

Frequency Components and Antennas for Hearing Aids



Mar. 2023

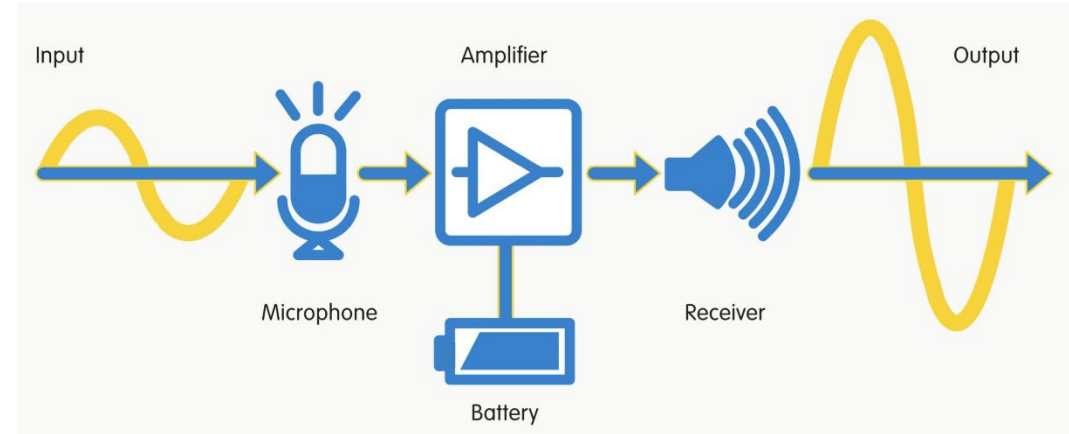
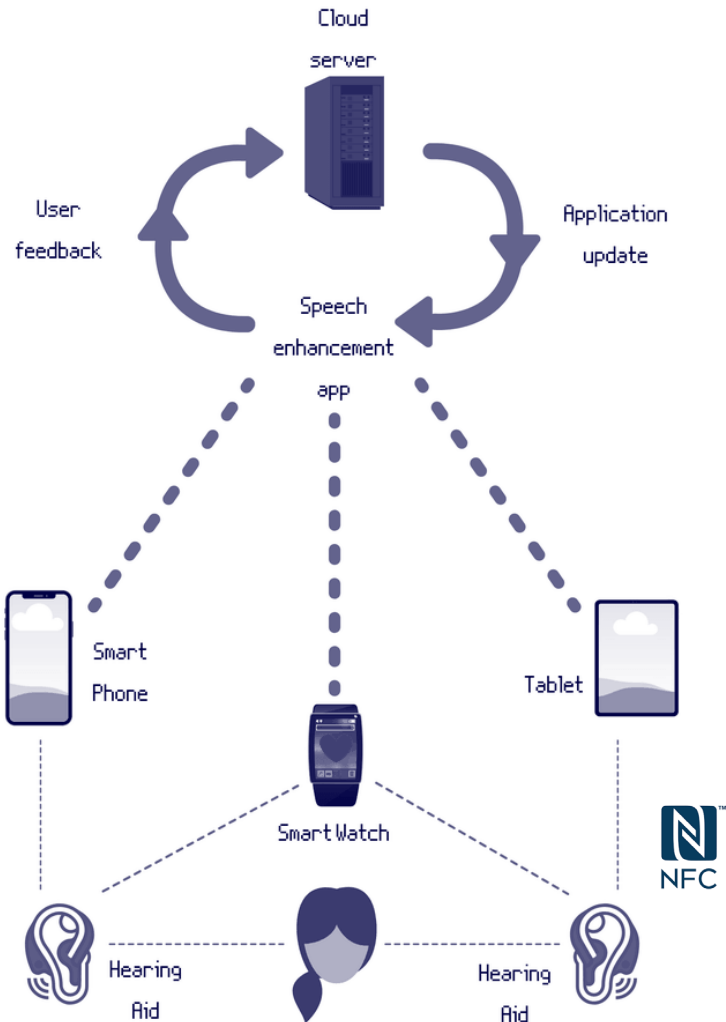
RALTRON

Introduction



Raltron offers the **most comprehensive and smallest** line of frequency management components for Hearing Aids, from simple tuning fork crystals to high stability temperature compensated crystal oscillators and antennas. These products are designed to satisfy the ultra-low power, small footprint, and low-cost requirements of this growing market.

