Sonic Spotlight

Tinnitus SoundSupport™

with EXPRESS*fit*® Pro

Tinnitus management is becoming more commonly available in today's clinical hearing aid practices. To support our partners who provide this valuable service to their patients, Sonic introduces Tinnitus SoundSupport. Tinnitus SoundSupport delivers flexible sound therapy options built into hearing aids on the SoundDNA platform. This Sonic Spotlight offers an introductory overview about tinnitus in general and includes a step-by-step guide on how to use Tinnitus SoundSupport in the EXPRESS*fit* Pro fitting system.

Tinnitus SoundSupport™

What do Ludwig van Beethoven, Charles Darwin, Michelangelo and Vincent van Gogh have in common? They're all notable people from history who suffered from tinnitus. From the past to present and into the foreseeable future, tinnitus remains a universal condition – it can strike anyone, anywhere, anytime. Are you prepared for the next patient with tinnitus who visits your clinic today?

Definition

Tinnitus, familiarly known as 'ringing in the ears', may be a household term but it's hard to define. Many people have it, and many things cause it, but it can present in many different ways. Tinnitus is often characterized as the perception of internal noise, variable in pitch and loudness, which lacks an outside source. It can be described as ringing, buzzing, whooshing or other descriptive types of sounds or noises. Furthermore, it can be classified into categories such as severity (acceptable or unacceptable), duration (permanent or temporary), and site (middle ear or sensorineural) (Dauman and Tyler, 1992).

Epidemiology

According to the American Tinnitus Association, tinnitus is a condition that affects millions of people. In fact, the U.S. Centers for Disease Control estimate that while 50 million Americans experience it, 20 million find it burdensome, and 2 million find it debilitating. Although a small fraction – approximately 15% – of the general population experience tinnitus, a much greater prevalence occurs in the clinic population, since it is a common symptom of patients seeking treatment for ear- and hearing- related concerns (Spoendlin, 1987).

Causes

Tinnitus is not a disease. Rather, it is a symptom of an auditory disorder. Hearing loss is the most common cause of tinnitus. Of note, the prevalence of tinnitus increases more so from noise-related hearing loss than from age-related hearing loss (Eggermont, 2012). Beyond hearing loss, there are many other causes of tinnitus – both related and unrelated to the ear (Fig. 1). Potential causes of tinnitus include any of the following:

- Outer ear disorders: Cerumen, foreign body touching the tympanic membrane
- Middle ear disorders: Middle ear infection, Eustachian tube dysfunction, vascular changes, otosclerosis, benign tumors, spasms
- Inner ear/retrocochlear disorders: Sensorineural hearing loss (e.g., presbycusis, noise exposure), vestibular conditions (e.g., Meniere's disease, labyrinthitis), acoustic neuroma/vestibular schwannoma
- Blood vessel disorders: Blood pressure problems, vascular conditions, head or neck aneurisms, atherosclerosis, arteriovenous malformation, head and neck tumors
- Injuries: Trauma to the head, ear or neck; temporomandibular joint (TMJ) problems
- Medications: Anti-inflammatory drugs (e.g., aspirin, ibuprofen, quinine), diuretics, certain sedatives, antidepressants, antibiotics and chemotherapy agents

Depending on the suspected cause, further testing may be required to identify the source and best course of treatment. Many of the above causes warrant diagnosis, treatment and/or monitoring by a medical doctor.

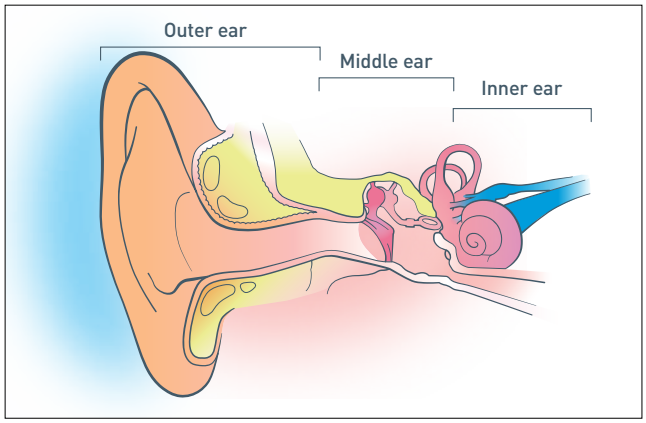


Figure 1: Parts of the ear associated with tinnitus

Demographics

Knowing that there are certain causes of tinnitus, it is also important to discover if some people may be more susceptible than others to tinnitus. Because tinnitus has no cure, determining possible risk factors for groups of people or identifying potentially susceptible individuals helps to better understand how it may present in clinic populations.

