almost closed, and gently slide it into place.



The children's battery pack has a **locking battery compartment**, to prevent young children from opening the battery pack.

When replacing the battery door, make sure that all batteries are inserted in the proper orientation. The flat side of the battery (usually marked "+") should be facing outward. Do not slide the battery cover over all of the batteries or attempt to snap it into place. Instead, simply place it directly over the batteries, as if it were almost closed, and gently slide it into place. It is not necessary to manipulate the latch when closing the battery door cover.

Locking battery compartment: The children's battery pack latch is designed to be slightly more difficult to open, as it is often used with toddlers and small children who are more likely to attempt to open the battery pack. It is necessary to insert a small object, such as a ballpoint pen or the tip of a paper clip, into the latch in order to slide it in the direction of the arrow.

Remote battery pack: The battery door latch is on the side of the remote battery pack, labeled "unlock." Slide the latch downward, holding it down, and the top of the battery pack will slide open to reveal the battery compartment. Insert the battery according to the diagram in the compartment. Slide the lid back into place.

Batteries

MED-EL cochlear implant systems have a patented power-efficient design that supports long battery life averaging 3-5 days using three size 675 high-powered hearing aid batteries. Using the **DaCapo** ear-level rechargeable battery pack, users can expect an average of 10-12 hours. Another alternative is the **Remote Battery Pack** which averages 1.5 days for a rechargeable AA and 2-3 days for an alkaline AA battery. Battery life is not dramatically affected by individual map settings, so all users are assured of being able to enjoy long battery life.

Note: Used batteries should be disposed of according to local regulations. Generally, it is best not to dispose of batteries with other garbage, as they can contaminate the environment. Batteries are toxic; if a child swallows a battery, call the nearest poison control center immediately. It is advisable to remove batteries from the battery pack if it will be stored for a long period of time.

Button batteries (size 675 HP)

For children using the standard, straight, children's or BabyBTE™ wearing options, high power hearing aid batteries, size 675, are required. It is critical that the batteries are labeled "high power;" as high power batteries tend to provide more consistent power over a long period of time. Some newer battery brands are labeled "ultra" or "extra" instead of "high power." MED-EL is continually evaluating battery brands. Please contact the implant center or MED-EL for recommendations of specific battery brands.

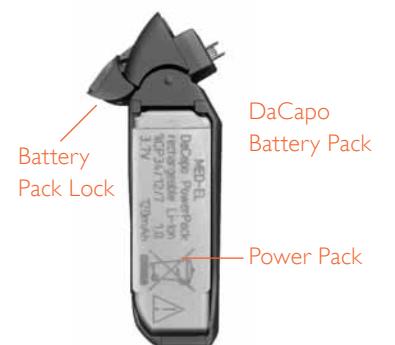
Most 675 hearing aid batteries are of the "zinc-air" variety. The power source is activated by the influx of air through tiny holes on the flat side of the battery. These batteries have a peel-off sticker that covers the holes until it is time to use the battery. When the sticker is removed, the batteries are activated and their useful lifetime begins. Zinc air batteries have a long shelf life as long as the sticker is intact. Once the sticker is removed, it must be used and cannot be deactivated (i.e., replacing the sticker will not conserve its useful lifetime or stop it from discharging).

DaCapo PowerPack

To replace the DaCapo PowerPack, you will need to have a fully charged replacement PowerPack on hand. In the event that you do not have access to a replacement PowerPack, any of the other battery pack options described in this guide may be used interchangeably. These batteries have approximately 500 charges each -- each charge should last about 10-12 hours.



A handy way to remove the used 675 batteries from the processor is to place the flat side of the coil against the open battery compartment. The magnet inside the coil will attract the batteries, removing them from the compartment.



AA battery

The remote (rechargeable) battery pack utilizes one AA battery. The remote battery pack uses one AA-size battery, either the rechargeable NiMH or non-rechargeable alkaline type. Each child receives 3 NiMH rechargeable batteries and a charger in the user kit. These batteries have a life of approximately 1000 charges each, and a charge should last 1 to 1.5 days. When the rechargeable batteries have reached the end of their useful lifetime, they can be replaced through MED-EL. Some families purchase rechargeable batteries locally. MED-EL cannot vouch for the quality of these batteries, but does not discourage families from trying other brands if desired. Regular alkaline AA batteries can also be used and should last 2-3 days. **Alkaline (non-rechargeable) batteries must NEVER be placed in the battery charger.**

Changing the batteries

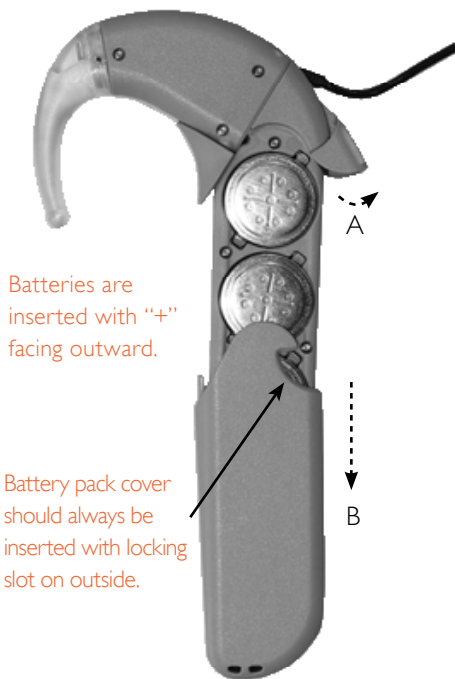
All battery pack options have a cover over the battery compartment, and some are designed to discourage children from tampering with the batteries. Simply (A) flip the battery pack lock up (this turns the processor off), and slide the entire battery pack cover off the battery pack. For battery packs using size 675 batteries, be sure the flat side of the battery (+) is facing you before closing the battery door.

When reinserting the battery pack cover, be sure that the **locking slot is positioned on the outside**. The battery pack cover is properly inserted only in this manner:

Changing the DaCapo rechargeable PowerPack

- 1 Open the battery pack lock to switch the processor off.
- 2 Slide the battery pack cover off the DaCapo Frame.
- 3 Remove the small white PowerPack from the battery frame.
- 4 Add a fresh, fully charged PowerPack.
- 5 Slide the battery pack cover over the DaCapo Frame and close the battery pack lock to switch the processor on.
- 6 The battery pack does not need to be disconnected to change the PowerPack.

For more information on the DaCapo Rechargeable System, see page 19.



WEARING OPTIONS

Ear level processors provide a compelling sense of freedom for parents and small children not to be encumbered by a large box worn on the belt or in a harness. The various wearing options provide the opportunity to wear the system in ways that are more secure to the body than the average ear-level system. The wearing options also allow the child to grow into a traditional ear-level placement as time and maturity permit, while taking advantage of all of the features of the advanced processing capability of the system.

In choosing a wearing option, the parent will probably consider factors such as:

- :: Will the processor be likely to fall off if the child is active?
- :: Will the child attempt to remove the batteries or change the controls?
- :: Do we want all, part, or none of the processor on the child's ear?
- :: Is sweating or moisture a problem?
- :: Do we prefer to use disposable or rechargeable batteries?
- :: Do we plan to use assistive listening devices?

It is important to remember that the audio processor consists of one control unit, with five different battery packs, that can be combined for six different wearing options:

- :: **Standard battery pack** – all-at-the-ear configuration with direct input for assistive listening devices
- :: **DaCapo Rechargeable Battery System** - combines the cost savings of a rechargeable battery with the convenience of an ear-level placement and direct input for assistive listening devices.
- :: **BabyBTE™** – securely placed on the clothing
- :: **Children's battery pack** – microphone placement at the ear with the added security of the battery pack attached to the clothing
- :: **Remote (rechargeable) battery pack** – low-cost alternative with direct input for assistive listening devices

The five battery packs can produce six different wearing options to facilitate wearing the system comfortably and securely regardless of age or activity level. Each wearing option and its assembly is described in detail on the next page.

THE WEARING OPTIONS
ALSO ALLOW THE CHILD
TO GROW INTO A
TRADITIONAL EAR-LEVEL
PLACEMENT AS TIME AND
MATURITY PERMIT.

.A variety of options for infants, young children, and adults

Standard Battery Pack

- Traditional BTE style
Wireless access for external devices
- CONTROL UNIT
 - STANDARD BATTERY PACK

BabyBTE™

- BabyBTE™ (for infants)
Activity pack for teens and adults
- CONTROL UNIT
 - STRAIGHT BATTERY PACK
 - LONG COIL CABLE

Children's Battery Pack

- Excellent for young children
Activity pack for teens and adults
- CONTROL UNIT
 - CHILDREN'S BATTERY PACK

DaCapo Rechargeable Battery System

- Cost-savings combined with the convenience of ear-level placement
Optional input for assistive listening devices
- CONTROL UNIT
 - DACAPO BATTERY PACK

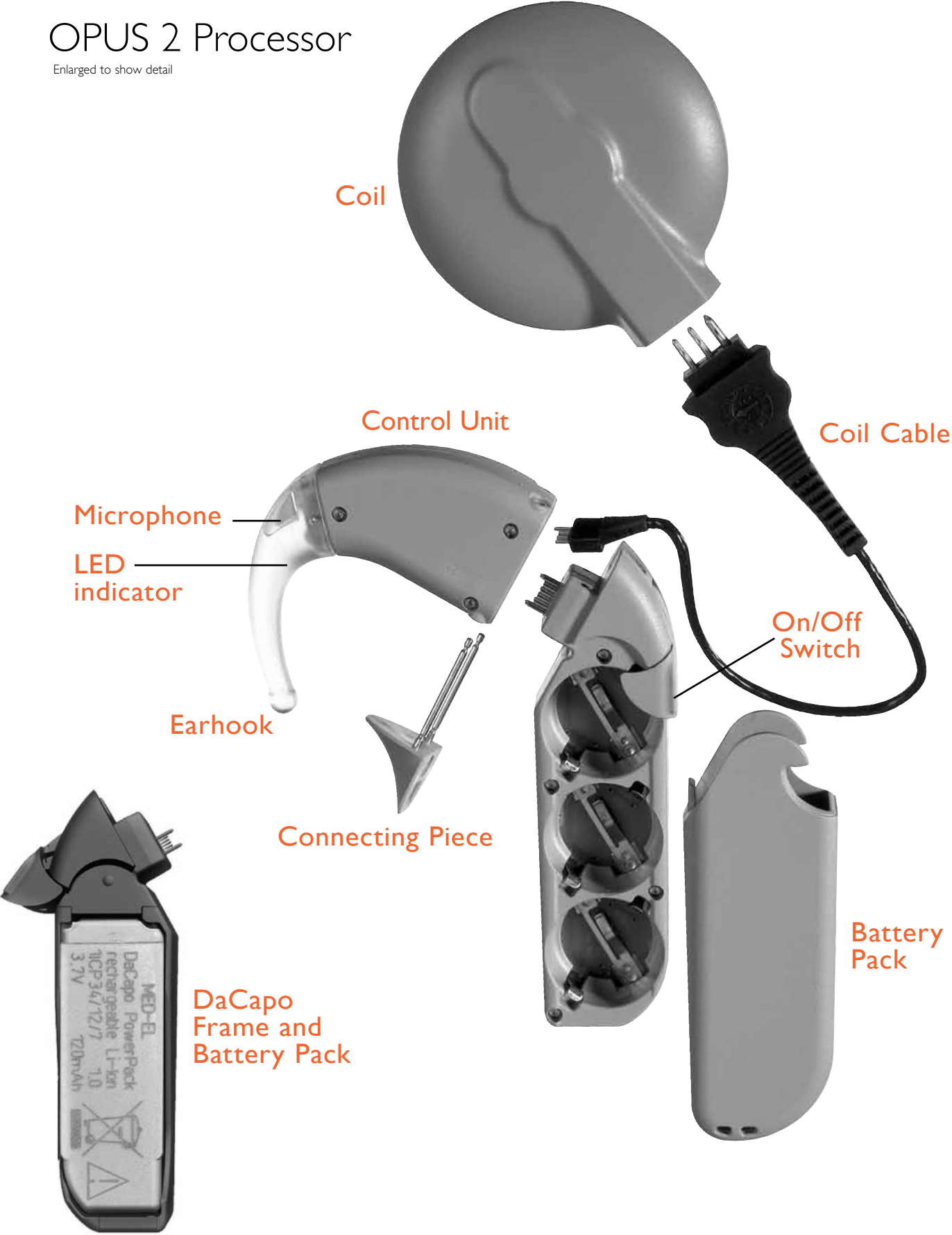
Remote Battery Pack

- Cost saving and efficient
Input jack for external devices
- CONTROL UNIT
 - REMOTE BATTERY PACK
 - REMOTE BATTERY PACK CABLE



OPUS 2 Processor

Enlarged to show detail





THE BABYBTE™ HAS THE
ADVANTAGE OF ALLOWING
A YOUNG CHILD TO
BEGIN USING THE SAME
EAR-LEVEL AUDIO
PROCESSOR THAT HE OR
SHE WILL USE FOR THE
LONG TERM, WHILE STILL
ACCOMMODATING A
BABY'S SMALL EAR
AND ACTIVITY LEVEL.