How do Hearing Aids Work?



Some hearing aid manufacturers have developed proprietary protocols that operate in the 2.4GHz frequency band, allowing for direct streaming of audio to the hearing aids.

Source: <https://www.clearliving.com/hearing/hearing-aids/bluetooth/>, <https://www.soundguys.com/how-do-hearing-aids-work-57482/>

Solutions for Bluetooth & BLE Protocol

Bluetooth Low Energy uses the same 2.4 GHz radio frequencies as classic Bluetooth
Some Typical Crystal or TCXO frequencies for [Bluetooth & BLE](#) Hearing Aids ICs:

Infineon - PSoC 6 MCU: CY8C63x6, CY8C63x7 - 16 MHz/32 MHz Crystal Oscillator
16 to 35 MHz, 32.768 kHz On-chip Crystal Oscillator
- 2.45 GHz Chip Antenna

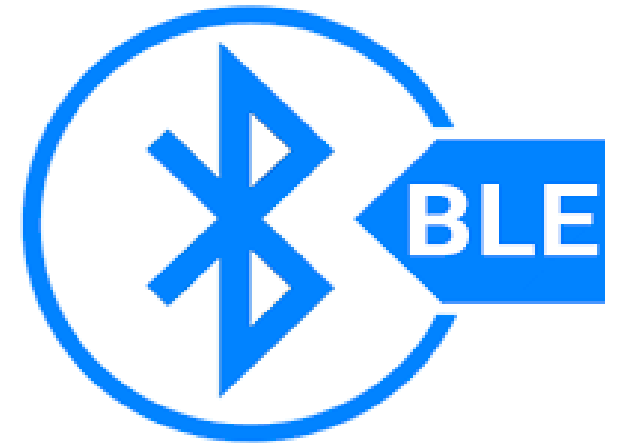
Nordic Semiconductor - nRF52810 - 64 MHz Crystal Oscillator, 32 MHz Crystal
32.768 kHz Crystal Oscillator, 32.768 kHz Crystal
1 MHz/16 MHz/32 MHz Peripheral Clock
- 2.4 GHz Antenna

Texas Instruments - CC2640R2F - 32.8 kHz/48 MHz RC Oscillator, 24 MHz Crystal Oscillator
32.768 kHz Crystal Oscillator
- 2.4 GHz Antenna

NXP Semiconductors - MKW39/38/37 - 26 MHz/32 MHz Crystal, 32.768 kHz Crystal Oscillator
- 2.4 GHz Antenna

Dialog Semiconductor - DA1469x - 32 MHz Crystal, 32.768 kHz Crystal Oscillator
- 2.4 GHz Antenna

STMicroelectronics - BlueNRG-LPS - 32 MHz Crystal, 32.768 kHz Crystal
- 2.4 GHz Antenna



[See All Crystal Products](#)

[See Antenna Products for Bluetooth](#)

Solutions for Near-field communication Protocol

NFC operates at 13.56 MHz on ISO/IEC 18000-3 air interface. The technology is a simple extension of the ISO/IEC14443 proximity-card standard(contactless card, RFID).

Some Typical Crystal or TCXO frequencies for [Near-field communication](#) Hearing Aids ICs:

NXP Semiconductors - PN7160_PN7161 - 27.12 MHz Crystal, 40 MHz Oscillator, 380 kHz Oscillator
PN7150 - 27.12 MHz Crystal, 40 MHz Oscillator, 380 kHz Oscillator
- 1 GHz VCOs

STMicroelectronics - ST25R3916 - 27.12 MHz Crystal, 27 kHz RC Oscillator, 32.768 kHz Crystal
ST25RU3993 - 20 MHz TCXO
ST95HF - 27.12 MHz Crystal
- 1800 MHz VCOs



[See All Crystal Products](#)

