



US 20240213958A1

(19) **United States**(12) **Patent Application Publication**  
**AMMANN et al.**(10) **Pub. No.: US 2024/0213958 A1**(43) **Pub. Date: Jun. 27, 2024**(54) **VERTICALLY COUPLED SAW  
RESONATORS****H03H 9/145** (2006.01)**H03H 9/25** (2006.01)(71) Applicant: **RF360 EUROPE GMBH**, Munich  
(DE)(52) **U.S. Cl.**CPC ..... **H03H 9/6483** (2013.01); **H03H 3/08**  
(2013.01); **H03H 9/1092** (2013.01); **H03H**  
**9/145** (2013.01); **H03H 9/25** (2013.01)(72) Inventors: **Stefan AMMANN**, Grosskarolinenfeld  
(DE); **Matthias PERNPEINTNER**,  
Grafing b. München (DE); **Manuel**  
**HOFFER**, Graz (AT); **Stefan Leopold**  
**HATZL**, Kloeck (AT)

(57)

**ABSTRACT**

Aspects of the disclosure relate to devices, wireless communication apparatuses, methods, and circuitry implementing filters with electroacoustic vertical coupling. One aspect is a filter comprising a piezoelectric substrate having a first piezoelectric surface and a second piezoelectric surface opposite the first piezoelectric surface. The filter further comprises a first electroacoustic resonator comprising a first interdigital transducer (IDT) disposed on or over the first piezoelectric surface of the piezoelectric substrate and a second electroacoustic resonator comprising a second IDT disposed on or over the second piezoelectric surface of the piezoelectric substrate. The second electroacoustic resonator is electrically coupled to the first electroacoustic resonator in series or in parallel.

(21) Appl. No.: **18/069,958**(22) Filed: **Dec. 21, 2022****Publication Classification**(51) **Int. Cl.****H03H 9/64** (2006.01)**H03H 3/08** (2006.01)**H03H 9/10** (2006.01)