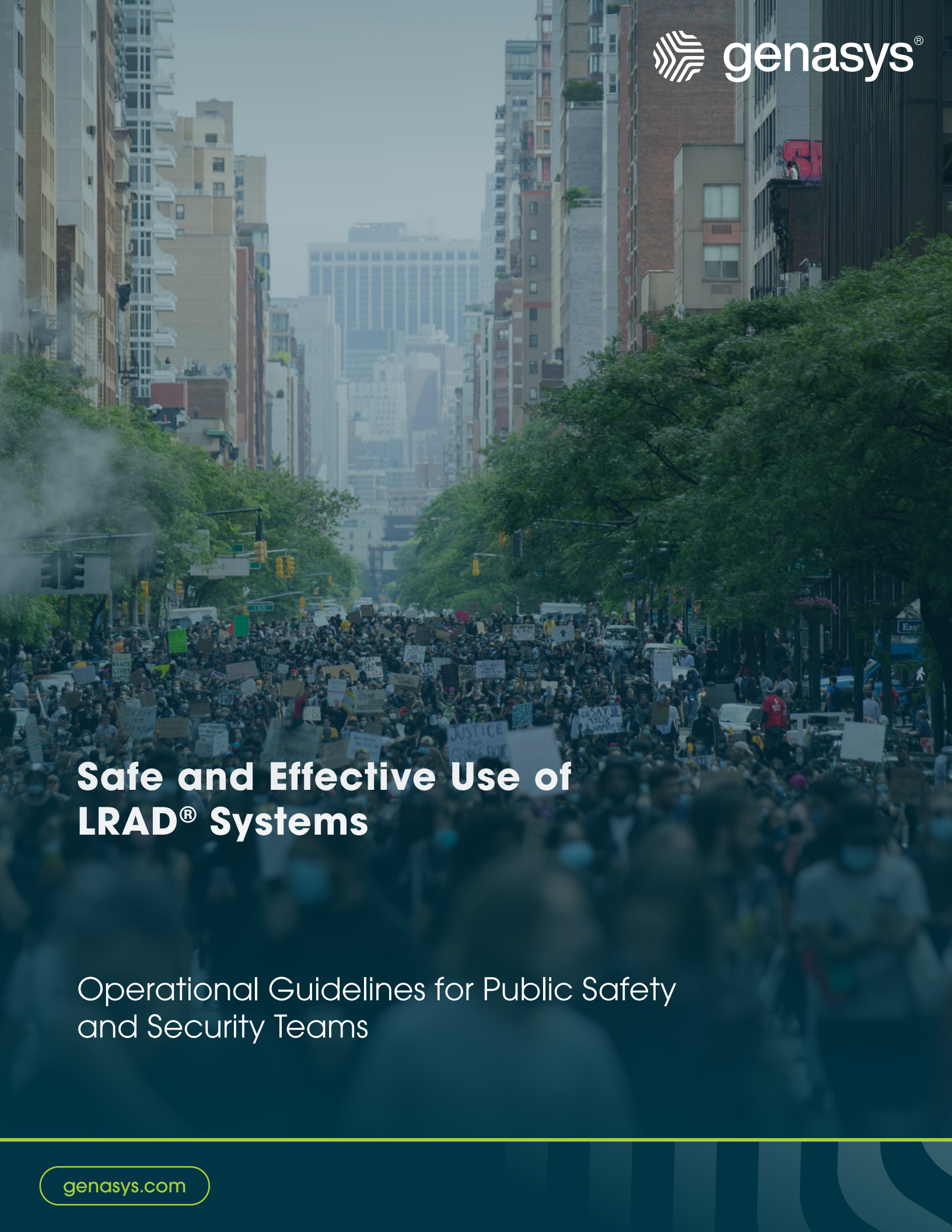
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Safe and Effective Use of LRAD® Systems
Operational Guidelines for Public Safety and Security Teams
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Introduction: What Is LRAD

LRAD systems are audible, directional communication systems designed to broadcast highly intelligible voice messages and alert tones over short and long distances. Unlike conventional loudspeakers, bullhorns, or vehicle P.A. systems that disperse sound in all directions, LRAD systems focus audio within a narrow broadcast area to improve clarity, increase communication range, and reduce unnecessary sound exposure outside the intended area.

