



N88 Receiver

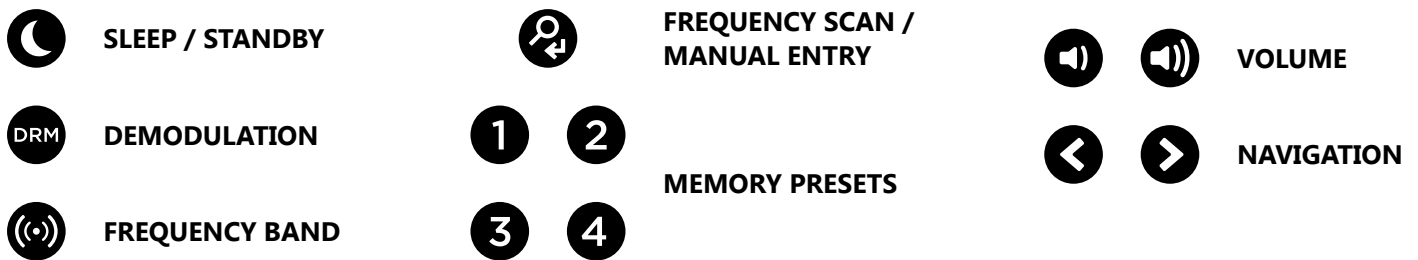
DRM USER MANUAL



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KEYPAD BUTTONS



INTRODUCTION

The N88 radio performs audio recovery from analog MF, SW and VHF frequencies by either AM, FM or DRM demodulation. The DRM-1000 module delivers mono audio to the audio amplifier and can be recovered by Internal speaker or 3.5mm T-R-S Headphone Jack (dual mono).

When receiving DRM broadcasts, the USB – C port may also be used to recover all DRM audio (mono/stereo channels) and / or data. The USB-C port is also a power source for the radio. When USB-C port 5V power is used, the internal three AA batteries are bypassed. Note: battery orientation identified on the N88 case.

If DRM external decoding is desired, the user may connect a USB-C cable between the radio and the PC or Android device (OTG cable). In this configuration the radio will be powered from Android or PC. The PC or Android device will present the UART of the radio as a serial port. Decoding software from AlgorKorea can be used on PC or Android. Streamline (MF/HF) Streamline Plus (VHF), DRMRX4WIN (MF/HF), DRMRX4WIN_E (VHF) PC.

External decoding software offers users stereo audio (if broadcaster supports stereo), visual data, and text, and can save a DRM presentation for later viewing or sharing by wireless link from one to one or one to group which creates a powerful E-Learning platform for remote education. This provides a unique upgrade for the user to experience all the benefits of DRM radio. The use of external DRM decoding requires a moderate signal level (2 bars of signal or more) to provide a reliable SNR. Weak or low SNR will result in dropped data and poor user experience. Remote control of the tuning and mode changes will work at any or no signal level.



GENERAL RADIO OPERATION

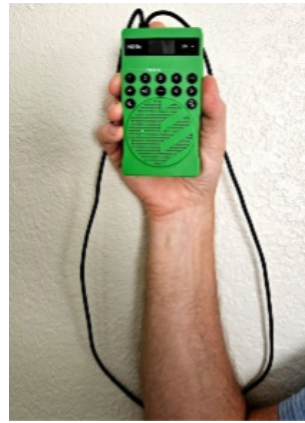
Long pressing  is the fastest way to identify all Analog and DRM radio signals (see [Radio Controls](#)). Manual tuning is also possible – see details below. When operating the N88 it is helpful to familiarize the user with the N88 antennas and types of radio signal being received.

VHF AND HF

For reception of Shortwave and VHF, the telescopic antenna should be fully extended for distance reception. For optimal reception the radio should operate in electrically quiet locations. VHF is less susceptible to electrical noise. Shortwave signals (especially low frequencies) are susceptible to noise such as electrical motors, LED and fluorescent lights, TV / PC monitors and wall (mains) supplies.