BABYBTE™ (ALSO CALLED 'ACTIVEWEAR')

Who should use the BabyBTE™?

MED-EL's signature wearing option for infants and young children is the BabyBTE™. The BabyBTE has the advantage of allowing a young child to begin using the same ear-level processor that he or she will use for the long term, while still accommodating a baby's small ear and activity level. For this wearing option, the entire BTE processor is placed on the clothing, and only the coil is placed over the implant on the head. The BabyBTE can also be used as an 'activity pack' for children or adults who participate in sports or other activities where a very secure placement is desired. For example, if the child is involved in an activity that requires wearing a helmet, using the activity pack allows the microphone of the processor to be positioned outside the helmet, with only the coil and cable fitting underneath.

When using the BabyBTE, it is important to be aware of the position of the microphone. It should be positioned in such a way that the majority of sound will be directed at the microphone, including the child's own voice. Usually the best option is to position the BabyBTE on the child's shoulder, with the microphone facing forward.

How do I assemble the BabyBTE?

- 1 Connect the coil cable to the coil. A longer coil cable (28 cm) is used for this configuration than the ear-level wearing options to allow for flexibility in processor placement on the clothing.
- 2 Connect the opposite end of the cable into the processor. See page 5.
- 3 Add the straight battery pack, with the cable slot positioned to accommodate the coil cable.
- 4 Insert the pins of the connecting piece into the small holes next to the serial number of the control unit. If the connecting piece has long pins, position the safety lock over the protruding pins on the other side of the processor. The coil cable plug rests in the cutout section of the safety lock. Engage the safety lock by sliding the small black lever.
- 5 Add the fixation bar or fixation clip by attaching it to the two screw taps next to the labeling of the battery pack and using the screwdriver to tighten it into place.
- 6 Add fresh batteries, and replace the battery pack cover.
- 7 Position the BabyBTE on the child, pinning or clipping it into place on the clothing. If possible, try to position the processor so that it is out of the child's reach, but with the microphone facing forward. Many parents choose to place the processor on the shoulder, facing up or forward.
- 8 Place the coil on the head, and turn the processor on (located on the tip of the battery pack). The red LED should illuminate 1, 2, 3 or 4 times to indicate which program position is active.
- 9 If desired, adjust processor settings using the FineTuner remote control.

CHILDREN'S BATTERY PACK

Who should use the children's battery pack?

The children's battery pack is the ideal configuration for active toddlers and preschoolers, or older children who still require the security of a system that is attached to the clothing. The control unit is worn at the ear, which provides optimal microphone placement and easy visibility of the LED indicator.

A cable allows the battery pack to be attached to the child's clothing. This cable is hard-wired into the battery pack and cannot be disconnected or replaced. If the cable is damaged, the entire battery pack should be replaced.

How do I assemble the children's battery pack?

- 1 Connect the standard 9.5 cm coil cable to the coil.
- 2 Connect the opposite end of the cable into the control unit. See page 5.
- 3 Add the children's battery pack, fitting the cable plug into the control unit with the cable slot positioned to accommodate the coil cable.
- 4 Insert the pins of the connecting piece into the small holes next to the serial number of the control unit. If the connecting piece has long pins, position the safety lock over the protruding pins on the other side of the processor. The coil cable plug rests in the cutout section of the safety lock. Engage the safety lock by sliding the small black lever.
- 5 Add the fixation bar or fixation clip to the battery pack, using the screwdriver to tighten the accessory into place.
- 6 Add fresh batteries, and replace the battery pack cover.
- 7 Position the control unit on the child's ear and position the battery pack on the clothing in an inconspicuous place.
- 8 Turn the processor on (located on the tip of the battery pack). The red LED should illuminate 1, 2, 3 or 4 times to indicate which program position is active. Place the coil on the head.
- 9 If desired, adjust processor settings using the FineTuner remote control.



THE CHILDREN'S BATTERY
PACK IS THE IDEAL
CONFIGURATION FOR
ACTIVE TODDLERS AND
PRESCHOOLERS, OR OLDER
CHILDREN WHO STILL
REQUIRE THE SECURITY
OF A SYSTEM THAT
IS ATTACHED TO THE
CLOTHING.



A huggie-aid or an earmold may help keep the processor in position on the ear. Contact the implant clinic or audiologist for assistance.



THE STANDARD
BATTERY PACK IS THE
MOST COMMON
CONFIGURATION FOR
OLDER CHILDREN
AND ADULTS.

STANDARD BATTERY PACK

Who should use the standard battery pack?

The standard battery pack is the most common configuration for older children and adults. This configuration allows the entire processor to be worn at the ear. In addition, a specialized battery pack cover (the FM Battery Pack Cover) provides a standard 3-pin input jack for direct connection to assistive listening devices and direct-link devices.

How do I assemble the standard battery pack?

- 1 Connect the standard 9.5 cm coil cable to the coil.
- 2 Connect the opposite end of the cable into the control unit. See page 5.
- 3 Add the standard battery pack, fitting the battery pack into the control unit port with the cable slot positioned to accommodate the coil cable.
- 4 Insert the connecting piece to secure the battery pack to the control unit.
- 5 Add fresh batteries, and slide the battery pack cover over the battery pack frame from the bottom.
- 6 Close the battery pack lock to turn the processor on. The red LED should illuminate 1, 2, 3 or 4 times to indicate which program position is active. Place the coil on the head.
- 7 If desired, adjust processor settings using the FineTuner remote control.
- 8 To use the direct input function, use the FM battery pack cover instead of the standard cover in step 5 above. To exchange battery pack covers, open the battery pack lock and slide the battery pack cover off the battery pack frame. Slide the new battery pack cover over the battery pack frame from the bottom, and close the battery pack lock to turn the processor on. Most modern FM systems can connect directly to the FM battery pack. Some accessory devices may require the use of a patch cable. MED-EL provides a variety of patch cables for connection to battery-operated external listening systems. See section "Connection to Accessory Devices" on page 44 for more information. For more information on connection to specific FM systems, see current FM literature from MED-EL.



INTERCHANGEABLE
WEARING OPTIONS,
ENSURE THAT THE
AUDIO PROCESSORS CAN
BE ADAPTED TO THE
CHANGING REQUIREMENTS
OF GROWING CHILDREN.

SPECIAL CONSIDERATIONS FOR SMALL CHILDREN

The audio processor has several features that are particularly designed for small children. Among them:

The **switch-free design** of the processor prevents accidental program, volume or sensitivity changes.

The **FineTuner accessory** is not necessary during normal daily use for most children. The processor remembers its last settings, even after changing the batteries. Once the child's program is set, the FineTuner is only needed to switch the telecoil on or off.

Locking earhook, which can be secured to the control unit with a small pin. See page 6.

Safety lock to prevent small children from disassembling the processor. See page 8.

Tamper-resistant battery covers on most battery packs, with a locking lever on the children's battery pack. See page 8.

Flexible programming to prevent accidental program, volume or sensitivity changes. It is possible to program each position and volume setting to the same map. In this configuration, changing the program or volume has no effect on the child's listening experience. Contact the implant clinic for assistance.

FineTuner controls may be deactivated to prevent accidental program, volume or sensitivity changes.

Wearing options for small ears that remove the processor from the ear and place it securely on the clothing. See page 14.





REMOTE (RECHARGEABLE) BATTERY PACK

Who should use the remote (rechargeable) configuration?

The remote configuration is ideal when cost is an issue, or when dexterity problems preclude the use of the smaller battery packs. Families are provided with three rechargeable size “AA” batteries and a charger, which will provide several years of use before the batteries need to be replaced. They can also use off-the-shelf alkaline (non-rechargeable) AA batteries. The battery pack is worn in a pocket or attached to the clothing or belt using the small clip supplied with the system. The cable can be replaced separately from the battery pack. The remote battery pack provides a direct input port for connection to assistive listening devices.

How do I assemble the remote (rechargeable) configuration?

- 1 Connect the standard 9.5 cm coil cable to the coil.
- 2 Connect the opposite end of the cable into the control unit. See page 5.
- 3 Add the remote battery pack cable, fitting the cable plug into the control unit with the cable slot positioned to accommodate the coil cable.
- 4 Plug the opposite end of the cable into the battery pack appropriate shaped port .
- 5 Insert the pins of the connecting piece into the small holes next to the serial number of the control unit. If the connecting piece has long pins, position the safety lock over the protruding pins on the other side of the processor. The coil cable plug rests in the cutout section of the safety lock. Engage the safety lock by sliding the small black lever.
- 6 Add a fresh or fully charged battery.
- 7 Turn the ON/OFF switch (located on the remote battery pack) to “ON.” The red LED should illuminate 1, 2, 3 or 4 times to indicate which program position is active. Place the coil on the head.
- 8 If desired, adjust processor settings using the FineTuner remote control.
- 8 The red LED should illuminate briefly to indicate that the system is functioning.
- 9 To use the direct input function, locate the input port on the battery pack, labeled with the symbol , under a small cover. The input port is a standard 3.5 mm (1/8”) stereo headphone jack. Next to the input port is a small switch labeled EXT/MIX. This switch provides an opportunity to choose whether the incoming signal will be mixed with the signal from the OPUS 2 microphone (on the head) or the accessory device alone. MED-EL provides a variety of patch cables for connection to assistive listening devices that do not use a standard headphone plug. FM cables can also be purchased directly through the FM manufacturers. For more information, see current FM literature from MED-EL.



Detail of the input port, EXT/MIX and ON/OFF switches of the remote battery pack.

DACAPO RECHARGEABLE BATTERY SYSTEM

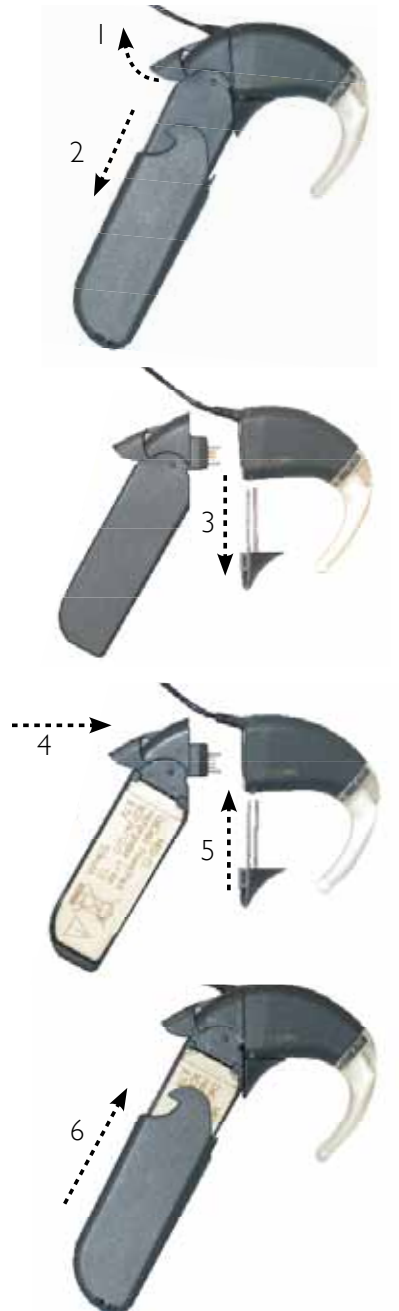
Who should use the DaCapo rechargeable system?