LRADs are not "sonic weapons," "non-lethal weapons," or "compliance devices." LRAD systems are communication systems built to help operators deliver clear instructions, warnings, notifications, and commands over long distances and in environments where bullhorns or vehicle PA systems may be ineffective.

LRAD systems are designed for:

- Focused 15° - 30°, audible communication
- Clear voice messaging in noisy or chaotic environments
- Delivering live or prerecorded voice messages from close range to long distances
- Establishing standoff distances and improving situational communication
- Deescalating dangerous situations during elevated risk operations

Using LRAD Correctly & Safely

All LRAD systems include a prominently positioned volume control knob that allows operators to quickly adjust audio output based on operational needs, environmental noise, distance, and crowd size.

Like all professional audio systems, safe and effective LRAD operation depends on how the system is used. **Misuse results from operator error, not device intent**. Safe and effective LRAD operation depends on disciplined use, proper training, controlled audio output, and prioritizing clear voice communication over unnecessary volume.

If an LRAD system is used to overwhelm people instead of communicating to them, it is being used improperly.

Why Safety Matters

Correct LRAD usage matters because it directly affects safety, effectiveness, and public trust.

- Safe operation reduces the risk of excessive sound exposure for operators, nearby personnel, bystanders, and the public.
- The goal is to be heard and understood. Excessive volume overwhelms recipients while appropriate volume and controlled direction make instructions clearer.
- Clear communication can reduce confusion, prevent misunderstandings, and help resolve uncertain situations before they become confrontational. Conversely, excessive volume can have the opposite effect.
- Poor operator judgment can cause harm, increase complaints, create public backlash, and expose agencies to legal risk, especially if the system appears to be used punitively rather than for clear communication.

LRADs are powerful and effective communication tools. Excessive volume undermines the system's primary purpose: delivering clear instructions that help reduce confusion, support deescalation, and improve safety for everyone involved.

Understanding Safe Use: The Science of Sound

LRAD broadcasts follow the same established acoustic principles as all professional audio systems. LRAD operators must understand these principles to communicate effectively while reducing unnecessary sound exposure.

Sound Fundamentals

Audio output, or sound pressure level (SPL), is measured in decibels (dB) at one meter directly in front of the device. In open-air conditions, sound follows the inverse square law: every doubling of the distance from the source reduces SPL by approximately 6 dB.

For example, if sound measures 100 dB at 5 meters, it would be about 94 dB at 10 meters. If sound measures 100 dB at 500 meters, it would also be about 94 dB at 1,000 meters. The distance doubled in both cases, so the SPL reduction is approximately the same.

This matters because louder sources require more distance before sound levels drop substantially. For example:

- A source at 100 dB @ 1 meter drops to about 82 dB at 8 meters
- A source at 140 dB @ 1 meter holds at roughly 122 dB at 8 meters, 116 dB at 16 meters, and still carries at around 82 dB near 800 meters — illustrating how a louder source sustains intelligible range far longer

However, these theoretical measurements are based on open air conditions without interference. Actual received sound levels can vary based on terrain, buildings, vehicles, reflected sound, wind, crowd density, and whether someone is directly within the primary broadcast beam. Operators must assess each scenario and adjust volume to the lowest level needed for clear, intelligible communication.

Exposure and Risk

Hearing risk is not determined by volume alone. Potential hearing damage depends on three primary factors:

- Intensity: how loud the sound is, measured in dB
- Duration: how long someone is exposed
- Frequency: the type and frequency range of the sound

As a general reference:

- 70 dBA or below: unlikely to cause hearing loss, even after long exposure
- 85 dBA: repeated or extended exposure can become hazardous; The National Institute for Occupational Safety and Health (NIOSH) uses 85 dBA over 8 hours as its recommended occupational exposure limit
- 100 dBA: NIOSH recommends limiting exposure to about 15 minutes per day
- 115 dBA: The Occupational Safety and Health Administration (OSHA) permits exposure for up to 15 minutes per day
- 140 dB peak: OSHA's upper limit for impulse or impact noise exposure

For everyday comparison:

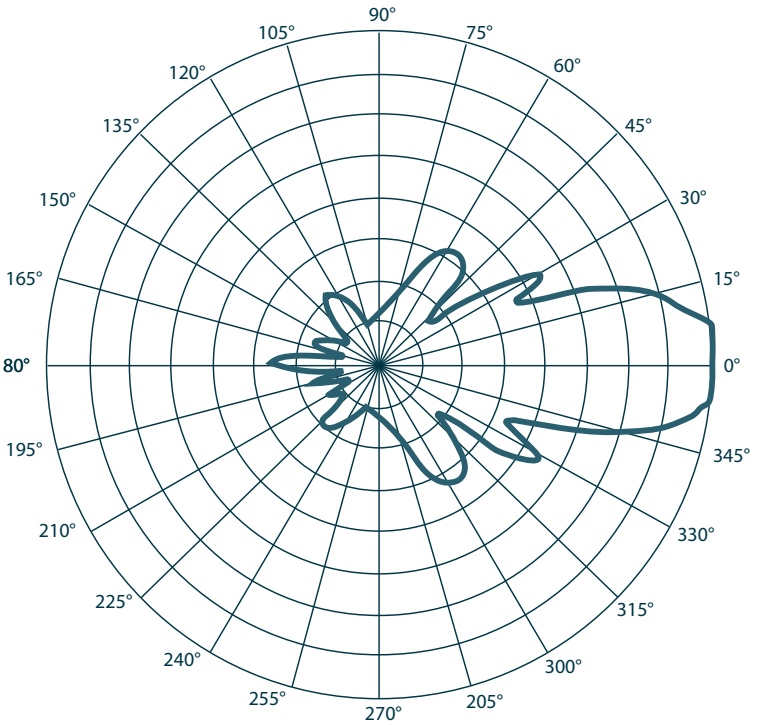
- Normal conversation: 60–70 dBA
- Busy city streets: 60–85+ dBA
- Movie theater: 74–104 dBA
- Motorcycles and dirt bikes: 80–110 dBA
- Sporting events and concerts: 94–110 dBA
- Ambulance and police sirens: approximately 130 dBA
- Fireworks: 140–160 dBA

If individuals experience auditory discomfort at closer distances, covering the ears and moving away from the sound source can reduce sound exposure significantly. Covering the ears with hands can reduce SPL exposure by approximately 25 dB, equivalent to moving approximately four times further away from a sound source.

LRAD 30° Broadcast Cone

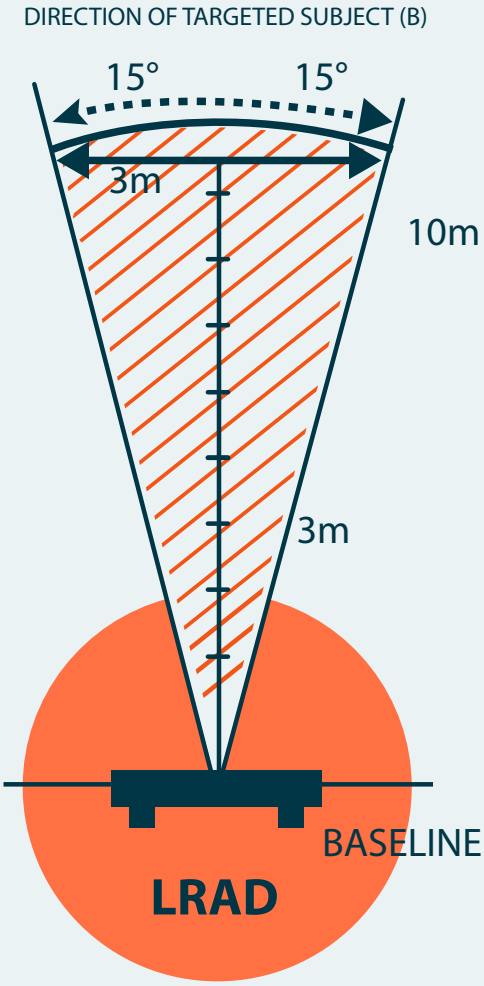
One of LRAD's most important characteristics is its focused directional audio output. LRAD systems use focused directional broadcasts within an approximately 30-degree primary broadcast area.