MEDIUM WAVE

The Antenna for Medium Wave Reception is located within the attached lanyard. The antenna provides excellent signal reception due to the large surface area of the antenna. The loop antenna is less sensitive to E-Field electrical noise than other antenna types. The lanyard antenna is a loop which is optimized for highest gain when shaped as a round loop. The antenna also works well when shaped as an ellipse such as when hanging the radio from the lanyard or while carrying (around the neck). Strong signals do not need any specific lanyard shape. Extremely weak stations require the lanyard to be shaped rounder and oriented towards the station. It is important to note the loop antenna is directional with best reception along the plane of the loop, also providing a way to null interfering noise along the axis of the loop.



ANALOG AND DIGITAL (DRM) RECEPTION

Analog reception: Radio reception of an AM / FM analog broadcast is intuitive as the user can listen to the quality of the audio and adjust accordingly. Steps should be taken to improve the RF signal and at the same time reduce noise by listening to the quality of the demodulated audio.

DRM reception: is not as intuitive as analog due to the reception is either all or nothing. To assist in resolving problematic distant station / low signal DRM reception it is encouraged to follow the following steps:

Digital Reception: If the DRM signal does not decode reliably or the signal level is low (one signal bar), simply move the N88 to a new location and see if the signal improves. The DRM signal level indicator provides SNR (Weighted Signal to Noise Ratio) feedback to the user. Increasing the number of bars increases the Signal to Noise Ratio which increases reception reliability.

If Reception is still not optimized...

1. **Change reception mode on frequency.** Switch the tuning from DRM to analog (AM or FM) depending on the frequency. Reception bars is no longer SNR but now RSSI in Analog mode. Listen for electrical noise and adjust.
2. **Move away from noise.** The N88 may be in an electrical noisy location or a location where the signal does not reach the N88 optimally. Since the N88 is highly portable, it can be moved to provide better reception.
 - a. **Use Analog "AM" or "FM" Audio to listen for noise sources.** To obtain a greater SNR and resolve reception issues – 1. Change the mode to Analog, and listen for electrical noise, buzzing, popping. 2. Move to a location where interfering noise is reduced and the DRM signal is increased. DRM sounds like "whooshing" or "waterfall" sound, ideally you want this to increase while Electrical noise decreases. 3. Reposition the N88 by rotating / reshaping the lanyard (Medium Wave plane of the loop is reception while axis is Null) or relocating to a new location away from electrical noise and towards the broadcast. This may mean if the broadcast comes from (location of broadcast transmitter) a southern direction and the radio is on the north side of the building, simply move to the south side of the building.
 - b. **Find an obstruction free location.** Radio signals do not traverse cement or steel well. Move to a location free from Radio signal blocking material.
 - c. **Attempt to tune the DRM signal by switching to DRM mode.**

RADIO CONTROLS

Power slide switch: located above the USB-C port. Sliding switch up turns Radio On, sliding switch down turns Radio Off.

External Power Jack: The USB data port is also (5V dc) power input (battery consumption is eliminated when external power is applied).

Headphone Jack: 3.5mm T-R-S Headphone Jack (dual mono) is located on the right side of the N88 next to the telescopic whip antenna.

Emergency: The N88 requires battery power or external USB power to operate. Once DRM stations have been received by "scan" or manual tuned and stored to memory the Emergency Warning Function (described below) can wake the unit while in "SLEEP" mode to alert the user of an emergency event. An emergency warning will blink the screen and automatically select the audio channel with emergency information. Activating "Sleep" and main power switch "ON" uses very low power (approximately 3mA).

Power: The N88 uses three "AA" batteries. The battery composition type used will determine the run time. Simple carbon batteries have considerably lower energy and will result in lower operational time. Disposable Alkaline and lithium batteries will provide more than 24 hours of operational time at 70% volume. New disposable Alkaline or Lithium batteries should power the radio in sleep mode for more than 1 month. Using external power via the USB-C port bypasses AA battery consumption to extend battery life. Care must be taken to insert AA batteries in the correct polarity to prevent damage and void warrantee. See Battery type details at the end of this document.

Sleep / Standby: For normal operation, pressing  will bring the N88 to full reception mode. To return the unit to standby, press .

Volume: Audio delivered to the speaker and headphone is adjusted using  or .

Frequency Band: (MF/HF/VHF) is selected by repeated presses of .