The DaCapo rechargeable battery system provides a cost effective choice for families but also offers the convenience of an ear-level placement. This option includes three rechargeable PowerPacks and a charger that will provide several years of use before the PowerPacks need to be replaced. The PowerPack provides 10-12 hours of continuous operation. The DaCapo system is compatible with FM systems and other external devices, such as MP3 players, when using the FM Extension Kit. The FM battery pack cover includes a standard input port that is compatible with a wide variety of audio devices.

How do I connect the DaCapo battery frame?

To connect the DaCapo Frame to the OPUS 2 Speech Processor, proceed as follows:

- 1 Open the battery pack lock.
- 2 Remove the battery pack cover.
- 3 Pull out the connecting piece
- 4 Remove the battery pack and connect the DaCapo Frame.
- 5 Secure the DaCapo Frame to the processor by inserting the two pins of the connecting piece into the two holes on the bottom of the Control Unit. The pins must be inserted completely.
- 6 Slide the battery pack cover over the DaCapo Frame and close the battery pack lock to switch the processor on.



2

GETTING TO KNOW THE FINETUNER™ REMOTE CONTROL

USING THE FINETUNER

The **FineTuner** remote control is an accessory device that can be used to optimize the audio processor in changing daily listening situations. The OPUS 2 processor has an ON/OFF switch. All other functions are accessed with the FineTuner, which transmits commands to the OPUS 2 processor. With the FineTuner, parents, teachers and therapists can maintain control of settings on the OPUS 2.

The FineTuner is not required for everyday use of the audio processor. When the OPUS 2 is turned on, it will return to the same program, volume and sensitivity settings that were in use before it was last turned off. The FineTuner is configured for its designated OPUS 2 processor, so that only the target OPUS 2 processor can execute a command from the FineTuner. The typical maximum operating distance between the FineTuner and OPUS 2 processor is approximately 80 cm (2.62 ft.). This range could be decreased near electrical equipment.



The slim FineTuner™ is credit-card sized with a thickness of only 6 mm.



HOW TO CONFIGURE THE FINETUNER

If a child comes to school with an OPUS 2 and a FineTuner, the two have most likely already been synchronized to talk to each other. Once synchronized, the OPUS 2 and FineTuner stay in synchronization until one of the two pieces of equipment need to be changed.

- 1 Turn off your OPUS 2 processor.
- 2 Place the coil of the OPUS 2 processor over the MT key on the FineTuner.
- 3 Turn on the OPUS 2 processor.
- 4 The audio processor and the FineTuner will be synchronized automatically.
- 5 Successful synchronization is indicated by a short blinking signal of the two amber indicator lights on the FineTuner.

Successful synchronization is indicated by a short blinking signal of the two amber indicator lights on the FineTuner.



WHEN TO CONFIGURE THE FINETUNER

It should only occasionally be necessary to synchronize the FineTuner and audio processor. Examples include use of a back-up processor or second FineTuner. For children with a cochlear implant on each ear (bilaterally implanted), one FineTuner can be used for both ears. However, a FineTuner can only be synchronized with one processor for each ear..

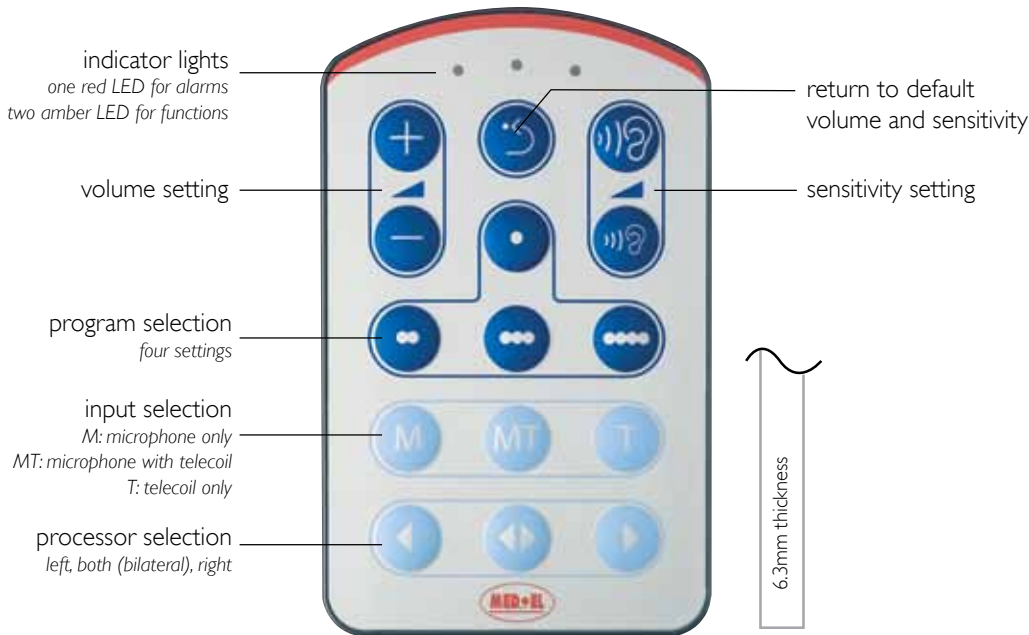
The FineTuner only needs to be configured:

- 1 At the initial processor fitting.
- 2 When using a different or additional processor (e.g., back-up, loaner, or replacement).
- 3 When using a different FineTuner (e.g., back-up, loaner, replacement, or bilateral).

NAVIGATING THE FINETUNER KEYBOARD

The FineTuner keyboard has 15 keys.

Any of these keys can be deactivated when the audiologist programs the OPUS 2 processor. When a key has been deactivated, the FineTuner will still send the command, but the OPUS 2 processor will ignore the command. If using a FineTuner during the school day or therapy session, it will be helpful to know how the OPUS 2 has been programmed to respond to the FineTuner. You will need to get this information from the child's cochlear implant center.



Keys on the FineTuner include:

Volume keys: Two keys to increase or decrease overall loudness.

Sensitivity keys: Two keys to increase or decrease the audio sensitivity.

Default key: This key sets volume and audio sensitivity to predefined values determined by the audiologist. (NOTE: It does not reset programs)

Program Selection keys: Four keys to access up to four different programs.

Bilateral User Support

The OPUS 2 is the FIRST processor in the industry to offer direct support to **bilateral users**. One FineTuner remote control can make adjustments to two audio processors!

Input keys: Three keys to select the microphone (M), the telecoil (T) or the microphone and telecoil together (MT) as the signal source.

Processor keys (for bilateral users): The Processor Selection keys allow selecting the left, right or both processors. The keys are also used to activate or deactivate the keyboard lock feature.

FINETUNER KEYBOARD LOCK FEATURE

Automatic keyboard lock: To avoid unintentional operation of a key, the FineTuner features an optional automatic keyboard lock. This function electronically locks the keyboard if no key is pressed for more than 10 seconds.

To activate the keyboard lock feature of your FineTuner, press the key for more than 5 seconds to enter the program mode (the red and both amber indicator lights on your FineTuner will both start blinking alternately indicating that you have successfully entered the FineTuner's program mode) and then the key to activate the automatic keyboard lock (the FineTuner will confirm successful activation of the automatic keyboard lock by a short blinking signal of the two amber indicator lights).

To deactivate the automatic keyboard lock enter the program mode just as described above and press the key. As above the FineTuner will confirm successful deactivation of the automatic keyboard lock by a short blinking signal of the two amber indicator lights.

ATTENTION: To enter the program mode while the keyboard lock is active, the key must be pressed twice (second time for more than 5 seconds).

To activate a certain function while the keyboard lock is active, press the desired function key twice. The first click temporarily unlocks the keyboard, the second click executes the command. After 10 seconds without pressing another key, the keyboard lock is active again.

FINETUNER INDICATOR LIGHT SIGNALS

The FineTuner has 3 indicator lights that can provide useful information about how the FineTuner is operating. Indicator lights are located above the FineTuner keyboard and include a red LED in the center with amber LEDs to the left and right. These LEDs can provide the following information:



FUNCTION	LIGHT PATTERN	MEANING
Keyboard locked		If you press a key while the keyboard is locked, the red indicator light comes on. In order to conserve power, the red indicator light will go off after 5 seconds even if the key is still pressed.
Transmitting Information	Left or right (or both) lights blink according to the side mode of the FineTuner.	Indicator lights will blink when signals are transmitted (the indicator light blinking corresponds to the processor being modified – either right, left or both sides for bilateral users.) To save energy, the FineTuner stops transmitting (and the indicator light stops blinking) after 3 seconds, even if the key is still pressed.
Switching Sides		To switch from the left to the right side, press the corresponding button and the amber light will illuminate. To switch both sides at once (for bilateral users), press the button in the center. Both amber lights will illuminate.
Programming Mode	(+ 5 seconds)	Press for more than 5 seconds to enter the programming mode. The three indicator lights will start flashing alternately. When the red indicator light is on, the two amber indicator lights are off and vice versa.
Low Battery	(blinks 3 times)	If a low battery status is detected, the red indicator light (center) will blink in a regular pattern – 3 blinks at a time.
Configuration Successful	(illuminates for one second)	If configuration of your FineTuner was successful, or if the automatic keyboard lock feature was successfully activated/deactivated, both amber indicator lights will illuminate for approximately one second.

CHANGING THE FINETUNER BATTERY

To conserve power, the FineTuner will only transmit a command for a few seconds. For this reason, you should press the desired key once for every change you wish to make. The FineTuner battery status is checked after each transmission. When the batteries are low, a red indicator light on the FineTuner blinks three times, indicating that the battery should be changed. The FineTuner battery should last for at least several months.

To change the battery:

- 1 Open the lid on the back of the FineTuner with a small screwdriver.
- 2 Replace the used button battery (type CR2025) by removing it with the coil magnet or by gently shaking it into your hand. Try not to touch the battery contacts.
- 3 Insert the new battery with the “+” sign facing up.
- 4 Close the lid by carefully inserting it on the right side, then sliding it in place and tightening the screw.



Insert the new battery with the “+” sign facing up.



TROUBLESHOOTING THE FINETUNER

If the OPUS 2 does not respond to FineTuner commands, there can be a number of potential reasons and subsequently there are several things to try. For example, the OPUS 2 needs to be within approximately 2.6 feet of the FineTuner in order to respond. Other examples are outlined in the table below.

Problem description	Possible cause	Action to take	Remarks
OPUS 2 does not respond to FineTuner commands	OPUS 2 out of FineTuner transmission range (~0.8 m)	Move closer	If the problem persists, replace FineTuner or processor
	Automatic keyboard lock active	Deactivate Automatic keyboardlock	
	Interference is present and blocking transmission	Go to different location	
	OPUS 2 and FineTuner are not synchronized	Synchronize	
	FineTuner battery low	Replace battery	
	Commands in OPUS 2 are disabled	Contact your audiologist	
	LED in OPUS 2 is disabled	Contact your audiologist	

IS IT WORKING? A TROUBLESHOOTING PRIMER

DAILY LISTENING CHECKS

In order to feel confident that the system is working and the child is receiving the best sound possible, it is advisable to formally check the system every day. It is helpful to think about this from two viewpoints, the viewpoint of **functioning equipment** and also the viewpoint of good **auditory discrimination**. Obviously the child doesn't hear properly if the equipment itself is not working. But it is also important to consider whether the child's hearing is optimal throughout the day and from day to day as well.

In order to establish a consistent and replicable method of evaluating the equipment and the child's auditory discrimination, many parents, therapists, and educators do a routine daily listening check, preferably at the beginning of the day or session. This quick check should take no more than 1-2 minutes, and will help to establish your comfort zone about the function of the device and the child's ability to make use of audition. In addition, some educators find it beneficial when working with very young children to repeat the listening check after PE or recess. The listening check should also be employed any time there is suspicion that the child is not responding in his or her typical fashion.