This focused output helps LRAD voice messages remain clear over longer distances, through loud background noise such as crowds, engines, and sirens, and into vehicles and buildings.



Sound behind LRAD unit is over 40 dB less than the on-axis forward output.

The highest sound pressure levels are directly in front of the device, within the primary beam. Sound exposure drops significantly outside the primary broadcast area and behind the device due to LRAD's directional design. Penn State Applied Research Laboratory guidance identifies the area directly in front of the device as the primary hazard area for elevated sound exposure, especially when high volume settings or alert tones are used at closer distances.



Alert Tone Hazard Area. Hearing damage may result in Alert tone mode. Do not use Alert tone if individuals are within the Hazard Area. Use voice mode only.

Operator Hazard Area. Hearing protection recommended for sustained operations.

General LRAD Model Guidance

The following principles apply across LRAD models:

- Use the minimum effective volume. Start low and increase output only as needed for clear, intelligible voice communication. If people can clearly understand the message, additional output is unnecessary.
- Control close-range exposure. Maintain standoff distance whenever possible, avoid direct close-range targeting, and do not use maximum output at close distance unless operationally necessary and properly controlled.
- Account for the environment. Crowd size, background noise, vehicles, buildings, reflective surfaces, weather, and terrain can affect both intelligibility and received sound levels.
- Understand the primary beam. LRAD systems are highly directional. The highest SPL is directly in front of the device, while SPL drops outside the primary broadcast area and behind the system.
- Adjust for close-range use. When operating under approximately 50 meters, reduce volume and use only the level needed for clear voice communication.
- Practice volume control. Operators should practice adjusting output based on distance, crowd size, crowd noise, and competing background noise.
- Limit continuous exposure whenever possible. Operators and nearby individuals should avoid unnecessary long-duration exposure to elevated sound levels.
- Use Alert Tone sparingly. Alert Tone should only be used in short 2–5 second bursts to gain attention and should be followed by recorded or live voice instructions.
- Prioritize voice communication. Alert Tones is intended to gain attention. Voice communication should remain the primary operational method whenever possible.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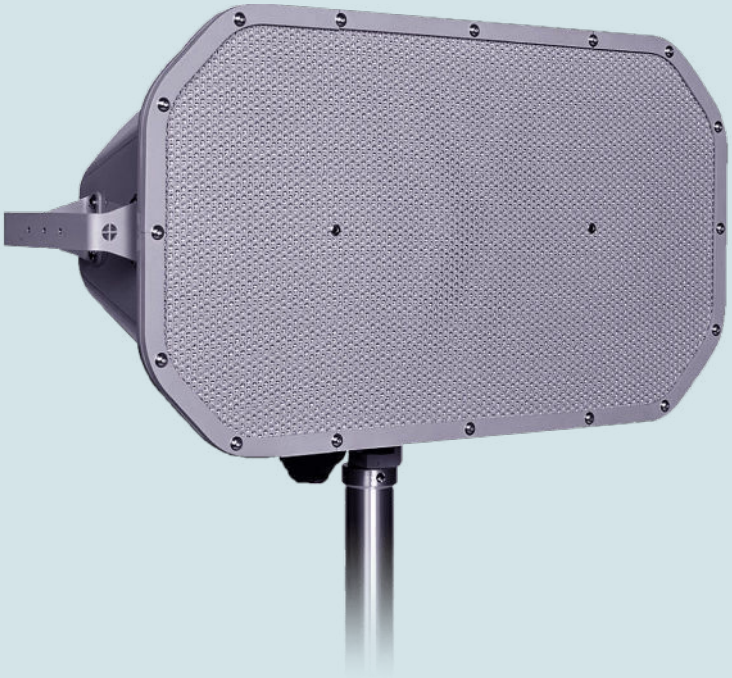
Model Specific Guidelines

LRAD 100X

Lightweight, portable LRAD for on-scene and tactical communication where mobility and quick deployment matter.

Continuous Output Communication Range:

- Maximum range: up to 600 meters in ideal conditions
- Operational range: up to 250 meters over 88 dB of background noise
- Minimum Standoff Reference: LRAD 100X SPL falls below 115 dB at approximately 10 meters.