Demodulation mode: is selected by pressing . This toggles between analogue (i.e. AMw, AMn or FM depending on band) and DRM.

Screen Display: The following details are displayed on the OLED display:

- Mode (AMw/AMn/FM/DRM) and currently tuned frequency is located on the Top of the screen.
- A measure of signal quality (weight modulation error ratio for DRM, or RSSI for AM/FM) with 4 bars of signal located at the top right of the display, one bar being weakest, 4 bars being strongest.
- Service label (DRM), RDS (FM) – Static Text (middle of display)
- Text messages (DRM), RDS (FM) – scrolling text (bottom of display)
- If an emergency warning is being transmitted the screen flashes at 1Hz.
- The display is programmed to automatically power off to save power. If an emergency warning is being transmitted the screen will turn on and remain on for the duration of the emergency.
- Low Battery Indicator – Right of OLED display, When battery is reduced by approximately 75% (25% power remaining), the LED will turn on. Different battery types such as Lithium may not provide Low battery warning until only 5 to 10 % battery life remaining. Battery power is estimated to allow the N88 to operate with moderate speaker volume beyond 24 hours with a fresh set of Alkaline AA batteries more than 1 month in "sleep" mode. Operating on low battery power is possible, however audio quality will be reduced, and auto shutdown / rebooting may occur with Low Battery LED intermittent. Battery Runtime can always be extended by reducing speaker volume.

TUNING

Auto-scan

N88 can automatically scan all enabled bands for AM, FM, and DRM stations. This is initiated by a long press on  or by using the SCAN command in control software / app.

When the scan is completed, the number of discovered AM, FM, and DRM stations will be displayed. All discovered stations will be stored in non-volatile memory and the user can step through each by using  or . The desired station can be transferred to a memory button     by long pressing the button after tuning to the station.

Station Selection

In DRM mode,  and  buttons can be used to select the program channel if more than one service / program is being transmitted. If a scan has been performed and DRM stations have been found, the N88 will step through the previously stored stations. The N88 will change between MF/HF/VHF as required to tune to the next saved DRM station. *Note: that some DRM broadcast service is data only and no audio may be available on this service.*

In DRM mode, if no scan has been performed or no stations have been found, and  or  are pressed, the module will tune to the next channel according to the channel raster of the currently selected frequency band.

In AM/FM, ◀ or ▶ buttons select the next station from the scanned station list in the current selected mode. In AM, this cycles around MF/HF channels and in FM it cycles around the VHF band. If there are no stations in the scanned station list then ◀ or ▶ will tune to the next channel according to the channel raster of the currently selected frequency band.

Memory buttons

1 2 3 4 are provided to store favorite stations. These provide access to 4 memory locations. The current station is stored by a long press (>2s) on the required memory button. A short press on a memory button recalls the stored station. If no station has been stored pressing the memory button produces no action.

A long press of ◀ or ▶ buttons will enter raster tuning mode. Further short presses will tune upwards/downwards by one channel spacing. After 5 seconds of no presses, raster tune mode will be exited.

Manual Frequency Entry

Manual frequency entry using the buttons is enabled with a short press of the  button. The currently selected mode remains unchanged during this process. Frequencies entered by this method are not limited to the broadcast bands.

Once the  button has been “short” pressed, the receiver is in manual tune mode. The most significant digit of the frequency display is highlighted, and the manual tuning process starts on this digit. All digits start unchanged. If any significant digits are zero before tuning, the empty space is filled with a zero.

MF/HF Tune examples:

- Current frequency 960 kHz, press  -> 00960 k
- Current frequency = 1234 kHz, press  -> 01234 k
- Current frequency = 23456 kHz -> 23456 k

VHF examples:

- Current frequency 87.90 MHz, press  -> 087.90 M
- Current frequency = 103.70 MHz, press  -> 103.70 M

Pressing ◀ or ▶ buttons increment and decrement the highlighted digit.

When pressing ▶ when digit is 9, or ◀ when digit is 0, the current number wraps without incrementing or decrementing the next significant figure.

Examples:

- 13969, pressing > changes to 13960.
- 03450, pressing > changes to 03459.