Verifying auditory detection and discrimination

Because we are checking for auditory ability, it is critical that the child has no access to visual cues during the daily listening check. Ideally, the child should be positioned next to and slightly in front of you (with the implant side nearest you) so that no speechreading cues are available. Another option for removing visual cues is to fashion a 'listening screen' from an embroidery hoop stretched with a lightweight but opaque fabric, such as 2 layers of stereo speaker cloth. Do not use paper or cardboard, as the sound will be deflected, making the hearing task more difficult.

Many professionals like to use a popular quick test called the "Six Sound Test" developed by the late Daniel Ling. This quick stimulus/response test uses isolated speech sounds that cover the entire frequency spectrum of speech. The six sounds are:

"mm" as in "mmm that's good" (not "em" as in "the letter M")

"ah" as in "father".

"ee" as in "bee"

"oo" as in "boot"

"ss" (not 'ess')

and "sh"

The teacher should present each sound, one at a time, and expect the child to indicate that it was heard. Each sound should be presented using the same intonation and duration so the child can't guess the sound based on those clues. For example, using a rising intonation for one sound and not others will cue the child, as will using a longer presentation of "mm", "ss" or "sh" than for the vowels. The presentation order needs to be varied, and additional (unexpected) stimuli included from time to time, such as the child's name or other familiar words, so that the task is not overly predictable.

Responses will vary depending on the age, maturity and listening level of the child. In the very beginning, the response may be inconsistent and will need to be encouraged and taught. New implant users will not typically hear the difference between sounds – only that a sound was made. This is referred to as the ability to **detect** a sound. At this level, the listener is expected to indicate she has heard the stimulus by giving a simple response. The response can be anything you choose to teach: pointing to the ear, dropping a toy into a container, turning to look at you, vocalizing, etc.

Soon we expect the child to move on to a higher level of auditory ability: **discrimination**. This means the child is beginning to recognize that sounds are different. For the purposes of these early tasks, we are expecting the child to detect and discriminate a set of **phonemes**, which are the individual sounds that make up the complex body of spoken language. During the discrimination phase, the child may begin to identify each phoneme as evidenced by her ability to repeat what is said to her. For example, the adult may say one of the six sounds (oo) and the child consistently repeats back, "oo." This is an exciting development because it demonstrates that for this phoneme, the child is able to detect (hear the phoneme), discriminate (distinguish it from other phonemes) and identify (label it by virtue of repeating it).

As the child's auditory skills increase and the ability to repeat a sound develops, you want to move toward having the child repeat back each speech sound after you say it. When the child first attempts to repeat the sounds you say, their approximation may not even resemble your model, but a vocalization is an indication a sound was heard and should be encouraged. As the child's ability to modify his or her own speech to match your model improves, the responses to the various sounds should begin to sound different, and should come closer and closer to accurately pronouncing the sound.

The important thing to remember here is this: if the child can't consistently repeat sounds accurately in general, but can indicate that a sound was heard, then you are measuring **detection**. Any indication that the child heard the sound is good. Once the child can consistently indicate that sounds are different from each other, you begin measuring **discrimination**. If the task is performed regularly, you will become familiar with the child's typical responses, and this quick test becomes even more useful. Once a consistent response is achieved, any changes from this baseline response, such as a change in the child's typical pronunciation, take on added meaning, and may indicate there is a need for a change in the map.

NOTE: Keep in mind the difference between discrimination difficulties and speech production difficulties. It is common for children with developing articulation skills to mispronounce or to be unable to pronounce certain speech sounds, even though the sound is heard. By experimenting with detecting and discriminating the target sound along with the mispronunciation, you may be able to determine whether the child can hear the sound, but just can't produce it accurately.

This very quick and simple method of evaluating detection and discrimination can provide a great deal of insight into the child's hearing acuity without any additional equipment. It can also be a fun way to reinforce listening skills and help the child experience success. Once the child knows the routine and the task, you will have a good sense of their hearing function from day to day, and small changes in hearing will quickly become apparent. Many educators turn the daily listening check into a fun game, often allowing the child a turn to be the speaker as well. This can provide a short one-on-one opportunity to praise and build confidence in the child's developing listening skills.

A daily listening check can also be used to teach the child to indicate when the device is not working properly. Children with cochlear implants should be encouraged to become their own strongest advocates for good hearing. It is a good idea to teach the vocabulary of listening as the child's listening skills begin to improve. Here are some target sentences and phrases that can help the child become responsible for the device and its sound quality:

"I need new batteries."

"My processor sounds different."

"The sound is going on and off."

"Your voice sounds funny."

"I can hear well today."

"What is that sound?"

"I heard that but I didn't understand it."

"My processor is not working" or "My processor is broken."

With an older child or more experienced child after presentation of the Ling Sounds to determine accuracy of discrimination and production, you may want to use the following target sentences. "Can you hear me" or "Can you hear me well." "Tell me what you hear" and have him repeat several short sentences. Vary your sentences from day to day to decrease the chance of prediction on the part of the child.

Verifying normal equipment function

Along with the importance of assessing the child's detection and discrimination, it is important to check the equipment for proper settings and function. One child's settings may be very different than another child's settings, so exact settings should be obtained from the implant center (and should be updated after each mapping visit) for each child. Be sure to check the individual settings for each processor for the child with bilateral cochlear implants.

A normally functioning system has the following characteristics:

- The **program change pattern** provides 1, 2, 3 or 4 quick blinks on the processor's red indicator light when the system is first turned on and when the program/position setting is changed.
- The **status pattern** can be programmed to provide 1 blink on the processor's red indicator light every 3.5 seconds. This optional indicator light signal can be activated for a specific fitting map and used to confirm that the processor is working properly. Otherwise, the red LED should not light or blink. Be aware that using this option in the child's daily use map will significantly impact battery life.
- The **ON/OFF** control is set to on. This control depends on the battery pack being used. If in doubt, switch it off and then back on again. The red LED should blink 1, 2, 3 or 4 times to indicate which position is currently active.
- **Placing the coil on the processor test device** (see page 32) should produce a red flashing light on the test device, which roughly blinks in the pattern of your speech or other loud sounds.



See pages 13 for a detailed diagram of the audio processor.

TROUBLESHOOTING FEATURES

The processor has a number of built-in features to facilitate troubleshooting the equipment.

LED indicator: Troubleshooting the batteries and processor

The red LED of the control unit flashes four different patterns to indicate different error conditions. There are also up to four additional patterns that can be selectively activated or deactivated for each fitting map. Contact the implant clinic to confirm how these indicator light signals have been programmed.



The LED provides information regarding the processor, batteries, battery pack, and communication between the FineTuner and OPUS 2. If the LED begins flashing, use the following table to determine the cause.

The audio processor can be replaced by the cochlear implant center. Many children have a back-up processor at home, keeping them 'on the air' while their primary processor is being repaired or replaced.

	BLINKING PATTERN	MEANING	ACTION TO TAKE	REMARKS
ERROR PATTERNS		Electronic problem or temporary processor disturbance.	Switch processor off. Switch processor back on.	If the blinking persists, the audio processor must be replaced.
		Selected setting is not programmed, or there has been a program failure.	Select another setting.	If the blinking persists, the processor should be reprogrammed by the clinic.
		Electronic problem or program failure.	Switch processor off. Switch processor back on.	If the blinking persists, the processor must be reprogrammed.
		Electronic problem or temporary processor disturbance.	Switch processor off. Switch processor back on.	
WARNING PATTERNS		Batteries are empty.	Switch processor off. Change the batteries. Switch processor back on.	If the processor is not switched off, the red indicator light will continue to blink.
		Maximum or minimum value of volume or audio sensitivity range reached.	Stop pushing button(s) on FineTuner.	
CONFIRMATION PATTERN	Brief flash of red indicator light	FineTuner command received and accepted.	None	IMPORTANT: Pressing the Default button on your FineTuner only affects volume and audio sensitivity. The program setting does not change.
PROGRAM CHANGE PATTERN		Program 1 to 4 selected.	None	The red indicator light will blink depending on the selected program setting. IMPORTANT: These blinking patterns start like the battery empty pattern.
STATUS PATTERN		The processor is initialized and working.	None	If the telecoil is active, a clicking sound may be heard whenever the light blinks.



Speech processor test device: Troubleshooting the cables and coil

The speech processor test device (SPTD) is an accessory that is part of every patient kit. Additional test devices can be purchased from MED-EL or the implant clinic. The SPTD assesses the integrity of the cable and coil.

There are two versions of audio processor test device. The newer version is a light gray color and is compatible with the TEMPO+, OPUS 1 and OPUS 2 processors. The older version is a dark gray (anthracite) color and is only compatible with the TEMPO+. If used with the OPUS 2, the dark gray SPTD will provide inaccurate results.

- 1 Confirm proper function of the processor, batteries, and battery pack using the LED indicator on the OPUS 2 processor.
- 2 Remove the coil from the child's head.
- 3 Place the flat side of the coil (the side that would be against the child's skin) against the side of the SPTD that does not have the indicator light on it.
- 4 Speak into the microphone on the processor. You should see the red light on the SPTD light in correspondence to your voice.
- 5 If the red light flashes with speech, the coil is sending a data stream to the implant.
- 6 If the red light does not flash or flashes intermittently, even though there is constant sound input, there may be a problem with a component (ie., cable, coil, or processor).
- 7 Sometimes it is possible to identify an intermittent problem with a cable by running your fingers down the cable while watching the red light of the SPTD. If the pattern of flashing on the SPTD does not seem to correspond to your voice, it could indicate a faulty cable.
- 8 If there is a problem with the equipment, the most likely culprit is the cable. Cables are the weakest point of any system and are vulnerable to excessive movement or force.

Red LED



It is important not to adjust the processor settings during testing with the SPTD. If the processor's program, volume or sensitivity settings are changed after you have begun testing, you may need to reset the audio processor test device by moving it a short distance away from the coil. Wait a few seconds, and then reposition the two and continue testing.

Microphone test device: Verifying microphone function

A microphone test device (MTD) is available to assist in determining whether the microphone is providing an adequate signal. The MTD can be purchased from MED-EL or from the implant clinic. To use the MTD, remove the connecting piece from the processor, and remove the battery pack. Plug the MTD cable into the processor as if it were a remote battery pack. Plug the accompanying earphones into the earphone jack of the MTD. Using the earphones, speak into the OPUS 2 microphone and listen to the quality of your voice. The MTD has a volume control so that the sound level can be adjusted for the listener. If the sound is scratchy or of poor quality, the microphone may need to be cleaned or repaired. Contact MED-EL or the implant center for repair or replacement options.

NOTE: If no signal is heard, push the Self-Test button on the MTD. If the MTD is working properly, a beeping sound will be present. The MTD features an LED that emits a green light if the MTD battery is good and a red light if the battery is low. The MTD uses one rechargeable or alkaline AA battery.

It is important to use the MTD only in an environment that is quiet. A noisy environment may trigger the audio processor's system of handling loud noises. To someone who is not an implant user, this may change the sound quality that is heard through the MTD. If the signal is perceived to be of poor quality, check to be sure the headphones are working properly to rule them out as the cause of the problem. The headphones can be checked by plugging them into any typical device (i.e., a portable CD player or some other device that uses stereo headphones). Further instructions are included with the MTD kit.

FineTuner remote control

The FineTuner remote control can be used to make changes to program, volume and sensitivity settings but is not necessary for everyday use of the OPUS 2 processor. Any time the OPUS 2 is turned on or the batteries are replaced, the processor will maintain the same settings that were in use before it was turned off or the batteries died. The only function that requires use of the FineTuner is activation of the telecoil. If a child does not use the telecoil at school and does not regularly change their program, volume or sensitivity settings throughout the day, then the FineTuner can remain at home.



MTD Headphones
(Photo courtesy of
SONY Corporation)

A STEP-BY-STEP TROUBLESHOOTING GUIDE

Most routine problems that occur with the processor will be easy to solve in the classroom. The batteries need to be replaced every 3-5 days (for size 675) or daily (for size AA). The power pack for the DaCapo rechargeable system needs to be replaced with a new fully charged pack every 10-12 hours. Cables are also prone to normal wear and tear, and will need to be replaced from time to time.

TIP: When troubleshooting the system using spare parts, it is best to try changing just one part at a time. If you swap out several parts at once, it is difficult to be completely sure of the original cause of the problem, and functioning equipment may be discarded unnecessarily.