In a 2010 study published in the American Journal of Medicine, Shargorodsky et al. examined the relationship between risk factors and self-reported tinnitus in over 14,000 participants in a nationally represented database. Their analysis confirmed, not surprisingly, that individuals with hearing loss, persons exposed to loud recreational or occupational noise, and adults between the ages of 60-69 are more likely to have frequent (daily) tinnitus. However, it also revealed that non-Hispanic whites, adults with hypertension, former smokers, and those with generalized anxiety disorder were more likely to experience tinnitus than the general population. Having an awareness of these at-risk subgroups may better inform professionals who treat a diverse population of patients in the clinic.

Pathophysiology of tinnitus caused by hearing loss

Patients with tinnitus from hearing loss often want to know how their condition occurred. A brief explanation will go a long way to support patients' concerns. The best approach is to begin with a simple definition of spontaneous activity in the nervous system. As tinnitus scholar Jos J. Eggermont, Ph.D., describes in Chapter 4 of the Tinnitus Handbook (2000), spontaneous activity refers to involuntary neural processes that occur within the brain. It may include background sounds arising from active hair cells in the cochlea (Fig. 2), action potentials firing in the auditory nerve, or electroencephalographic (EEG) activity. Spontaneous activity occurs in the normal auditory nervous system – we don't hear it because we adapt to it.

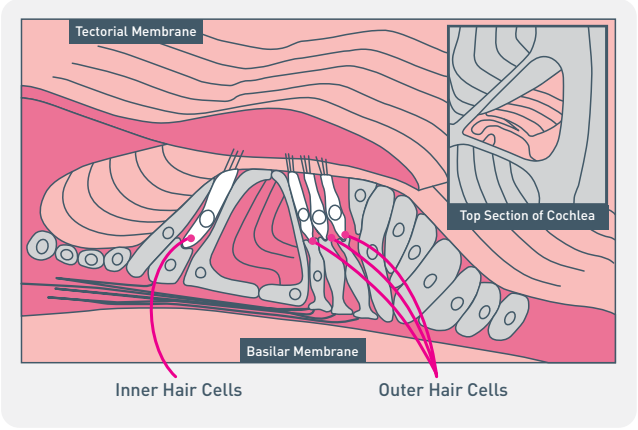


Figure 2: Cochlear hair cells

Eggermont continues to explain its correlation to tinnitus. When the spontaneous activity in a portion of auditory nerve fibers changes – for example, by outer hair cell damage due to aging or noise exposure – neural modifications start to occur. Synapses at higher neural levels reorganize, become re-tuned and respond to the edge, or borders, of the remaining healthy parts of the cochlea. The re-tuned neurons may continue to fire in the absence of sound, producing a pitch similar to frequencies bordering the hearing loss, close to the frequency of maximum hearing loss.

This explanation contributes to one of the leading theories about tinnitus from hearing loss – that it likely results from excessive neural noise caused by hair cell damage in the cochlea. Whereas this level of information may be too much for some, it may not be enough for others. Directing concerned patients to trusted resources like the American Tinnitus Association may satisfy their need for further education about their condition.

Tinnitus measurement

Tinnitus measurement is an integral part of a tinnitus management plan. It characterizes the type of tinnitus and helps to determine the best way to manage the condition. Patients with chronic tinnitus may exhibit stress, anxiety, insomnia or a high emotional state about having a disorder that persists over time (Tyler and Baker, 1983). The ability to measure or quantify their tinnitus will provide welcome reassurance that their tinnitus is real, and that there is hope to treat a sound only they can hear.