Once user has selected the desired most significant digit, pressing the  moves to the next significant digit, and the process repeated for the second most significant digit (1000 kHz for MF/HF, 10 MHz for VHF).

For VHF, the decimal point in the frequency is ignored; the highlighted character skips the decimal point and moves to the final fractional part.

Example:

- 097.90, pressing  moves the active character to 097.90

The process is repeated until the least significant digit is set.

For MF/HF, the smallest tuning increment is 1 kHz, and for manual tuning in VHF, the smallest tuning increment is 0.05 MHz. Once the least significant digit has been set, pressing  once more executes tuning to the specified frequency.

EMERGENCY WARNING FUNCTION (EWF) DETAILS

The N88 receiver is enabled for EWF (Emergency Warning) and no user actions are required to enable EWF. EWF is provided as a service of the broadcaster.

The details of how the Broadcaster and N88 interoperate with EWF are as follows:

The DRM Emergency Warning Function (EWF), specified in <https://solargrove.solutions/pdf/DRM-EWF.pdf> is implemented on N88, no user action is needed to implement EWF. The broadcaster must support DRM EWF, with the following rules and restrictions:

- Audio and basic text services are provided.
- Interactive text services are not supported, due to the size and nature of the display and user controls.
- Same band only (MF, HF, VHF) – for example, if tuned to DRM in MF, only other stations in MF can be switched to, in order to account for unknown antenna connections.
- Unrestricted region only.
- Unrestricted schedule only, unless the currently-tuned station has supplied time information. DRM1000 does not include a real-time clock to support scheduled services.
- Switching to a DRM service is prioritized, swapping only to AM (from MF/HF) or FM (from VHF) if DRM fails, or no DRM option is listed.
- At least one frequency must be specified in the EWF broadcast – scanning all bands searching for a particular service ID is not feasible.
- AM AMSS is not supported.
- If a target AM/FM frequency is specified with a service ID (via RDS), the service ID is ignored and DRM1000 tunes to the specified frequency anyway.
- If DRM and multiple frequencies are listed, DRM1000 will search through the list for the specified service ID. If it is not found, DRM1000 will return to the original station.
- If multiple AM/FM target frequencies are listed, DRM1000 will search through each frequency until one is found above an RSSI threshold. If none are above this threshold, DRM1000 will return to the original station.
- If the specified emergency station is found at a frequency away from the currently tuned multiplex (either having found the correct service ID if DRM, or AM/FM above some RSSI threshold) then DRM1000 will remain on that station and will not attempt to switch back to original station at end of announcement. This is because DRM does not guarantee signaling the end of an EWF transmission. Only switching due to active 'Warning / alarm' announcement is supported. Other notification types have no effect.

For technical reference of the following sections see Reference 1 (ETSI ES 201 980).

EWF – DETAILS, ANNOUNCEMENT SIGNAL

N88 switched on and tuned to DRM multiplex

The N88 will check the 'Announcement support and switching data entity (type 6)' every time it is received on the SDC channel. If this entity indicates that there is an active announcement of type 'Warning / alarm' for the currently tuned service, the N88 shall commence the switching process.

The N88 will not switch from the currently tuned service until it has received at least one 'Alternative frequency signaling: Other services data entity (type 11)' that describes the announcement ID that is active. The N88 will not switch from the currently tuned service until it has received any additional SDC data entities that are indicated as necessary to fully specify the other service (region, schedule, time/date).

Target service on same DRM multiplex

If the 'Announcement support and switching data entity (type 6)' indicates that the target service is on the same DRM multiplex as the currently tuned service (same multiplex / other service flag = 0: announcements are carried in the tuned multiplex), then the N88 will retrieve the target short ID and switch to the service if the FAC service parameter block for this service indicates it is an audio service and the Audio Conditional Access flag is set to 0.

When the N88 switches to the target service the audio volume will increase, and the display will flash. This audio volume increase will be to the louder of two levels below the maximum volume (level 12 of 14, ~ 77%) or the current listening volume.

If the target short ID is the same as the currently tuned short ID, the N88 will continue to decode the current service with no audio interruption but the volume and display will behave as above.

The N88 will switch back to the originally tuned service on this multiplex when an announcement ceases, and the display will stop flashing, but the volume will stay at the elevated level.