TIP: When troubleshooting using spare parts, it is helpful to keep spare equipment separate from the questionable equipment as you change out each part. It is very easy to get the two sets confused!

Problem: LED is flashing.

Solution: Refer to LED table (page 31).

If you are certain the batteries are fresh, and the processor has been reset, it is possible that the battery pack or the connection between the battery pack and processor is faulty. This problem needs to be investigated further with spare equipment (a spare battery pack and possibly a spare processor) to determine the fault.


Problem: Battery life is very short when using size 675 batteries (substantially less than 3 days).

Solution: Check battery life after each step:

- ∴ Some brands and/or types of batteries work better than others. For specific battery recommendations, you may contact MED-EL or the implant clinic. You may also want to experiment with different batteries to find one that works best for you. An easy way to keep track of battery life is to place the battery tab (sticker on 675 zinc-air batteries) on the calendar when you remove it for use.
- ∴ Check the battery compartment. Zinc-air batteries need air circulation in order to maintain power, so make sure that the openings at the bottom of the battery pack cover (standard and DaCapo battery packs) are not covered. For the straight and children's battery packs, the battery pack cover/lid should fit so that there is a very thin opening where the battery cover meets the battery pack.
- ∴ Check to see that the battery door is not too loose. If the battery pack or cover become worn, the battery door may not hold tightly enough, resulting in poor contact between the batteries and the contacts in the battery pack. A spare battery door is provided in the patient kit, or can be obtained from MED-EL or the implant clinic.
- ∴ Use of direct input assistive listening devices, especially those without their own power source, may noticeably decrease the normal battery life.


Problem: The system appears to be working (no flashing lights) but the child is not responding to sound.

Solution: After each step, check to see whether sound is restored:

- ∴ Switch the processor off and back on. The red LED should blink 1, 2, 3 or 4 times to indicate which program position is currently active. Be sure that the current program is set to the child's typical daily use settings.
- ∴ Use the audio processor test device (SPTD) to determine whether the coil is sending information to the implant. See page 32 for instructions
- ∴ If the SPTD does not light in response to loud sounds, try replacing the cable. See pages 5 and 13-19 for instruction on assembling/disassembling the system, depending on the child's wearing option, in order to change the cable.
- ∴ If a spare cable does not solve the problem, use the microphone test device (if available) to verify that the child's microphone is functioning properly. See page 33 for instructions.
- ∴ If the FineTuner is available, check to see whether volume and sensitivity settings are adequate. If these settings are too low, the child may not be able to detect sound at normal levels. Use the FineTuner remote control to start at the child's default  volume and sensitivity settings. If possible, gradually increase volume while monitoring the child's response to sound. If the child was hearing normally at an earlier point in time, and the FineTuner has not been used since that time, then volume and sensitivity settings are not likely to be the problem.
- ∴ If, after these steps, you cannot determine the problem, it is a more complex issue. Further troubleshooting will require a spare battery pack, coil, and possibly a control unit. If needed, you can contact the child's parent, implant center, or MED-EL for troubleshooting assistance.

Problem: The child is detecting sound, but discrimination is poorer than usual.

Solution: Check discrimination after each step:

- ∴ Check to see that the child is using his or her typical daily use program.
- ∴ Use the microphone test device (if available) to assess the integrity of the microphone.
- ∴ Check to see that the volume and sensitivity settings are adequate. Use the FineTuner remote control (if available) to start at the child's default  volume and sensitivity settings. If possible, gradually increase volume while monitoring the child's response to sound.
- ∴ Contact the implant center to discuss whether a mapping visit is appropriate. Important feedback to the center will include:
 - The type of errors the child appears to be making
 - Whether the problem was of sudden or gradual onset
 - The child's overall performance level

Problem: Parts of the equipment seem to be broken (earhook, battery door cover, etc).



Solution: Contact the parent, the implant team, or MED-EL for assistance in replacing parts.

Problem: The OPUS 2 does not seem to be responding to FineTuner commands.

Solution: Check the OPUS 2's response after each step:

- ∴ Move the FineTuner closer to the OPUS 2 processor. They need to be within ~2.6 feet of one another.
- ∴ Press the desired command twice. If the keyboard is locked, a red light will blink each time you press a key. Pressing the desired key twice will temporarily override the keyboard lock and execute the command.
- ∴ Move away from any electrical or electronic equipment that could be interfering with transmission between the FineTuner and OPUS 2.
- ∴ Synchronize the FineTuner and OPUS 2. See instructions for "how to configure the FineTuner" on page 21.
- ∴ Change the FineTuner battery. The red LED on the FineTuner will blink 3 times after pressing any key when the battery is low. If a malfunction of the FineTuner is suspected, reset the FineTuner by removing the battery, waiting a few minutes, and reinserting the battery.
- ∴ Keep in mind that FineTuner commands and the FineTuner indicator light signal of the OPUS 2 can be deactivated by the implant center during programming.

Problem: I can't deactivate the FineTuner keyboard lock feature.

Solution: To deactivate the keyboard lock feature of your FineTuner, press the  key for more than 5 seconds to enter the program mode (the red and both amber indicator lights on your FineTuner will both start blinking alternately indicating that you have successfully entered the FineTuner's program mode) and then the  key to deactivate the automatic keyboard lock (the FineTuner will confirm successful deactivation of the automatic keyboard lock by a short blinking signal of the two amber indicator lights).

KEEPING SPARE EQUIPMENT ON HAND

The following basic "kit" will handle most routine problems and replacements for basic trouble shooting. Items specific to the device (i.e. cables, earhooks and fixation devices) can be obtained from the parent, the implant clinic or from MED-EL. It is best to keep everything together in a small plastic container where they are easily accessible:

- ∴ **High power zinc air batteries** have a long shelf life, so there is little concern that the useful lifetime will diminish, as long as the stick-on tab that covers the air vents has never been removed. Once the tab has been removed, however, the battery life will drain even if the tab is replaced.
- ∴ **A spare coil cable** is also extremely useful to have on hand. Although the system is designed to be durable, cables are particularly subject to wear and tear and need to be replaced from time to time.
- ∴ Consider keeping a **spare earhook** or other fixation device on hand.
- ∴ **Small screwdriver**, like those used on eyeglasses, for detaching locked fixation devices or earhooks. MED-EL provides a specialized pin removal tool in the patient's kit.
- ∴ If the child uses the **children's battery pack** or the safety lock, consider keeping something that will open the recessed lock. The screwdriver mentioned above will work, or an unfolded paper clip. Even a ballpoint pen will do the job.
- ∴ **Laminated troubleshooting card** "MED-EL Made Easy." This is a smaller sized copy of the chart on page 25. These can be obtained at no charge from MED-EL or the implant center.
- ∴ If the child **uses the DaCapo battery pack**, consider whether it makes sense to keep a spare PowerPack on hand. A charger will be needed to maintain a charge. Alternatively, a spare battery pack that uses standard 675 batteries might be useful (ensure that you have all the necessary accessories for connection, including an earhook).

For more advanced troubleshooting, a spare battery pack, coil and pre-programmed control unit will be needed (unless your facility provides mapping services). MED-EL offers families the option of purchasing a spare processor at the time of implantation, and many implant centers and families opt to do this. If the child has a complete, functioning spare system, problems can be solved instantly and troubleshooting one part at a time is much easier. If the family does not have a spare system, additional troubleshooting equipment may be purchased from the implant clinic or from MED-EL if desired.

Additional troubleshooting tools, such as the audio processor test device (SPTD) or the microphone test device (MTD) can be particularly helpful. All patient kits contain one SPTD, and additional test devices can be purchased from the clinic or from MED-EL. The MTD is purchased separately. Please call MED-EL for current pricing and ordering information.



MED-EL offers the **EarGear troubleshooting kits**, designed especially for schools. EarGear kits are offered in three levels, depending on the needs of the school. They contain all that the educator needs to do basic troubleshooting, and some kits offer options for more advanced troubleshooting. Please refer to MED-EL's BRIDGE to Better Communication product catalog at www.medel.com for a complete description and pricing or call MED-EL for information. (NOTE: This service is only available the USA.)

WHAT TO DO IF YOU DON'T FEEL COMFORTABLE WITH THE CHILD'S EQUIPMENT

If, after the above sections, you are still not comfortable handling the child's equipment, there are a number of available resources. The parents or implant center may be able to provide assistance. You may also call MED-EL for telephone assistance or to schedule an in-service visit.

A WORD ABOUT WARRANTIES

MED-EL offers several warranty options to assist families in keeping equipment in good working order. These options include the manufacturer's warranty, the extended warranty, and a choice of loss and damage coverage. Warranty information is provided in the patient's kit.

Manufacturer's Warranty: The external equipment (coil, processor; and all battery packs) carries a 3-year warranty in the US that is effective at the time of initial stimulation of the implant. The manufacturer's warranty ensures timely equipment replacement in the event of equipment failure that is not due to obvious misuse or negligence.

Extended Service Contract: After the 3-year manufacturer's warranty has expired, MED-EL offers an extended service contract that essentially continues the warranty. Families whose insurance coverage does not prohibit extended service contracts can purchase this option.

Theft, Loss and Accidental Damage: MED-EL offers a one-time replacement of a lost or damaged system during the 3-year manufacturer's warranty. Families can elect to purchase a comprehensive theft, loss and accidental damage coverage plan through MED-EL or ESCO. ESCO is an independent hearing aid insurance company. You may contact the implant center, MED-EL, or ESCO directly (www.earserv.com) for more information about ESCO's policies. (NOTE: This service is only available the USA.)

For more information on any of the above warranty options, please contact the implant center or MED-EL.



4

CARING FOR THE SYSTEM

MOISTURE

The processor is an electronic device, and therefore it is susceptible to problems if it is exposed to moisture or perspiration. It is advisable to take precautions to protect the system from moisture if the child will be in a wet environment. The external device should be removed altogether prior to swimming, bathing or other water-related activities where the system may become wet. If moisture is allowed to enter the microphone port, the microphone sound quality may eventually be degraded. Repeated or significant exposure to moisture may cause corrosion of the internal electrical components and require repair or replacement of the system. It is wise to develop a habit of wiping down the processor and coil after the child has been playing outside. If a child has a tendency to sweat excessively, it may be worthwhile to consider using a wearing option that moves the processor away from the ear or source of sweat.

If the processor does get wet, its function and the sound quality of the signal may be compromised. The child may report a “crackling” sound, intermittency, or other unpleasant sound sensations. Remove the system, turn it off, wipe off any excess moisture, and let it dry completely before attempting to assess whether it is permanently damaged. The best way to dry the internal components of the processor is to use a commercially available hearing aid drying kit. One drying kit is supplied with each patient kit, but they are readily available from hearing aid dealers, the implant center or MED-EL at nominal cost. These kits contain absorbent silicone, which is placed in an airtight container with the entire system (batteries removed) and left to dry for several hours or overnight. Disassembling the parts of the processor may promote faster drying.

ELECTROSTATIC DISCHARGE (ESD OR STATIC ELECTRICITY)

As an electronic device, the processor is susceptible to influence by electrostatic discharge (ESD). Static electrical energy can build up naturally on an object or on the human body. It usually occurs in dry environments when there is friction between two objects. Synthetic materials are common sources of static electricity build up. Some electronic equipment, such as computer and TV screens, actively create static electricity. This static buildup is generally not noticed until it is discharged. All of us experience this at one time or another, perhaps most often when walking on a carpeted floor and then touching another object. This discharge, or ESD, happens when two objects that have different charge levels come into contact, and the charge equalizes between the two objects. Children who have cochlear implants don't build up static charge any differently than people without cochlear implants.

Although the MED-EL implants and processors have several internal safety features designed to reduce ESD, there is a small risk that either the external or internal equipment can be damaged if the static discharge flows through the external equipment. Switching off the processor will not prevent damage from occurring. Electrostatic charge due to friction is usually mild and generally will cause the processor to switch off. In rare cases, the user may experience uncomfortably loud hearing sensations. Electrostatic charge from contact with plastic play equipment can build up to greater levels and requires a few additional precautions mentioned below.

The following safety precautions will ensure long life of both the internal and external equipment.