LRAD 450XL-RT

The 450XL-RT supports remote and autonomous applications, making it ideal for UGVs, USVs, and UAVs; the 450XL-MMT supports helicopter-mounted air-to-ground communications.

Continuous Output Communication Range:

- Maximum range: up to 1,700 meters in ideal conditions
- Operational range: up to 500 meters over 88 dB of background noise
- Minimum Standoff Reference: LRAD 450XL SPL falls below 115 dB at approximately 28 meters.

LRAD 500X-RT

The 500X-RT is designed for fixed security installations, small/mid-size vehicles, vessels, tripods, and remote operations; the 500X-MMT supports helicopter-mounted air-to-ground communication.

Continuous Output Communication Range:

- Maximum range: up to 2,000 meters in ideal conditions
- Operational range: up to 650 meters over 88 dB of background noise
- Minimum Standoff Reference: For larger LRAD systems, targeted groups and individuals must be 75 meters away for safe operation at higher volume settings.

LRAD 950NXT

Fixed, remotely operated perimeter security system combining LRAD communication with pan-and-tilt control, HD camera capability, diagnostics, and optional sensor integrations.

Continuous Output Communication Range:

- Maximum range: up to 3,000 meters in ideal conditions
- Operational range: up to 1,250 meters over 88 dB of background noise
- Minimum Standoff Reference: For larger LRAD systems, targeted groups and individuals must be 75 meters away for safe operation at higher volume settings.

LRAD 1000Xi-RT

Longer-range remote communication system for critical infrastructure, coastal, border, port, maritime, and larger vehicle or vessel-mounted applications.

Continuous Output Communication Range:

- Maximum range: up to 3,000 meters in ideal conditions
- Operational range: up to 1,250 meters over 88 dB of background noise
- Minimum Standoff Reference: For larger LRAD systems, targeted groups and individuals must be 75 meters away for safe operation at higher volume settings.

LRAD 1950XL-RT

Extended-range remote communication system for large-area security, maritime, port, border, emergency warning, and mass communication applications.

Continuous Output Communication Range:

- Maximum range: up to 5,000 meters in ideal conditions
- Operational range: up to 1,600 meters over 88 dB of background noise
- Minimum Standoff Reference: For larger LRAD systems, targeted groups and individuals must be 75 meters away for safe operation at higher volume settings.

Practical Use Guidance

Scenario 1: Crowd Direction (100m+)

For crowd direction at longer distances, operators should focus on broad, intelligible communication rather than individual targeting.

- Use moderate volume and increase only if the message is not clearly understood.
- Sweep the broadcast area when addressing a group or crowd.
- Avoid fixating the primary beam on one person.
- Repeat short, clear instructions, so people have time to hear, understand, and respond.
- Use prerecorded messages when consistency is important.

Scenario 2: Close-Range Interaction (Under 50m)

Close-range operation requires extra control. Operators should significantly reduce output and prioritize voice communication.

- Lower volume before broadcasting.
- Avoid direct high-output aimed at individuals.
- Avoid Alert Tone usage unless necessary.
- Keep instructions short, calm, and specific.
- Increase volume only if background noise prevents the message from being understood.

Scenario 3: Volatile Situations

In elevated-risk operations, LRAD can support communication, warning, and deescalation.

- Maintain safe standoff distance between LRAD and groups or individuals whenever possible.
- Start with voice instructions.
- Increase volume gradually if needed.
- Use the Alert Tone only in short bursts to gain attention.
- Follow Alert Tone use immediately with clear recorded or live voice instructions.
- Avoid maximum output directed at a single individual at close range.

Alert Tone use is to call attention to the voice messages that follow. It is not a substitute for clear voice instructions. Voice communication remains the primary method.

Operator Training and Responsibility

LRAD effectiveness depends on trained operators. Safe use requires judgment, discipline, and an understanding of how sound behaves in real operating conditions.

Training should include sound behavior basics, distance judgment, volume control, and scenario-based decision making.

Operators are responsible for positioning, aiming, and operating LRAD systems in a way that supports clear communication while avoiding unnecessary exposure for nearby personnel, bystanders, and the public.

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Command Attention. Communicate Clearly. Without Contact.