The user can use the interface as normal when an announcement is active, including switching away from the target service or change the audio volume.

Target service on another frequency

EWF – DETAILS, CANDIDATE TARGET SERVICE SELECTION

If the 'Announcement support and switching data entity (type 6)' indicates that the target service is on another frequency from the currently tuned multiplex (same multiplex / other service flag = 1: announcements are carried elsewhere), then the N88 will retrieve the announcement ID.

The N88 will retrieve all received 'Alternative frequency signaling other services data entity (type 11)' for the specified announcement ID. If it has not yet received any, then the N88 will not switch from the current tuned service.

Otherwise, the N88 will check, classify, and construct a candidate list of target services from this data entity's list of available frequencies.

If the list of candidate target services contains one or more entries, then the N88 will prioritize the services to switch to. Switching to another DRM service will be most preferable, followed by analogue services.

EWF – DETAILS, SWITCHING TO TARGET SERVICE

The N88 will attempt to switch to each service in the prioritized candidate target service list, unless announcements for the currently tuned service ID have been muted due to previous unsuccessful switching attempts.

When attempting to switch to a candidate target DRM service, the N88 conducts an RSSI check and then a synchronization attempt to the DRM station on that frequency. If either fail the N88 will proceed to the next candidate frequency.

If the N88 successfully obtains all FAC blocks for the target service, then it will search these blocks for the candidate 24-bit service ID specified in the relevant 'Alternative frequency signaling: other services data entity (type 11)' in field 'Other Service ID'. If this indicates that the target service is not present on this frequency, the N88 will proceed to the next candidate frequency.

If the target service is present and if the FAC service parameter block for this service indicates it is an audio service and the Audio Conditional Access flag is set to 0, the N88 will begin to decode the target service.

When attempting to switch to a candidate target analogue service, the N88 will first perform an RSSI check on the specified frequency. If the RSSI check indicates that there is a signal on that frequency, the N88 will switch to the appropriate analogue demodulation mode and begin audio output else the N88 will proceed to the next candidate frequency.

When the N88 switches to the target service and the announcement type is 'Warning / alarm', the audio volume will increase, and the display will flash. This audio volume increase will be to the louder of two levels below the maximum volume (level 12 of 14, ~77%) or the current listening volume.

The N88 will not attempt to switch back to the original service at the end of the announcement. The screen will continue to flash, and the volume will stay at the elevated level. The user may use the N88 interface as normal when an announcement is active, including switching away from the target service or change the audio volume.

If none of the candidate target services were successful, the N88 shall return to the originally tuned DRM service. The N88 will mute further announcements for the originally tuned DRM service to prevent continuous attempts at switching.

EWF – DETAILS, EWF STANDBY MODE

If the N88 entered standby (sleep with wake on DRM emergency warning) mode while in DRM mode, then the N88 will, after a configurable time, wake from standby and attempt to receive a DRM service on the last tuned frequency. During this periodic wake, the N88 display will not switch on nor give the user any other indication that the device is switched on. The default wake interval is set to 30 seconds. The N88 will not permit any input from user buttons except for the standby/wake button, which if the user presses while the N88 is periodically waking, the N88 will wake as normal.

If there is a frequency present and the N88 can successfully decode the FAC block, and the announcement is classified as type 'Warning / alarm' the N88 will perform a full wake-up and will switch on the screen. Otherwise, the N88 will go back to standby and wake sometime later to re-check.

The N88 will then search for the service in the currently tuned multiplex that has an active announcement and tune to

the service if the FAC service parameter block for this service indicates it is an audio service and the Audio Conditional Access flag is set to 0.

If the service with the active announcement cannot be found, the N88 will go back to standby and wake sometime later to re-check. If the N88 loses synchronization with the multiplex during this full wake-up, it will attempt to resynchronize indefinitely.

If the N88 finds the service with an active announcement, it will tune to it and begin decoding. Then it will attempt to switch to the target service as described in Section “**EFW Announcement Signal**”.

If the switching process is unsuccessful, the N88 will switch back to the originally tuned service and not re-enter standby.