Following the listed guidelines below can reduce the probability of ESD:

- ⌘ If you believe the child is statically charged, have them discharge by touching a radiator, a watertap, or any other grounded metal object.
- ⌘ Do not allow another person to touch the external parts of the implant system unless the person and the child are discharged.
- ⌘ The child should discharge (touch another person) before taking off or putting on the processor. Have them use the two-step approach:
 1. Touch the person's body.
 2. Touch the equipment.
- ⌘ When picking up the processor from a table:
 1. Touch the table.
 2. Touch the processor.

- ∴ The child should be “discharged” when leaving a car. Touching the door is a good way to discharge. The processor or any cables should never touch the door or other parts of the car body.
- ∴ When working on a computer, the computer should be grounded (grounded outlets have a three-pronged plug receptacle). The child’s processor must not be directly connected to the computer if it is plugged into a wall outlet.
- ∴ An antistatic mat under a work area may reduce static buildup.
- ∴ The child should not directly touch the screen of the computer or TV. The risk of problems from computer screens is very small, but may be further reduced by using an antistatic screen over the monitor.
- ∴ Using an antistatic spray for upholstery, TV or computer screens can reduce static buildup. These sprays are also available for carpets and clothes.
- ∴ The processor should be removed before dressing and undressing, especially if garments include synthetic fibers. Generally cotton or natural fibers are preferred since they are less likely to cause ESD problems. Fabric softeners will also reduce static. When getting dressed, put the processor on last of all, and remove it first when undressing, in order to avoid ESD.

Plastic play equipment

The processor should be removed before touching plastic play equipment such as plastic slides, crawling tunnels, or pools of plastic balls. Friction with this type of play equipment can generate surprisingly large static voltages. Switching off the processor is not enough to prevent damage from occurring! The processor must be completely removed from the body. Afterwards, do not touch an implanted child at the site of the implant. Have them touch another person or grounded object to discharge before touching the processor. If there is any doubt about a particular material, it is best to err on the side of caution and have the child remove the processor.

Static electricity generators (Van de Graaff generators)

Some school science classrooms do experiments using static electricity. Before experimenting with static electricity or high voltages, the processor must be removed. **Implant users must not operate Van de Graaff generators at all, as they produce very high levels of static electricity.** A Van de Graaff generator looks like a globe that produces static electricity or “lightning,” they are sometimes found in science exhibits or museums.

In the case of an ESD event

If the processor stops working and you suspect an ESD event (static electricity) as the reason, switch off the processor, wait for 10 to 20 minutes and switch it on again. The programs should be restored. The MED-EL cochlear implant system features a unique SoundGuard™ system that protects against program loss due to ESD events. This is reassuring to families and educators because it dramatically reduces the potential for the child to be without sound or the need to return to the implant center for a re-mapping session. In the rare case that the programs are not restored, the red LED will flash a double-blinking pattern (II...II...II). Try switching the processor off and changing to a different program (using the FineTuner); it is possible that one of the program positions will function. If not, contact the parent and/or the implant center.

SPORTS

Contact sports that might result in severe blows to the head or continuous pressure on the implant should be avoided, as they may damage the implant. Other physical activity is generally allowed, however, the external equipment should be worn securely (see Wearing Options), and protected from physical damage. Sports that generally require a helmet are also acceptable if they do not exceed the given capabilities of the child. The use of a helmet is strongly advised, as this will help protect the implant site from any blows. The helmet should be of high quality and may need to be modified to meet the child’s needs. For specific questions about contact sports, especially with respect to a particular child’s medical history, contact the parent or implant team.

Most water sports are allowed as long as the external parts of the implant system are removed. The family should consult with the implanting physician prior to snorkeling and scuba diving.

METAL DETECTORS

Metal detectors and some anti-theft devices may produce a soft sound perceptible to the implant user, whether they are near or walking through the magnetic field. The processor should be switched off when walking through metal detectors. Any sound sensation should cease when the processor is switched off. The implant itself may trigger a metal detector.



CONNECTING TO ACCESSORY DEVICES

The standard, remote and DaCapo battery packs provide a direct input connection to external accessories and assistive listening devices. These battery packs can be safely connected to any external device that is battery-operated. The system **must not** be connected to external devices that are plugged into the wall or a power strip.



OPUS 2 with Phonak MicroMLxS and FM Battery Pack

The additional components required for connection of Assistive Listening Devices (ALDs) – FM battery pack cover and Adapter Cable – are included in the FM Extension Kit, which may be purchased separately if not already included in the child's kit. This special battery pack cover connects the OPUS 2 to external, battery-powered audio devices, such as MP3 players, portable video games, laptop computers (as long as they are running on battery power), etc. The FM battery pack cover includes a standard 3-pin input jack that enables wireless access to many common FM receivers and direct-link devices, such as Bluetooth systems. This means that many FM receivers (e.g., Phonak MicroLink MLxS), can be transferred directly from a child's hearing aid to their OPUS 2 processor. The FM battery pack cover is slightly longer than the standard cover to accommodate the integrated FM connector.

To assemble the FM battery pack cover, proceed as follows:

- 1 Open the battery pack lock.
- 2 Remove the battery pack cover.
- 3 Slide on the FM battery pack cover.
- 4 Close the battery pack lock.



FM Battery Pack

The OPUS 2 is also compatible with a variety of **patch cables** to facilitate connection to various battery-operated devices. All implant users receive a patch cable that is compatible with battery-operated equipment that uses a stereo headphone jack. You can identify a stereo headphone jack by looking at the plug of the headphone that would normally plug into the jack. If the plug is sized 3.5 mm (1/8 inch), and has two black rings on the shank of the plug, it is a **stereo jack**. If there is only one black ring, it is a **mono jack**. An inexpensive mono-to-stereo adapter can be purchased from an electronics store, which will enable the patch cables to be used with this device. However, most modern portable audio devices utilize a stereo jack.

Other adapter cables (external only, bilateral) are also available for purchase separately. Most ALD manufacturers provide suitable patch cables for the use with the standard three-pin input jack. Thus, FM cables can be purchased directly from the FM manufacturer if they are needed.

- 1 Connect the three-pin connector of the Adapter Cable (gray end) to the openings at the bottom of the FM battery pack cover. **Mind the orientation of the three pins and do not use excessive force when connecting the cable.**
- 2 Connect the audio phone plug (yellow or red end) to the audio output of the battery-powered device.



Patch cables that connect the OPUS 2 to various battery-powered devices

Audio plugs

2.5 mm
(used with cell phones)

3.5 mm
(standard size for use with MP3 players, stereos, assistive listening devices)

stereo plug
(two rings)

mono plug
(one ring)

MED-EL provides detailed product ordering information, along with pricing, and instructions for use of various FM patch cables. This information is updated periodically, when new FM systems become available and have undergone compatibility testing. Please contact MED-EL or the implant center for current resources on FM systems. You can also refer to MED-EL's website for an interactive database that can be used to search the latest information and recommendations regarding current ALDs.

WHEN TO USE ACCESSORY DEVICES SUCH AS FM SYSTEMS

FM systems are assistive listening devices that help amplify and focus the child on the teacher's voice. The teacher wears a microphone and transmitter, and the child wears a receiver that is connected to the processor. These "direct input" FM systems can be very effective in improving the child's ability to hear in a noisy environment and can successfully reduce the effect of distance and reverberation between the speaker and listener. Each FM system has different settings and connection capabilities. For specific information on connecting a particular FM system to the processor, see current MED-EL FM resources, available from the company or an implant center.

Although direct input FM systems can be very helpful, they also have some drawbacks. More equipment can sometimes mean more equipment to troubleshoot. Unfortunately, the child is the only person who can truly indicate whether the sound quality through the FM, coupled to the cochlear implant system, is acceptable. For this reason, we strongly recommend that direct input FM systems be used only with children who are good at reporting when equipment is or is not functioning normally. We also recommend that the school audiologist or implant center verify the FM settings to ensure that speech perception skills are at least as good while using the FM as they are without it.

In situations where the child is not a good reporter, a sound field system can be an excellent solution. With these systems, the teacher wears a microphone and transmitter, and the child sits next to a small desktop speaker. The problems of distance and background noise are reduced, and the teacher can verify that the system is working properly.

It is important to remember that when a child is listening through an FM system, they are effectively connected auditorally to the teacher. In other words, the FM can be very appropriate for teacher-directed activities or group lecture, but it is not effective (and can actually degrade the learning experience) when the teacher is not the focal point. For example, if the class is doing small-group work, where the teacher is moving from group-to-group, it is not effective for the child to be listening to the teacher's voice in another group while trying to concentrate on his/her own group's work. In addition, FM is often unnecessary in one-on-one situations, such as speech-language or auditory therapy, where distance and background noise are not a concern. Conscientious use of the FM in appropriate situations can greatly assist a child; blanket use of the FM, without fully understanding its advantages and disadvantages, may detract from the child's ability to make the most of the classroom environment.

MIXING OPTIONS

Mixing refers to the ability to combine the input from an assistive listening device (such as an FM system) with the sound input from the OPUS 2 processor. In general, mixing is almost universally preferred over external input only, because it allows a child to monitor his or her own voice. It also allows a child to hear the voices of other children in the classroom through the processor, in addition to receiving the benefit of the assistive device.

For the standard and DaCapo battery packs, the FM battery pack cover allows a wireless connection. With wireless FM systems, the OPUS 2 will accept the mixing ratio that has been set on the FM receiver. If an adapter cable is required, you can choose either a "mixing" or "non-mixing" patch cable. Mixing cables allow the child to hear both signals, with the input from the OPUS 2 microphone (environmental sound and their own voice) mixed one-to-one along with the sound from the external device. Non-mixing cables provide sound input only from the external device. The patch cable included in the standard/FM Extension kit is a mixing cable – a yellow plug with 3.5mm stereo jack. The non-mixing cable is a red plug with 3.5mm stereo jack and is available for purchase from MED-EL.

With the TEMPO+ or OPUS 1 processor it was possible to reduce the emphasis of the processor microphone signal (i.e. increase the emphasis of the ALD) by reducing the Automatic Gain Control of the processor. For the OPUS 2 if you want to increase the emphasis of the ALD, increase or decrease the volume of the ALD or the ALD's FM gain settings. It is not possible to deactivate the OPUS 2 microphone by reducing the Automatic Gain Control (AGC) only as reduction of the AGC would reduce the signal of the ALD at the same time. It is therefore required to use a "external-only" patch cable if you want to deactivate the OPUS 2 microphone.

The remote battery pack has the mixing option built into the battery pack. The sliding switch labeled "EXT/MIX" on the base of the battery pack allows the user to choose whether to combine the OPUS 2 microphone input along with the external system (MIX) or simply listen to the external system alone (EXT). If nothing is plugged into the direct audio input port of the battery pack, the position of the sliding switch has no effect.



The remote battery pack has the mixing option built into the battery pack

When plugging into any external device (in this example, an MP3 player), follow these steps:

STEP BY STEP CONNECTION GUIDE

Standard battery pack




- 1 Ensure that the MP3 player is battery operated (not plugged into a wall outlet), that the batteries are fully charged, and that it is functional.
- 2 Ensure that you have the correct patch cable (refer to MED-EL literature, the implant center, or the external device manufacturer).
- 3 Ensure that the FM battery pack cover (shown at left) is in use.
- 4 Plug the patch cable into the three-pin connector at the bottom of the battery pack.
- 5 Decrease the volume on the MP3 player as much as possible. Connect the other end of the cable into the MP3 player's headphone jack. Turn the processor on and place the processor on the child. If needed, use the FineTuner remote control to select everyday program, volume and sensitivity settings.
- 6 Increase the volume of the MP3 to a comfortable level.

DaCapo battery pack

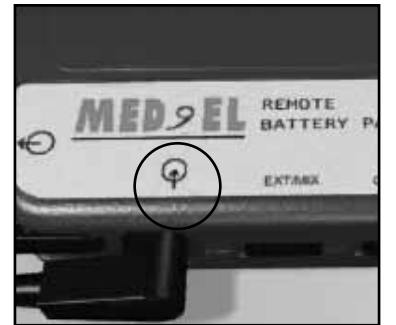
The DaCapo battery pack allows direct input when using the FM battery pack cover. The same FM battery pack cover with three-pin connector is used for the DaCapo and Standard battery packs.