A tinnitus assessment begins like all other hearing evaluations – with a complete diagnostic battery of tests that includes pure tone and speech audiometry, tympanometry, acoustic reflexes and otoacoustic emission testing. Following routine clinic exams, further tests can be administered with a clinical audiometer or other specialized equipment (e.g., MedRx Tinnometer) to measure the sound, pitch, and volume of the patient's tinnitus. Common tests include the following:

- Pitch matching: identifies the center pitch of the tinnitus. Common tinnitus tones or sounds are presented to the patient, who then identifies the sound that most closely matches the tone or sound heard in the ear. Pitch matching provides an important baseline for sound therapy.
- Test for octave confusion: confirms the octave of tinnitus pitch. Patients sometimes confuse the pitch of their tinnitus with a tone one octave from it. With this test, a tone is presented at one octave above and below the selected frequency to confirm the correct octave.
- Loudness matching: identifies the loudness of the tinnitus. The patient must choose the closest level of a tone among two different ones. The intensity is recorded in dB Sensation Level (SL).
- Minimum masking level: indicates when tinnitus is no longer heard. A masking signal is presented in ascending steps until the patient reports the tinnitus is undetectable.
- Loudness discomfort level: finds the upper loudness limit of sound. It is the volume at which a presented sound becomes uncomfortable for a patient. This measurement is particularly useful for those with hyperacusis.
- Residual inhibition: determines if tinnitus can be reduced with sound. A masking signal, presented to the ear for 60+ seconds, reveals if the tinnitus is completely or partially reduced. In some cases, there is no change, or it is increased.

These tests better inform the feasibility of sound therapy, masking and hearing aids as management options. Of note, a study by Henry et al. in 2004 acknowledged that tinnitus measurement methodology was inconsistent across clinics and had the potential to affect treatment outcomes negatively. Today it remains true that it is important to obtain reliable and repeatable measurements of a patient's tinnitus, in order to achieve the best treatment outcomes for the individual. Interested practitioners are encouraged to explore the Audiologic Guidelines for the Diagnosis and Management of Tinnitus Patients, a resource available from the American Academy of Audiology (AAA, 2000).

Tinnitus questionnaires

Subjective assessments of tinnitus are another fundamental part of managing tinnitus. It is essential to assess the impact of tinnitus on a patient's health and well-being, because the severity of tinnitus does not necessarily correlate with the degree or type of hearing loss (Perry and Gantz, 2000). For example, a patient with mild high-frequency loss may describe their tinnitus as severe. In addition, a person with self-described mild tinnitus may find it more burdensome compared to another who reports moderate tinnitus. A careful case history in addition to the use of tinnitus scales such as the Tinnitus Handicap Inventory (Newman et al., 1996), Tinnitus Functional Index (Meikle et al., 2012) or others will uncover patient perceptions of their tinnitus, how it impacts day-to-day functioning, and how to best treat, manage and counsel the individual.

Tinnitus management with sound therapy

While tinnitus management encompasses a variety of techniques – including counseling, cognitive behavioral and habituation therapies – the remainder of this paper will focus on sound therapy via hearing aids. According to the American Tinnitus Association, sound therapy refers to the use of external noise to reduce a patient's perception of, or reaction to, tinnitus. Tinnitus researcher Fagelson (2014) reports that sound therapy can be used in one of three ways to manage tinnitus:

1. as a masking sound – to reduce the contrast of the tinnitus in one's listening environment to promote habituation
2. as a relaxing sound – to decrease stress or anxiety
3. as a distracting sound – to divert the patient's attention away from their tinnitus

Whether the goal is to habituate, relax or distract from the tinnitus, patients often report that their tinnitus is more noticeable in a quiet environment and less noticeable in background noise – however sometimes the opposite is true (Pan et al., 2015). Therefore, sound therapy fitting goals may change depending on a given patient and their listening situation.