BATTERIES

The N88 uses three “AA” batteries. Replaceable Alkaline, Carbon or Lithium types are recommended. The battery type and condition will determine operational time. Carbon-Zink batteries have lower capacity and will result in lower operational time. Replaceable Alkaline and Lithium types will provide more than 24 hours of operational time. The low battery indicator will activate when approximately 20% battery life remains for Alkaline and 25% for Carbon Zink disposable types. The N88 may be used with rechargeable Nickel Metal-Hydrate and Nickel Cadmium type, however, lower performance will occur and the Low battery indicator is not calibrated for the low operating voltage. **For good rechargeable battery operation, it is recommended to use Nickle-Zink (Ni-Zn) AA batteries which are externally charged or a rechargeable external USB power bank feeding power via the N88 USB-C port.**

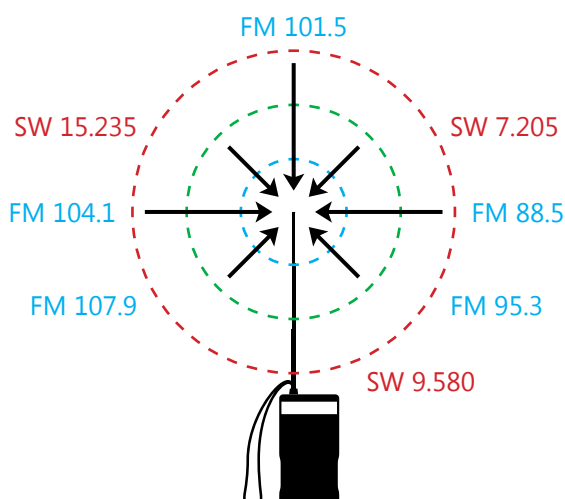
N88 - Internal AA Battery Compatibility + USB Power Bank							
Chemistry Type	Voltage	mAh Capacity (Approx.)	Disposable / Rechargeable	Discharge Capability	N88 Compatibility	Expected Operational Time (70% volume)	Performance
Alkaline	1.5V	2,000 - 2,850 mAh	Disposable	Slow to moderate drain	Yes - excellent	> 24hrs	Excellent performance, Low battery indication 20% remaining
Lithium (Li-FeS2)	1.5V	2,700 - 3,400 mAh	Disposable	High drain (fast discharge)	Yes - excellent	> 24hrs	Excellent performance, Low battery indication 10% remaining
Zinc-Carbon	1.5V	400 - 1,700 mAh	Disposable	Very slow drain (slow discharge)	Yes - very good	4 – 8hrs	Excellent performance, Low battery indication 25% remaining
Nickel-Zinc (NiZn)	1.6V	1,500 - 1,800 mAh	Rechargeable	High drain (fast discharge)	Yes - excellent	15 – 18hrs	Excellent performance, Low battery indication changes to less than 1% remaining
Nickel-Metal Hydride (NiMH)	1.2V	600 - 2,750 mAh	Rechargeable	High to moderate drain	Yes - marginal	6 – 18hrs	Audio performance low, Low battery indicator 60% remaining
Nickel-Cadmium (Ni-Cad)	1.2V	600 - 1,000 mAh	Rechargeable	High drain (fast discharge)	Yes - marginal	6 – 10hrs	Audio performance low, Low battery indicator 60% remaining
Lithium-Ion (with regulator)	1.5V	1,500 - 2,000 mAh	Rechargeable	High drain (fast discharge)	No	18 – 20 hrs	Extreme Radio reception Interference
Power Bank – USB-C	5V	2,500 - 10,000	Rechargeable	High drain (fast discharge)	Yes - excellent	24 – 96hrs	Excellent performance if bank is good quality (quiet switching regulator), Low Battery Not applicable

N88 ANTENNA PLACEMENT / RECEPTION

Telescopic whip antenna: The HF/VHF antenna must be fully extended for best FM (VHF) 87 – 108 Mhz, Shortwave (HF) 3 – 30Mhz reception receives and receives radio signals 360 degrees.

The Lanyard is an antenna ground that may be used as a counterpoise (antenna ground radial) to enhance performance of the telescopic whip. Therefore, it can assist the Shortwave and VHF reception if the lanyard hangs vertically below the N88 body. To enhance HF/VHF performance, the N88 should be placed away from noise sources.