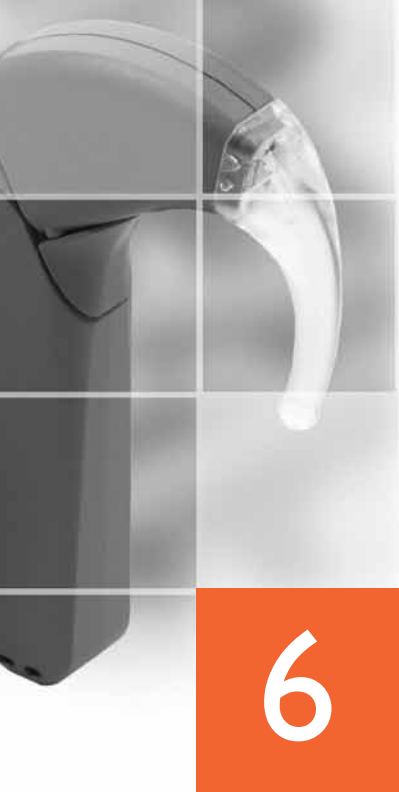
- 1 Ensure that the MP3 player is battery operated (not plugged into a wall outlet), that the batteries are fully charged, and that it is functional.
- 2 Ensure that you have the correct patch cable (refer to MED-EL literature, the implant center, or the external device manufacturer).
- 3 Ensure that the FM battery pack cover is in use.
- 4 Plug the patch cable into the three-pin connector at the bottom of the battery pack.
- 5 Decrease the volume on the MP3 player as much as possible. Connect the other end of the cable into the MP3 player's headphone jack. Turn the processor on and place the processor on the child. If needed, use the FineTuner remote control to select everyday program, volume and sensitivity settings.
- 6 Increase the volume of the MP3 to a comfortable level.

Remote battery pack

The remote battery pack provides a direct input port for connection to assistive listening devices. This port is located on the battery pack, labeled , under a small plastic cover. The input port is a standard 3.5 mm (1/8") stereo headphone jack.

- 1 Ensure that the MP3 player is battery operated (not plugged into a wall outlet), that the batteries are fully charged, and that it is functional.
- 2 Ensure that you have the correct patch cable (refer to MED-EL literature, the implant center, or the external device manufacturer).
- 3 Plug the patch cable into the remote battery pack. Then, go to step 5 under "Standard battery pack" above.





GLOSSARY OF TERMS RELATED TO MED-EL COCHLEAR IMPLANT SYSTEMS

Apical region :: The apical region is the tip of the 'snail shell' shape of the cochlea. This region is responsible for sensing low-pitched sounds. MED-EL cochlear implants are the only implant systems that reach deep enough into the cochlea to stimulate the apical region and the part of the system that is 'tuned' to low pitched sounds.

Audiogram :: The audiologist does an audiogram (sometimes called audiometry) to determine the softest levels that a child can hear across low and high pitches. Often, the audiologist will also assess how well the child perceives speech sounds, which is called speech perception testing. Additionally, the audiologist may measure how softly a child can understand speech.

Audiologist :: An audiologist is a specialist in the diagnosis and non-medical treatment of hearing and balance problems. Audiologists obtain either a Master's or Doctoral level degree, and then complete a training fellowship prior to entering practice.

Audio processor :: A tiny wearable computer that transforms sound into the coding understood by the implant. The TEMPO+ and OPUS 1 processor contain a microphone, a sensitivity control, a program switch, and a volume switch. The OPUS 2 contains a microphone and an on/off switch, with other functions accessible through the FineTuner remote control unit. The processors connect to different battery packs. The term "audio processor" is often used to refer to the entire external part of the system (control unit, battery pack, coil and cable).

Auditory brainstem response testing (ABR) :: An audiologic test that roughly measures hearing acuity without any participation from the child. As the child sleeps, a clicking sound is presented to the ear, and the resulting brain activity is measured. This measure is used extensively for diagnosing hearing problems in infants and young children who are unable to respond behaviorally.

Auditory habilitation specialist :: This term is used in this handbook to refer to the wide variety of professionals who become specialists in teaching deaf children to use their residual hearing with hearing aids or cochlear implants. It is well accepted that children with hearing loss need special assistance to develop auditory skills. An auditory habilitation specialist can be a speech-language pathologist, a teacher of the deaf/hard of hearing, a certified auditory-verbal therapist, an audiologist – any one of a variety of related professions – who has specialized in the habilitative aspect of hearing loss.

Auditory nerve Response Telemetry (ART™) :: This is a test done by the audiologist that allows visual confirmation of the auditory nerve firing in response to stimulation from the implant. The ART measurement helps the clinician make a "rough guess" as to the sound level required to trigger the auditory nerve; although this measurement isn't completely predictive of the levels he or she will need to set in the child's processor program, it does provide confirmation that stimulation levels are roughly in the audible range for the child. ART measurements can be helpful in cases where a child cannot give adequate feedback during fitting sessions.

Automatic gain control (AGC) :: The AGC is a system the audio processor uses to manage sounds of different loudness. The child with a cochlear implant does not have a wide range of sound tolerance, as does a person with hearing. The AGC ensures that very loud and very soft sounds are processed accurately so that they fit into the range of hearing of the implant user.

BabyBTE™ :: A unique wearing option available with all MED-EL audio processors that allows the entire audio processor to be attached to the clothing for security.

Basal region :: The basal region of the cochlea is the high-pitched region. This is the area that would be considered the base of the 'snail shell' shape, and is the area closest to where sound first enters the inner ear.

Batteries :: MED-EL audio processors are unique in that they have very long battery life. Several pack configurations run on size 675 batteries (for an average battery life of 3-5 days). These batteries can be purchased from MED-EL or at many drugstores and hearing aid dealers. It is critical that they are labeled as "high power" batteries. Size 675 batteries that are not labeled "high power" will result in very short battery life because their power levels fluctuate enough to signal a dead battery to the processor, even though the batteries may be fully charged. The remote battery pack uses one size AA battery (either rechargeable or alkaline).

Battery pack :: A modular component of the audio processor that houses the batteries that power the system.

Channel :: A channel refers to one of the 12 electrode pairs that are arranged along the array. The channels are numbered consecutively, with channel 1 being the lowest in pitch, and channel 12 being the highest in pitch. Not all children use all available channels, however. Channels can be deactivated for various reasons without any negative overall effect.

Coding strategy :: A coding strategy is a series of calculations used by the cochlear implant system to measure the sound that is presented to the microphone, analyze its components, and then determine which electrodes should be stimulated and how they should be stimulated to best represent the original sound. Next, it generates a code that is sent to the implanted portion of the system. This code tells the implant which channel to stimulate within the cochlea, when to stimulate it, and how loud that stimulation should be to accurately represent the sound at the microphone.

Coil :: The coil sends the coded information from the audio processor to the internal implant. It uses radio signals to send this message across the skin. The radio signals produced by the coil are a special frequency that is the only frequency understood by the implant receiver. The coil also contains a magnet that holds it against the correct area of the head so that it is aligned properly with the implanted portion.

Coil cable :: The cable that connects the coil to the audio processor.

Control unit :: The computerized part of the audio processor that does the work of transforming sound into a code that can be sent to the implant.

Connecting Piece :: A connection accessory that allows a battery pack to be connected to the processor. All wearing options use some form of connecting piece; in some configurations, the connecting piece may also be the earhook. A special locking Connecting Piece safely locks the control unit and battery pack which keeps a small child from removing it from the processor.

Communication methodology :: The form that communication (and education) takes. Speaking, listening, using a signed or cueing system, or a complete signed language are all various communication methodologies.

DaCapo System :: The DaCapo Rechargeable Battery System can be directly connected to the control unit. The system makes the processor even lighter and preserves the slim design. It is compatible with FM and other external devices. The rechargeable battery cell provides 10-12 hours of continuous operation.

Decibels (dB) :: The decibel is the measure of a sound's loudness. The range of normal human hearing is typically 0-120 dB, with 0 dB being barely audible and 120 dB being barely tolerable. Conversational speech is fairly loud, at around 50 dB.

Detection :: An auditory response that indicates a sound was heard. A child might indicate he or she detects a sound with a head turn, nodding, raising a hand, putting a toy in a container, etc. The fact that a child detects a sound does not necessarily mean he or she can discriminate it from other sounds – detection is simply an indication of the presence or absence of a sound.

Diagnostic therapy :: Diagnostic therapy refers to the process of using the therapy environment to gain an understanding of a child's level of speech, language or auditory development. Through a series of fun activities, the auditory habilitation specialist may attempt to determine how well the child is making use of hearing through a hearing aid or an implant, without the use of formal test measures.

Direct input :: Direct input refers to plugging an external sound source directly into the audio processor using a patch cable. Any battery-operated device can be connected to the MED-EL audio processors.

Discrimination :: The ability of a child to understand a sound, word, or sentence. Usually speech discrimination is measured by asking the child to point to various objects or repeat various words or sentences.

Dynamic range :: A term used to define the loudness difference between the softest sound a person can hear, and the loudest sound they can still comfortably tolerate. The dynamic range of hearing is about 120 dB for most people with typical hearing. The dynamic range of the implant user is about 30 dB. The Automatic Sound Management system allows a sound range of 25-100 dB to be represented accurately by the audio processor, giving the implant user an expanded input dynamic range of 75 dB.

Earhook :: The earhook has a dual purpose: it holds the audio processor on the ear, and in the case of the TEMPO+/OPUS 1, it connects the battery pack (or battery pack cable) to the audio processor. The earhook can be ordered in a locking configuration to keep a child from removing it.

Educational specialist :: In this guide, the term refers to a professional who specializes in educating children with cochlear implants in a wide variety of educational settings. This professional may provide advice and support to a child's educational team, or evaluate a child's readiness for a certain type of educational approach. The educational specialist could be a teacher of the deaf/hard of hearing, an educational audiologist, or other related professional.

Electrical auditory brainstem response testing (EABR) :: This is a method of obtaining an ABR but using the sound generated by the implant. Because head movement can obscure the response, children are often lightly sedated for the test. This test assists in determining how well the auditory system is responding to the stimulation generated by the implant.

Electrical stapedius reflex test (ESRT) :: An objective measure that can be useful in establishing an MCL measurement in children who are unable to provide feedback to the audiologist about the loudness of sound. A small probe is placed in the opposite ear. The stimulation level of the implant is increased until a small muscle reflex is seen in the opposite ear. This muscle reflex is present in most people, and occurs at a level that is loud, but still comfortable. The level at which this reflex occurs correlates well with the MCL level of the map.

Electrode array :: The implanted device has a long, flexible portion that is inserted into the cochlea through a small opening. This portion of the device is called the electrode array.

Electrode contacts :: Electrode contacts are small oval-shaped disks made of platinum that are arranged along the electrode array. In MED-EL implants, they are arranged in 12 pairs. Each pair stimulates a different frequency region in the cochlea.

Electrostatic discharge (ESD) or static electricity :: A build-up of charge difference between a person and an object, often caused by friction between synthetic materials, or electronic equipment (such as TV screens), usually felt as a “shock” when the statically charged person touches a grounded object. The cochlear implant user does not feel the “shock” any differently from a non-user. A good example is the shock that occurs when touching a light switch after walking on the carpet. ESD tends to be worse in a dry environment. ESD can cause damage to electronic equipment of all kinds. MED-EL audio processors have built-in safeguards to protect the processor from program loss due to ESD.

Expressive language :: The ability of the child to produce language to communicate with others.

FineTuner :: The FineTuner is the remote control device for use with the OPUS 2 processor. It is used for changing sensitivity, volume and program settings.

Fixation device :: A small accessory that is attached to the battery pack that allows it to be connected to the clothing. The fixation bar can accommodate a small safety pin or diaper pin. The fixation clip can be clipped directly to clothing.

FM system :: An assistive device that consists of a microphone and transmitter worn by the speaker, and a receiver worn by the listener. In the case of the implant, the receiver must somehow connect to the audio processor with a patch cable, or with direct connection to the OPUS 2 FM battery cover. An FM system sends the speaker’s voice to the listener using FM radio waves to help overcome the problems of distance and background noise.