Raltron Solutions – MHz Crystals

Available Crystal Packages

Part #	SIZE(mm)	FREQUENCY(MHz)
R2016-16.000-8-1015-EXT-TR	2.00 x 1.60 x 0.50	16
R2016-16.000-8-2020-EXT-TR	2.00 x 1.60 x 0.50	16
R1612-27.120-8-F-1015-EXT-TR	1.60 x 1.25 x 0.32	27.12
R1612-27.120-8-F-2020-EXT-TR	1.60 x 1.25 x 0.32	27.12
R1210-32.000-8-F-1015-EXT-TR	1.20 x 1.00 x 0.35	32
R1210-32.000-8-F-2020-EXT-TR	1.20 x 1.00 x 0.35	32
R1210-48.000-8-F-1015-EXT-TR-N1 Rev B	1.20 x 1.00 x 0.35	48
R2016-64.000-8-F-1015-EXT-TR	2.00 x 1.60 x 0.50	64
R2016-64.000-8-F-2020-EXT-TR	2.00 x 1.60 x 0.50	64

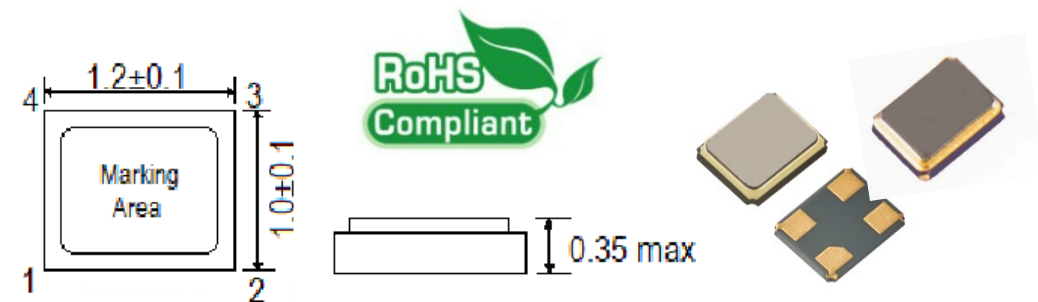
Typical Frequencies:

16 MHz , 27.12 MHz, 32 MHz, 64MHz

[See All Crystal Products](#)

R1210 Specifications

PARAMETER	VALUE
FREQUENCY RANGE*	32.000 MHz to 60.000 MHz
MODE OF OSCILLATION	AT CUT, Fundamental
FREQUENCY TOLERANCE AT 25°C	±50 ppm max ±10ppm, ±20ppm, ±30 ppm available
FREQUENCY STABILITY OVER TEMPERATURE*	±50 ppm max ±10ppm, ±20ppm, ±30 ppm available
OPERATING TEMPERATURE RANGE*	-10°C to +60°C Standard -40°C to +85°C Extended
STORAGE TEMPERATURE RANGE	-40°C to +85°C
AGING	±2 ppm 1st year max
LOAD CAPACITANCE	8 pF to 32 pF or Series Resonance
EQUIVALENT SERIES RESISTANCE	See Table 1
SHUNT CAPACITANCE	3.0 pF max
DRIVE LEVEL	50 µW max



Raltron Solutions - Tuning Fork 32.768 kHz

Raltron is offering 32.768 kHz tuning fork crystals in:
Ceramic Packages:

1.2 x 1.0 mm Raltron Tuning Fork Crystal - [RT1210](#)

1.6 x 1.0 mm Raltron Tuning Fork Crystal - [RT1610](#)

[See All Crystal Products](#)

Load capacitance values: 6 pF, 7 pF, 9 pF and 12.5 pF

Frequency Tolerances: ± 20 ppm and ± 10 ppm

Typical example of IC for Hearing Aids using
a 32.768 kHz crystal as frequency reference:

Texas Instruments - CC1352P7

Using 32.768 kHz crystal

CL: 6, 7 or 12 pF

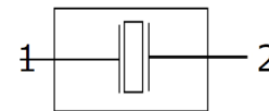
ESR: 90 k Ω max



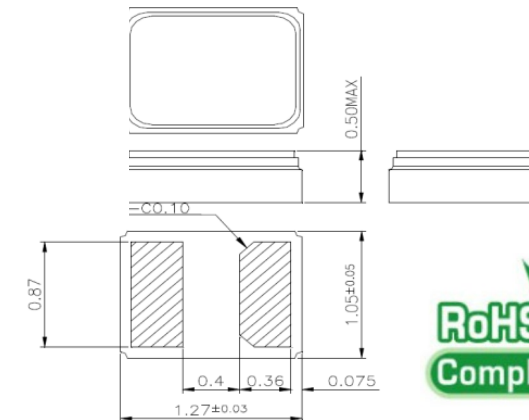
RT1210 Specifications

PARAMETER	VALUE
NOMINAL FREQUENCY	32.768 kHz
MODE OF OSCILLATION	Fundamental
FREQUENCY TOLERANCE AT 25°C \pm 3°C	± 20 ppm *
FREQUENCY STABILITY OVER TEMPERATURE COEFFICIENT	-0.036 ppm / °C ² typ
OPERATING TEMPERATURE RANGE	-40°C to +85°C
STORAGE TEMPERATURE RANGE	-55°C to +125°C
AGING AT 25°C \pm 3°C	± 5 ppm first year max
INSULATION RESISTANCE AT 100 VDC	500 M Ω
LOAD CAPACITANCE	6 pF to 12.5 pF
EQUIVALENT SERIES RESISTANCE	90 k Ω max
SHUNT CAPACITANCE	1.4 pF typ
DRIVE LEVEL	0.3 μ w max

Internal Lead Connections



Unit: mm

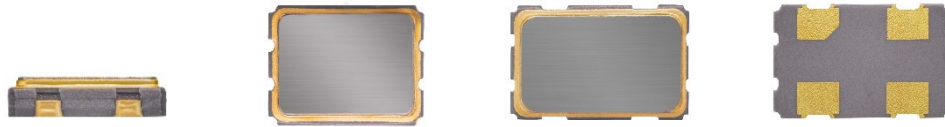


Raltron Solutions - TCXOs and VCTCXOs

Raltron TCXOs IC Solutions

Part #	Size(mm)
RTX-1612BD32-S-32.000-TR	1.6 x 1.2
RTX-1612AF31-S-48.000-TR	1.6 x 1.2

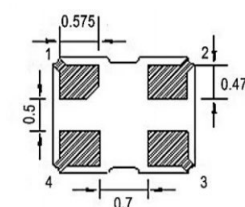
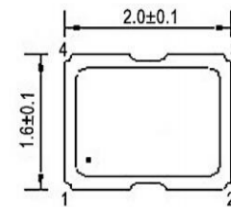
[See All TCXOs Products](#)



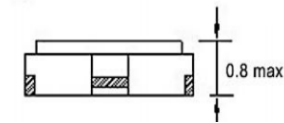
- Tighter Stability: $\pm 0.5 \text{ ppm} \sim \pm 2.5 \text{ ppm}$, $-40 \sim +85^\circ\text{C}$
- Improved Frequency Tuning Characteristic
- Superior Phase Noise Performance (-130 dBc/Hz on the floor)
- Range Supply Voltage: $1.8 \text{ V} \sim 3.3 \text{ V}$
- Typical Frequencies: 26.0 MHz, 32.0 MHz, 38.4MHz, 48.0 MHz, 50.0 MHz, 52.0 MHz

SERIES RTX/RTV-2016

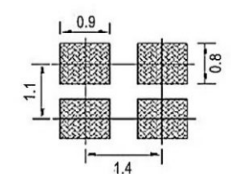
PARAMETER	VALUE	
FREQUENCY RANGE	13 ~ 52 MHz	
SUPPLY VOLTAGE	1.8 ~ 3.3 V	
INPUT CURRENT	3.0 mA max	
FREQUENCY STABILITY	vs. TEMPERATURE	$\pm 0.5 \sim \pm 2.5 \text{ ppm}$
	vs. LOAD ($\pm 10\%$)	$\pm 0.2 \text{ ppm max}$
	vs. SUPPLY VOLTAGE	$\pm 0.2 \text{ ppm max}$
	AGING 1 st YEAR	$\pm 1.0 \text{ ppm max}$
FREQUENCY TOLERANCE at 25°C AFTER 2 REFLAWS	$\pm 2.5 \text{ ppm max}$	
OPERATING TEMPERATURE RANGE ¹	$-40 \sim +85^\circ\text{C}$	
STORAGE TEMPERATURE RANGE	$-40 \sim +85^\circ\text{C}$	
CLIPPED SINEWAVE OUTPUT VOLTAGE	0.8 VP-P typ	
OUTPUT LOAD	10 k Ω // 10 pF	
START-UP TIME	5 ms max	
FREQUENCY TUNING RANGE ²	$\pm 7 \sim \pm 16 \text{ ppm}$	
PHASE NOISE at 1 kHz OFFSET	-130 dBc/Hz max	