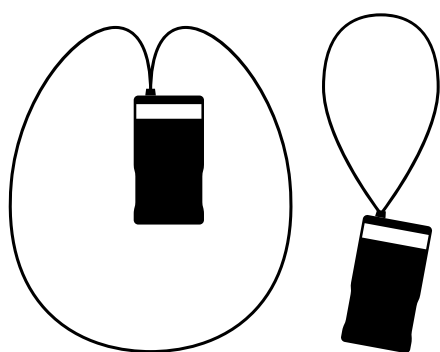
Lanyard Antenna: For Moderate to Strong MF signals .5 – 1.7 Mhz, no shaping of the lanyard is necessary, however, for weak signals the Lanyard may need to be adjusted. For best performance shape lanyard in a loop and point the loop plane towards the transmitting antenna. The axis or center of the antenna is the reception “Null” and should be pointed at noise sources if possible.



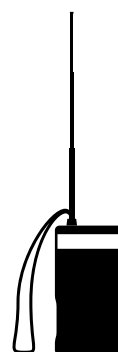
Radio Antenna Signal Reception Pattern

Signal Reception:

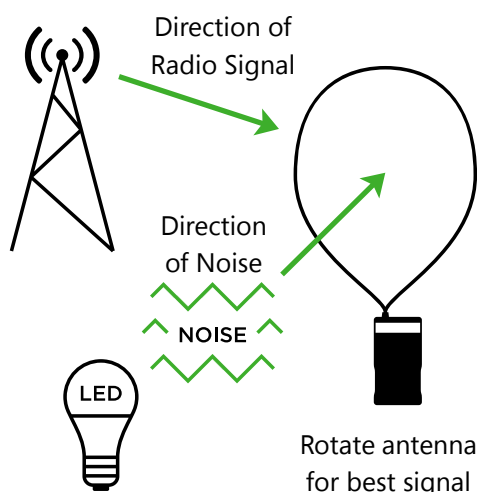
- Omnidirectional (360o)
- Vertical Polarization
- Signal Strength varies by distance
- Optimal for FM (88-108 MHz)
- Good for SW (3-30 MHz)



Lanyard loop shape for “Enhanced” MF reception



Lanyard loop shape for “Standard” MF reception



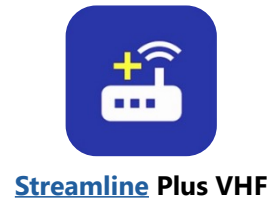
MORE INFORMATION

For more information about the DRM N88 or to download a copy of the full user manual, please visit <https://sgrove.com/drm> or scan the QR code below.



N88 ANDROID APP

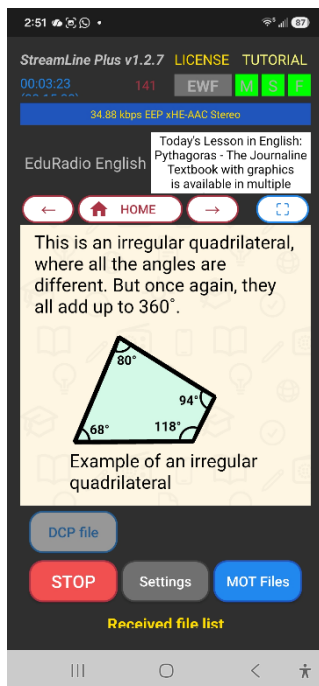
Enhanced features: enhanced features: Visuals, Text, device control saving and Sharing is possible! Streamline Apps are available on the Android Play store and provide connectivity for DRM30 (Medium Wave, Shortwave) [Streamline MF/HF](#) or DRM Mode E (VHF) [Streamline Plus VHF](#). USB connectivity requires Strong Clean signal. Bluetooth (future version) can use lower signal levels / entry level devices.