Hair cells :: The hair cells in the inner ear sense the pitch and intensity of sound waves that travel through the fluid of the inner ear. In most instances of deafness, the hair cells or some part of the anatomy associated with them do not function properly and cannot send signals accurately to the brain. The cochlear implant attempts to mimic the function of the hair cells by generating a signal similar to what the brain might normally receive from the inner ear.

Hertz (Hz) :: A measure of pitch that refers to the number of cycles per second that a sound causes oscillation. The range of human hearing is 20 Hz – 20,000 Hz. Speech information falls roughly in the frequency range 200 Hz – 6000 Hz. “Middle C” on the piano occurs at 262 Hz.

Implant :: The implanted portion of the system. The implant contains the receiver circuitry that decodes the signal from the coil, and also generates the tiny electrical pulses that travel down the electrode array and stimulate the cochlea. This receiver and stimulation circuitry is encased in a thin, and very strong package that sits just under the skin. The electrode array carries the electrical pulse from the implant case to the cochlea. The implant also contains a reference electrode that ensures the appropriate handling of electrical current. The implant contains a magnet, which attracts the external transmitting coil so that it is held in the correct place on the head.

Implant case :: The implanted electronics are hermetically sealed inside the case. MED-EL implants are the smallest implants available.

Individualized education plan (IEP) :: Although the IEP has a different name in some states, the term refers to the formal educational plan that is developed for each child who receives special services through a local school district. Federal law requires that schools provide a “free and appropriate” education to all children, including those with special needs. The IEP is a document that defines the services that will be provided to meet that law. The IEP is developed with input from the child’s parents, the child (when appropriate), teachers, school administrators and special service providers.

Inner ear :: The anatomical portion of the hearing system that triggers nerve impulses that travel to the brain. Both the hearing and balance systems are found in the inner ear. The cochlea is a small snail-shaped structure that contains the tiny hair cells that sense sound and send signals to the auditory nerve. The semicircular canals sense balance and position changes and report these changes to the brain.

Input dynamic range (IDR) :: See Dynamic Range. The IDR is a measure of the implant system's ability to handle a wide range of sound inputs accurately. The IDR of the MED-EL system is 75 dB.

LED indicator :: The small red light on the front of the processor will flash in a variety of blinking patterns to indicate different status or error conditions of the processor or batteries.

Localize :: The act of locating the source of a sound.

Magnet :: There are two magnets in the system: one in the coil and the other in the implant case. Together the two hold the coil in place on the head. The implant center audiologist can adjust the magnetic strength of the coil.

Map :: The program stored in the audio processor that tells the system how to process sound on each channel so that it is most audible and comfortable for the individual user. Each implant user's map varies considerably from every other user. Maps also change over time, as the human body also fluctuates slightly in its sensitivity to electrical stimulation over time.

Mapping sessions :: A visit to the implant center where the individual's audio processor program is evaluated and changed if necessary

Mastoid bone :: The area of bone directly behind the ear where the implanted portion of the system is placed.

Microphone port :: The tiny opening on the front corner of the processor is the microphone port.

Microphone test device (MTD) :: An optional accessory that allows a hearing person to listen to the microphone of the processor to determine whether it is functioning adequately.

Middle ear :: The anatomical portion of the ear just beyond the eardrum. The middle ear consists of a small air space that holds the three small bones of hearing (malleus, incus and stapes). The Eustachian tube allows air exchange between the middle ear air space and the outside; when the ears 'pop' during a change in altitude, this is actually the pressure equalizing between the middle ear and the outside. The middle ear is the most common site of an ear infection.

Mixing cables :: "Mixing" refers to a feature of certain assistive listening devices (such as FM systems) that allows the user to combine the signal from the speaker with the signal from the audio processor microphone. The processors support this feature, but it is necessary to ensure that a mixing patch cable is in use.

Most comfortable loudness (MCL) :: MCL refers to a loudness level that is loud, but still comfortable, to the listener. This is an important measurement made on each channel during a mapping session. The final MCL setting of the map sets an upper limit for loudness, and stimulation will never exceed that limit. MCL levels are different for each user; therefore it is important that audio processors are never traded between users.

MRI scan :: Magnetic Resonance Imaging is a medical diagnostic procedure. At the time of printing, MED-EL cochlear implants are FDA approved for 0.2T (Tesla) MRI scanners without the removal of the implant's internal magnet. Only machines of 0.2T strength should be utilized with MED-EL at this time. Additional factors, such as head placement, make it important for the scanning radiologist to contact MED-EL prior to scheduling the MRI scan.

Newborn hearing screening :: A program in place in many hospitals that allows a child's hearing to be evaluated immediately after the baby is born.

ON/OFF switch :: The ON/OFF switch is located on each of the TEMPO+ and OPUS 1 battery packs. The battery pack lock functions as the ON/OFF switch for the OPUS 2.

Otologist/Neurotologist :: An otologist is a physician who first became an ear, nose and throat specialist, and then went on to specialize in just the ears and the area of the head surrounding the ear. An otologist completes over 10 years of medical training and a specialized otology training fellowship prior to entering practice.

Outer ear :: The anatomical portion of the hearing system that includes the pinna (the visible "ear" on the outside of the head), the ear canal, and the eardrum (tympanic membrane).

Phoneme :: The smallest unit in a language that is capable of conveying a change in meaning. For example, the m in mat and the b in bat. There are 41 phonemes in the English language

Phonemic repertoire :: The range of various phonemes (speech sounds) that a child is able to produce. Generally, certain speech sounds seem to develop earlier than others over a period of several years.

Play audiometry :: An audiometric technique that teaches a young child to complete an activity when a sound is heard (such as dropping a block into a container or putting a piece in a puzzle). This facilitates testing the hearing of preschoolers and toddlers.

Program switch :: The program switch on the TEMPO+ and OPUS 1 allows the user to select different programs, or maps. The FineTuner is used to change programs for the OPUS 2 audio processor. Please refer to the implant center audiologist or parent to determine which program should be used most of the time.

Receptive language :: The ability of the child to understand language that is presented to him/her.

Residual hearing :: This is the term used to describe the hearing that remains after a hearing loss occurs. Most people with significant hearing loss still have some residual hearing that can be stimulated by amplifying sound using a hearing aid. However, the remaining hearing often does not provide enough clarity for a hearing aid to be of much benefit. These are the individuals who are candidates for cochlear implantation.

Sensitivity control :: The sensitivity control determines how sensitive the microphone is. High sensitivity settings cause the microphone gain to be increased. This can be good in a quiet environment, but in a noisy environment, it results in poor loudness relationships between soft and loud sounds. The general “rule of thumb” is to keep the sensitivity setting at about half-way on.

Sound field FM system :: An FM system that does not plug into the audio processor. Instead, a small speaker near the listener amplifies the speaker’s voice. A sound field system is a good alternative to regular FM if the child is unable to provide feedback on the quality of a direct FM connection.

Speech awareness threshold (SAT) :: The softest level at which a child can detect a spoken word. However, the child is not required to be able to understand the spoken word.

Speech reception threshold (SRT) :: The softest level at which a child can hear a spoken word well enough to repeat it back correctly.

Speech-language pathologist :: A speech language pathologist is a specialist in the diagnosis and non-medical treatment of speech and language disorders. An SLP obtains either a Master’s or Doctoral level degree, and then completes a training fellowship prior to entering practice.

Steady state evoked potentials :: An objective measure of hearing that requires no participation from the child. SSEP’s provide detailed information about the child’s hearing acuity. This is a very new measure that does not yet have widespread availability.

Suprasegmental :: The cues of language that come from pitch, intensity and durational differences in the pattern of speech. Suprasegmentals are what allow an English speaker to recognize the inflection of a question, even though the question is asked in another language.

Telecoil :: The OPUS 2 has an integrated telecoil. The telecoil picks up magnetic sound signals coming from telephone receivers or loop systems which are installed in some public buildings, allowing another option for hearing on the phone or receiving input from assistive devices.

Telemetry :: A feature built into the implant system that allows the audiologist to test the function of the implanted portion of the system. This is a quick test that requires no input from the child, and provides valuable information about how well the electrodes are functioning.

Threshold :: Hearing threshold is defined as the level at which a person hears a sound 50% of the time. This means it is so soft, that the listener isn’t even sure the sound is really there. When the audiologist performs an audiogram, he or she is trying to find the child’s threshold of hearing at different pitches across a spectrum from low to high pitch. Threshold can also refer to the softest level of electrical stimulation a child can perceive. In the MED-EL mapping software, the threshold setting of the map is abbreviated as “THR.” However, with MED-EL cochlear implants, threshold is defined as a level below the level where the patient perceives a sound. Threshold measures do not significantly impact the quality of the resulting map, and often are not measured.

Tonotopic organization :: The inner ear and the auditory area of the brain and central nervous system are arranged in pitch order, from low to high. Sounds of different pitches are processed by different hair cells, nerve fibers, or brain synapses. The cochlear implant, therefore, is designed to present pitch information to the areas of the cochlea that are “tuned” to be sensitive to those pitches.

U-pin :: A connection accessory that allows a battery pack to be connected to the audio processor without using an earhook. It is most commonly used in the BabyBTE™ configuration. The u-pin can also be ordered in a “locking” configuration, which keeps a small child from removing it from the processor.

Visually reinforced audiometry (VRA) :: This is a technique for obtaining responses to sounds from children who are not yet able to report what they hear. The child is presented with a sound, and when they respond, they are rewarded with something they can see, such as a puppet or an animated toy. The audiologist attempts to condition the child to look for the toy when a sound is heard, thus providing a method for testing the hearing of small children.

Vocal play :: The act of experimenting with the voice. Babies go through various stages of playing with their voices. This play becomes more and more speech-like until true words emerge. When a young child with a cochlear implant begins experimenting with his or her own voice, it is a good indicator that the child is hearing sound through the implant and is beginning to make the connection between hearing and the voice. With more time and practice, these vocalizations should begin to approximate words or phrases.

Volume switch :: The volume switch (x-y-z) on the TEMPO+ and OPUS 1 allows the user to choose different volume levels for each program. The FineTuner is used to adjust the volume levels for the OPUS 2. The audiologist sets the volume levels, so it is best to consult the child's parent or implant center for guidance on the correct volume setting for the child.



**A Commitment
to Excellence**

MED-EL is a company that is dedicated to helping improve the lives of individuals with hearing loss through research and development of technologies that restore hearing. We pride ourselves on technological excellence, providing service and support that are second to none. We continue a tradition of innovative research and development that began in 1975.

A Heritage of Industry Firsts

- 2010** Launch of the Amadé, the new audio processor of the Vibrant Soundbridge.
- 2008** The new MAESTRO™ 3.0 system software means that OPUS processors are now also available for COMBI 40+ implant users.
- 2007** **First introduction of EAS™** and approval of the Vibrant Soundbridge® for conductive and mixed hearing losses in Europe. Launch of the DaCapo rechargeable battery system.
- 2006** MED-EL launches the OPUS family of audio processors and introduces the SONATA™¹⁰⁰ cochlear implant with a new small titanium housing.
- 2005** Introduction of the MED-EL DUET, the **first hearing system** worldwide to integrate cochlear implant audio processing and hearing aid technology in one compact device.
- 2004** MED-EL launches the PULSARci¹⁰⁰ cochlear implant, providing future-ready electronics in an optimized ceramic housing.
- 2003** Acquisition of the Vibrant Soundbridge®, the **first implantable middle ear hearing device** for mild-to-severe sensorineural hearing loss.
- 1999** Launch of the TEMPO+ behind-the-ear (BTE) audio processor.
- 1997** The COMBI 40+ Split Electrode (GB) first implant to address cases of cochlear ossification.
- 1996** Introduction of the COMBI 40+, the **thinnest cochlear implant available** worldwide.
- 1995** Introduction of the CIS LINK system.
- 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) audio processor.
- 1989** Introduction of the COMFORT cochlear implant.
- 1977** Implantation in Vienna of the **world's first microelectronic multi-channel cochlear implant**.
- 1975** Cochlear implant development started by MED-EL founders Ingeborg and Erwin Hochmair.

BRIDGE is a program for education and rehabilitation professionals developed by MED-EL.
For more information about BRIDGE products, please visit www.medel.com.



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