To begin with, properly fitted hearing aids alone will provide tinnitus relief for some patients (Vernon and Meikle, 2000). This is because amplification makes ambient noise audible. As such, hearing aids can be considered as a type of sound therapy – they amplify external sounds, diverting attention from the perception of tinnitus. Besides providing improved communication for the hearing loss, they also help the listener focus on soft, external sounds that otherwise may not be heard. However many tinnitus sufferers require more targeted sound therapy from their hearing aids, instead of relying on just amplification alone. Certain signals with differing characteristics offer relief for many tinnitus sufferers. These include:

» *White Noise* – The most common sound in tinnitus therapy, white noise is a broadband signal with a flat spectrum, represented by equal amounts of energy for each frequency (Fig. 3). Its sound resembles the static noise heard on a radio between stations, or the /sh/ consonant digraph.

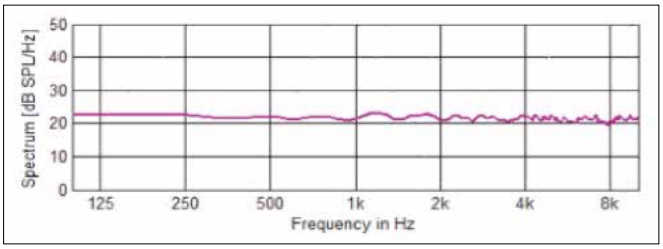


Figure 3: Spectrum of white noise

» *Pink Noise* – Consisting of equal energy per octave, pink noise is a broadband signal that decreases in power by 3 dB per octave (Fig. 4). Compared to the stronger sound of white noise, pink noise may be more tolerable for patients with mild to moderate hearing loss.

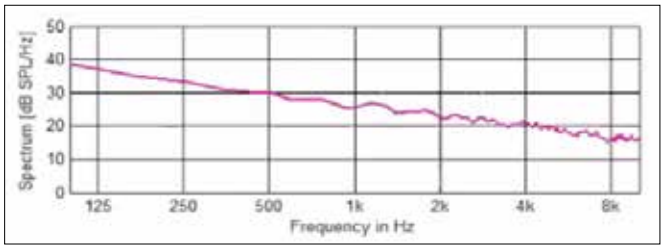


Figure 4: Spectrum of pink noise

» *Red Noise* – Also called Brownian noise, red noise is a broadband signal that has more energy at lower frequencies than pink noise (Fig. 5). It decreases in power by 6 dB per octave. Compared to white or pink noise, it has a softer sound quality, resembling a waterfall or heavy rainfall.

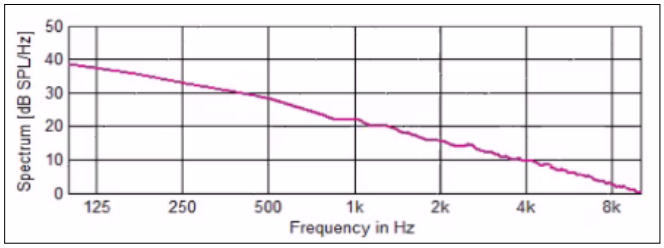


Figure 5: Spectrum of red noise

While masking sounds do not make tinnitus go away, they are typically more tolerable than the tinnitus. Broadband signals like the ones described are commonly available in hearing aids designed for tinnitus management. In addition, nature sounds may also be available in select instruments as a calming or relaxing alternative to steady-state sounds. Since the perception of tinnitus varies greatly per patient, a variety of tinnitus relief sounds – and the ability to modify their level, frequency and/or modulation rate in the fitting software – is beneficial to support diverse patient needs and individual preferences.

How to use Tinnitus SoundSupport in EXPRESS*fit*® Pro

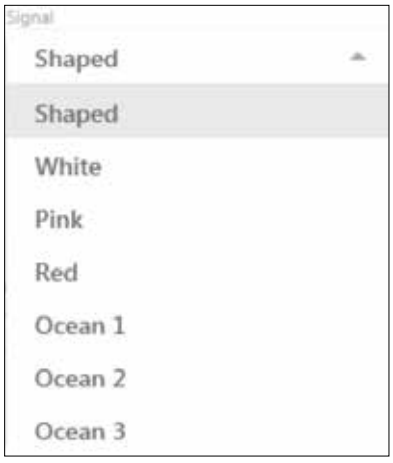
Tinnitus SoundSupport is a tool in Sonic's EXPRESS*fit* Pro fitting system that generates sounds for use in a tinnitus management program to help patients suffering from tinnitus. This step-by-step guide shows how to select and modify sounds to suit your patient's preference.