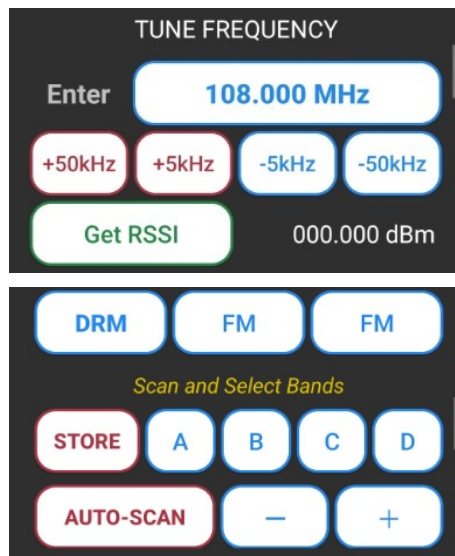
Benefits of using the app:

- See graphical information and text, EWF, Reception information
- Save a DRM program to replay or view later / Share with others
- Control N88

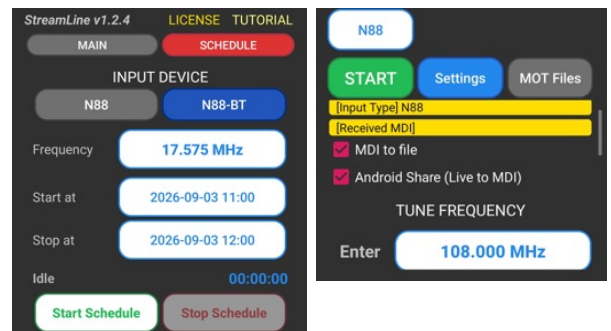
Visuals, Navigate, Text



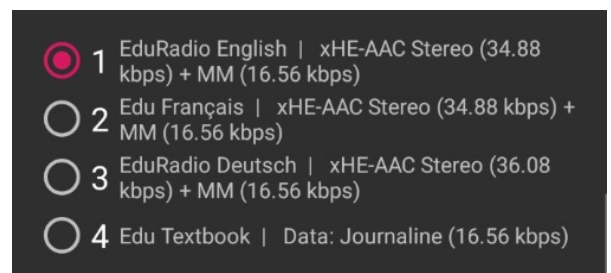
N88 Controls



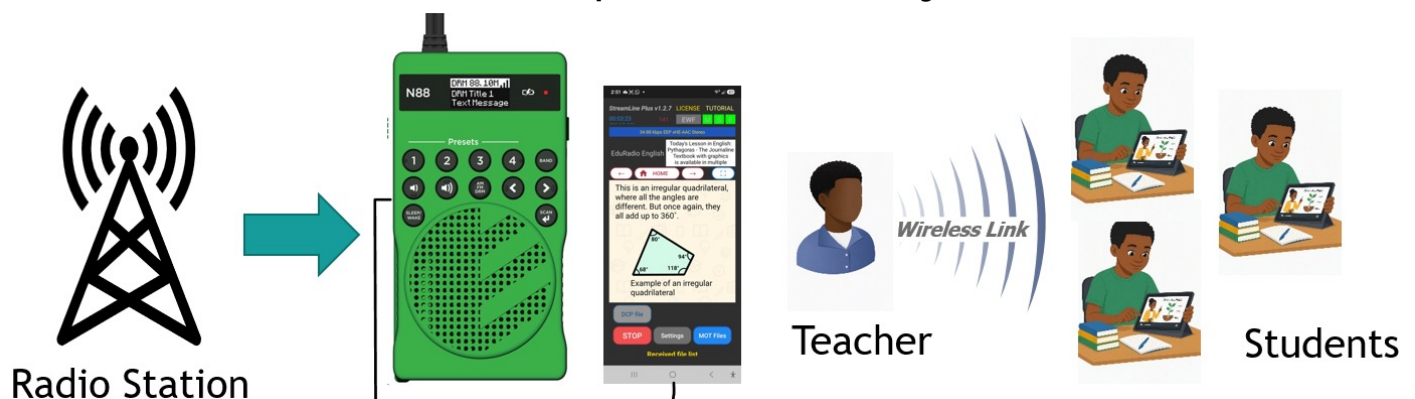
Save/Share Recording



Select Audio Channel



Use Example: Non-Internet E-Learning





[StreamLine App - App Store](#)
(MF/HF)



[DRM Video Plus App - App Store](#)
(VHF)