(Bottom View)



Recommended Solder Pattern



*Add a 1000 pF DC-cut capacitor to the output pad of the TCXO



Raltron Products – LTCC Filters, Baluns and Diplexers

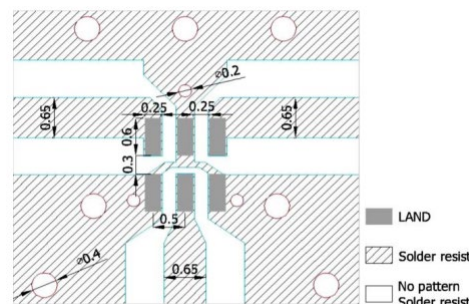
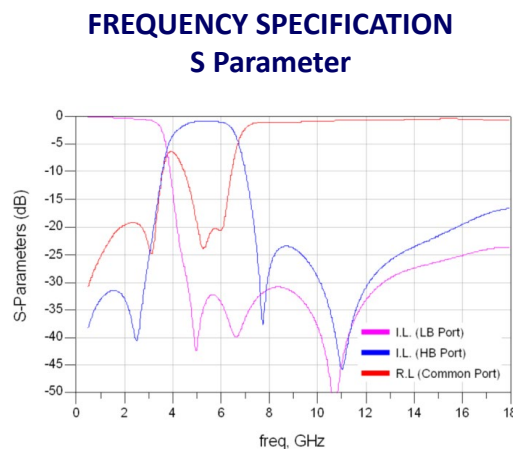
Raltron LTCC Filters, Baluns and Diplexers Solutions

Part #	Size(mm)
RCF-5500.000-700000-1005-W-001	1.00 x 0.50
RBL-2430.000-1005-EV-001	1.00 x 0.50 x 0.40
RCDI-24-49-1608-W-TR	1.60 x 0.80 x 0.60
RCDI-W2A1-W5A17-1608-W-TR	1.60 x 0.80 x 0.60

[See All LTCC Filters, Baluns and Diplexers Products](#)

RCDI-W2A1-W5A17-1608-W-TR

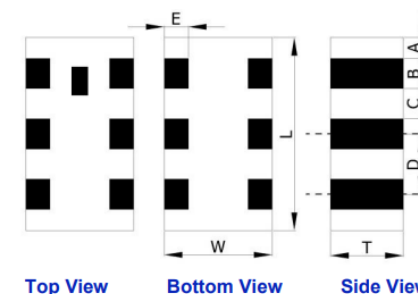
PARAMETERS	SPECIFICATIONS		UNIT
Frequency Range	2400 ~2496	5150 ~ 5950	MHz
Insertion Loss, max	0.5		1.0
Attenuation, min	35 @ 4800~5000 MHz	30 @ 70~2000 MHz	dB
	15 @ 7200~7500 MHz	30 @ 2400~2690 MHz	dB
		12 @ 7250~7800 MHz	dB
		25 @ 10300~12000 MHz	dB
	10 @ 15000~18000 MHz	dB	
VSWR, max	1.6		-
Impedance	50		Ω
Operating Temperature Range	-40 ~ +85		$^{\circ}\text{C}$
Moisture Sensitivity Levels	Level 1 (IPC/JEDEC J-STD-020)		-



Solder Land Pattern

Unit: mm

Line width to be designed to match 50 Ω characteristic impedance, depending on PCB material and thickness.



Unit: mm

	L	W	T	A
Dimension	1.60 \pm 0.15	0.80 \pm 0.15	0.60 \pm 0.10	0.175 \pm 0.15
Dimension	B	C	D	E
Dimension	0.25 \pm 0.15	0.25 \pm 0.15	0.50 \pm 0.15	0.20 \pm 0.15



Contact



<http://www.raltron.com>

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