To begin, launch EXPRESS*fit* Pro. Access **Tinnitus SoundSupport** from the navigation bar in the **Fit Instrument** section.

How to select a sound for use in a program:

1. First, create a program in Manage programs. We recommend using P1 as the primary program for amplification and P2 - P4 for amplification and tinnitus sounds.
2. In the Tinnitus SoundSupport tool, click the Tinnitus SoundSupport control to turn it on.
3. Click the Signal drop-down list and select a sound for each program.

The Signal drop-down list offers four broadband sounds:
» Shaped: spectrum shaped to the patient's audiogram
» White: flat spectrum
» Pink: spectrum decreases at -3 dB per octave
» Red: spectrum decreases at -6 dB per octave



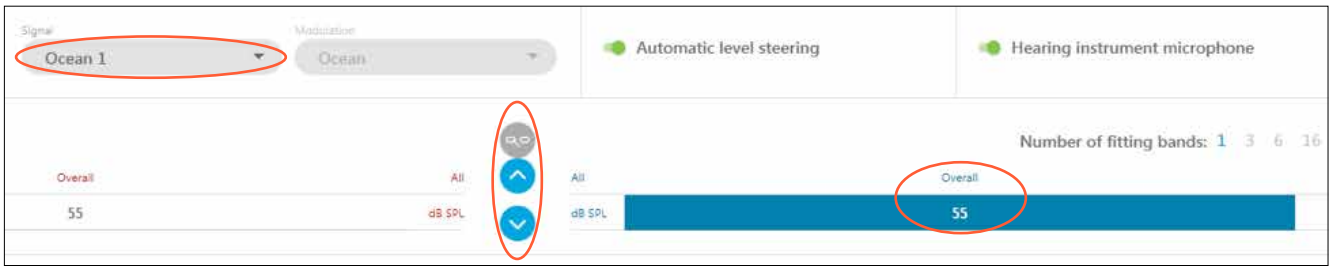
In addition to the broadband sounds, three sounds that mimic the rhythm of the ocean are available:
» Ocean 1
» Ocean 2
» Ocean 3

These sounds are based on the spectrum of the white, pink and red broadband sounds, respectively.

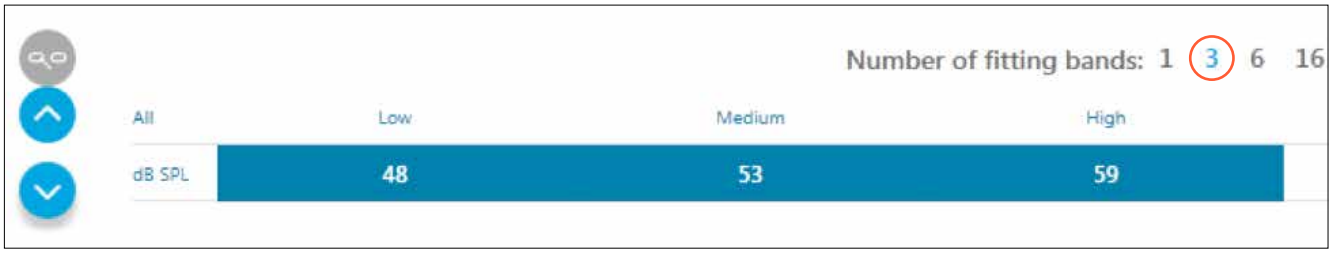
How to modify sound in a program:

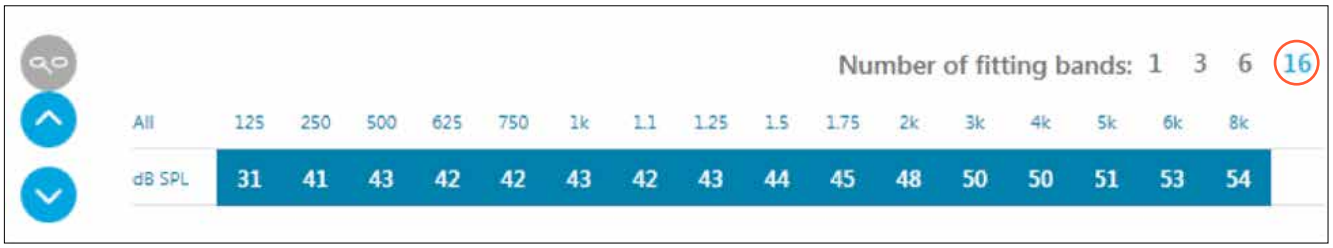
Signal Level – Tinnitus sounds play at a fixed, low-level starting point (the start-up Tinnitus volume) when the Tinnitus program is selected in the instrument. By keeping the level low (instead of higher to completely mask the tinnitus), the brain can better learn to habituate to it. Therefore, the default level is programmed from the average of the patient's three best audiometric thresholds. The control table on the screen indicates the in-situ dB SPL value (or values). This level can be adjusted for both nature and broadband sounds.

» For nature sounds, you can adjust the overall signal level monaurally or binaurally:

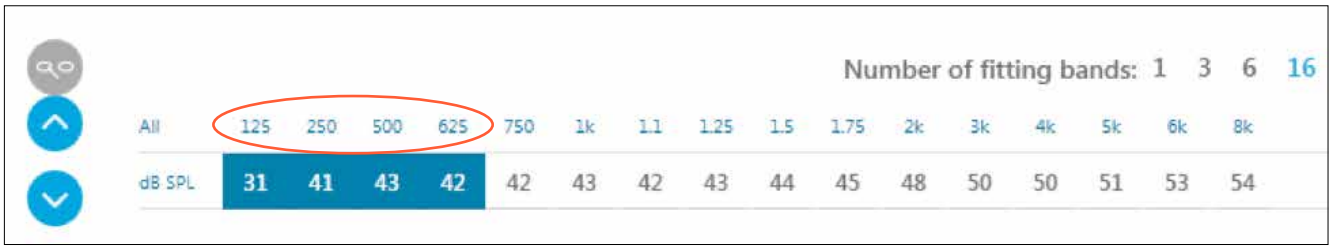


» For broadband sounds, you can fine-tune further by changing the number of fitting bands from 1 to 3, 6, or 16, shown in the control grid below:



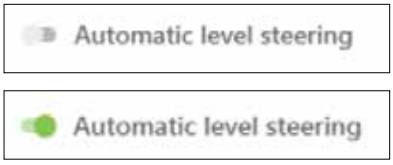


Frequency shaping – Use the controls to modify the frequency content of the broadband sounds. The bandwidth of the controls can be adjusted in the same way as those for gain in the Amplification tool.



Modulation – Several modulation options can be applied to the broadband sounds. Modulation varies the volume of the sound over time, and ranges from slow (Tranquil) to fast (Bustling).

Automatic Level Steering™ – Use this option to automatically adjust the intensity of the Tinnitus sound in response to the environmental noise. If the environmental sound increases above 50 dB SPL, the Tinnitus sound level decreases. The maximum decrease in the Tinnitus sound is 10 dB.

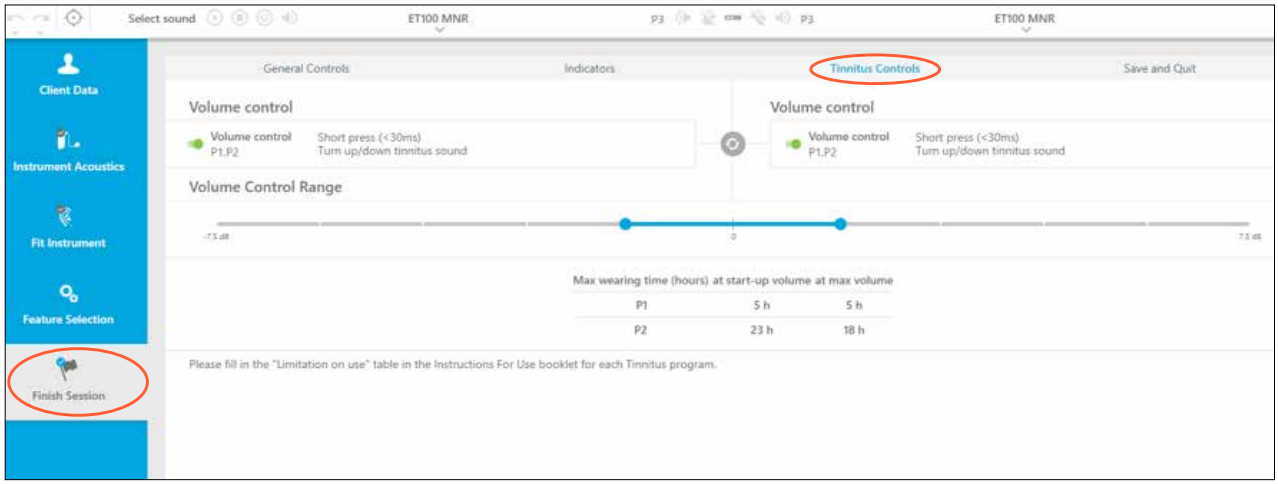


Hearing instrument microphone – The microphone is turned on by default. If you want to offer a program with only Tinnitus SoundSupport, click the control to turn off the microphone.

Maximum wearing time – Please note that the Tinnitus sounds can create high output levels. If you increase the signal level to 80 dB (A) SPL, a notification showing the maximum wearing hours per day will appear in the left and right upper corners. The maximum wearing time will continue to decrease as you increase the signal level. To ensure safe listening levels, we recommend that you carefully instruct the patient about limiting the use of Tinnitus sounds based on the maximum wearing time indicators.

Tinnitus volume control

The push button on the instrument works as a volume control for the Tinnitus sounds. You can turn on the Tinnitus volume control and set the volume control range in the Tinnitus Control tab in the Finish Session section.



Setting the volume control range – Tinnitus volume control settings apply to all programs with Tinnitus sounds. You may want to decrease the number of steps below the signal level, as the signal level is usually only a few dB above threshold. You may also want to limit the upper range of the volume control to prevent the patient from turning up the Tinnitus sound to a level that interferes with normal listening. Volume change synchronization can be on or off, depending on patient preferences.

Please note that changing the volume control range might affect the maximum wearing time. When you choose to use the Tinnitus volume control, a max wearing time table may be displayed. Here you will find an overview of how many hours per day the patient can use each Tinnitus program at the start-up Tinnitus volume (signal level) and at the max Tinnitus volume. **Fill in the "Limitation on use" table in the Instructions for Use booklet for each Tinnitus program and make sure to instruct the patient about limiting the use of the Tinnitus sounds.**

Max volume control range	30 dB/15 dB*
Default setting (on either side of signal level)	7.5 dB
Step size	1.5 dB

* With binaural coordination turned off or for a monaural fitting.

	Max wearing time (hours) at start-up volume	at max volume
P1	15 hours	2 hours
P2	2 hours	2 hours

Tinnitus SoundSupport: Limitation on use

☐ No limitation on use

Program	Start-up volume (Tinnitus)	Max volume (Tinnitus)
☐ 1	Max ____ hours per day	Max ____ hours per day
☐ 2	Max ____ hours per day	Max ____ hours per day
☐ 3	Max ____ hours per day	Max ____ hours per day
☐ 4	Max ____ hours per day	Max ____ hours per day

Benefits

Tinnitus SoundSupport offers personalized sound therapy with a variety of broadband and nature sounds built into hearing aids on the SoundDNA platform. Sound modification parameters include signal level, frequency shaping, modulation, Automatic Level Steering, hearing instrument microphone and maximum wearing time that help to customize Tinnitus SoundSupport control and preferences for individual patient needs. With flexible control options, hearing care professionals and patients alike will appreciate the many benefits of Tinnitus SoundSupport as part of a tinnitus management program:

- *Simple activation in EXPRESSfit Pro*
- *Easy assignment in up to four hearing instrument programs*
- *Seven tinnitus relief sound options (4 broadband sounds, 3 nature sounds)*
- *Flexible relief sound control (including start-up level, frequency shaping and modulation)*
- *Combination of hearing aid amplification and relief sound, or use of relief sound only*
- *Automatic Level Steering adjusts relief sound volume as environmental noise fluctuates*
- *Adjustable tinnitus volume control range*
- *Patient control of relief sound volume per program*

Complement your practice with innovative technology that supports your patients with tinnitus. Versatile and easy to use, Tinnitus SoundSupport aims to reduce your patient's perception of tinnitus. It is available in the SoundDNA platform from Sonic.

For a demonstration or to learn more, please contact your local Sonic provider.

References

American Academy of Audiology. 2000. “Audiologic guidelines for the diagnosis & management of tinnitus patients.” http://www.audiology.org/publications-resources/document-library/tinnitus

Dauman R., & Tyler R. S. 1992. “Some considerations on the classification of tinnitus.” In Aran J.M. & Dauman R. (Eds.), Tinnitus 91: Proceedings of the Fourth International Tinnitus Seminar. Amsterdam, the Netherlands: Kugler Publications, pp. 225–229.

Eggermont, J. J. 2000. “Physiological Mechanisms and Neural Models.” In R.S. Tyler (Ed.), Tinnitus Handbook, Singular, Thomson Learning, San Diego, CA, pp. 85-122.

Eggermont, J. J. 2012. “The Neuroscience of Tinnitus.” Oxford University Press, Oxford, UK. p. 14.

Fagelson, M. 2014. “Approaches to Tinnitus Management and Treatment.” Seminars in Hearing. 35,(2):92-104.

Henry, J.A, Flick, C.L., Gilbert, A., Ellingson, R.M., Fausti, S.A. 2004. “Comparison of manual and computer-automated procedures for tinnitus pitch-matching.” Journal of Rehabilitation Research and Development. 41:121-138.

Newman, C. W., Jacobson, G. P., Spitzer, J. B. 1996. “Development of the Tinnitus Handicap Inventory.” Archives of Otolaryngology—Head and Neck Surgery. 122:143-148.

Pan, T., Tyler, R.S., Ji, H., Coelho, C., Gogel S.A. 2015. “Differences Among Patients That Make Their Tinnitus Worse or Better.” American Journal of Audiology. Dec; 24(4):469-476.

Meikle M.B., Henry J.A., Griest S.E., Stewart B.J., Abrams H.B., McArdle R., Myers P.J., Newman C.W., Sandridge S., Turk D.C., Folmer R.L., Frederick E.J., House J.W., Jacobson G.P., Kinney S.E., Martin W.H., Nagler S.M., Reich G.E., Searchfield G., Sweetow R., Vernon J.A. 2012. “The tinnitus functional index: development of a new clinical measure for chronic, intrusive tinnitus.” Ear and Hearing. Mar-Apr; 33(2):153-76.

Perry, B.P., Gantz, B.J. 2000. “Medical and Surgical Evaluation and Management of Tinnitus.” In R.S. Tyler (Ed.), Tinnitus Handbook, Singular, Thomson Learning, San Diego, CA, pp. 221-241.

Shargorodsky, J., Curhan, G.C., Farwell, W.R. 2010. “Prevalence of Tinnitus.” The American Journal of Medicine. 123;8:711-718.

Spoendlin, H. 1987. “Inner ear pathology and tinnitus.” In H. Feldmann (Ed.), Proceedings of the Third International Tinnitus Seminar. Munster: Harsch Verlag Karlsruhe, pp. 42-51.

Tyler R.S., Baker L.J. 1983. “Difficulties experienced by tinnitus sufferers.” Journal of Speech and Hearing Disorders. May; 48(2):150-154.

Vernon, J.A., Meikle, M.B. 2000. “Tinnitus Masking.” In R.S. Tyler (Ed.), Tinnitus Handbook, Singular, Thomson Learning, San Diego, CA, pp. 313-356.

www.sonici.com

05.18 I UK

SONIC
Everyday Sounds Better