RF Filters in 2025

Choosing the right technology for performance, cost, and integration

As 5G and Wi-Fi 6E/7 reshape RF frontend design, the balance between BAW and SAW filters becomes more critical than ever. Yole Group's comparative analysis across 40+ filters reveals how OEMs optimize acoustic platforms to align performance with budget and board constraints.

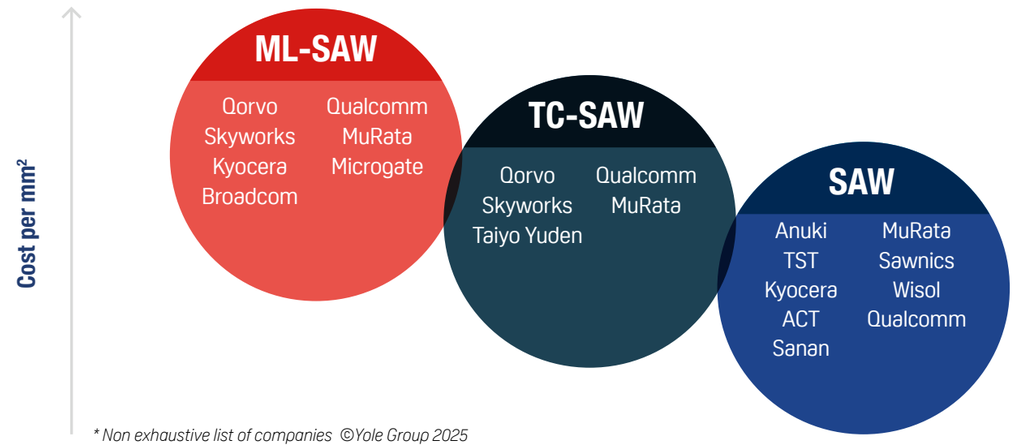
RF filters share a sizable number of components in modern RF frontend devices. In Yole's recent Status of the RF Industry 2025 report, the overall filter market is valued at $8.2 billion in 2025. The RF Filter ecosystem is diverse, with many players and filter technologies. Yole Groups reports, BAW filter Comparison 2025 and SAW Filter Comparison 2025, compared more than forty commercial filters from around twenty suppliers, including Broadcom, Murata, Qorvo, and Qualcomm, covering Automotive & Mobility, Industrial, Telecom & Infrastructure, and Mobile & Consumer equipment. Our analysis spans all mainstream surface acoustic wave (SAW) families – conventional, thermo-compensated (TC-SAW) and multilayer (ML-SAW) – and bulk acoustic wave (BAW) architectures, namely FBAR, SMR, DBAR, and XBAW. The arrival of 5G and Wi-Fi 6E/7 pushed demand for BAW filters, especially in medium- and high-band paths. FBAR still yields the best radio performance but depends on costly cavity steps and 8-inch wafer lines. SMR removes the cavity, so unit cost falls with only a modest loss in selectivity. Both flows rely on aluminum nitride layers – poly-AlN or AlN doped with niobium or tantalum – and several makers now boast electromechanical coupling by moving to aluminum scandium nitride with more than 40 % scandium. BAW devices only use Sc-AlN, not lithium niobate. Since 2022, many OEMs have trimmed FBAR and SMR usage, trading a small hit in performance for lower bills of material.

Filters manufacturers overview*

* Full analysis (company profile, physical and cost analyses)

** Non exhaustive list of companies ©Yole Group 2025*

SAW filters cost comparison – by type of filter*



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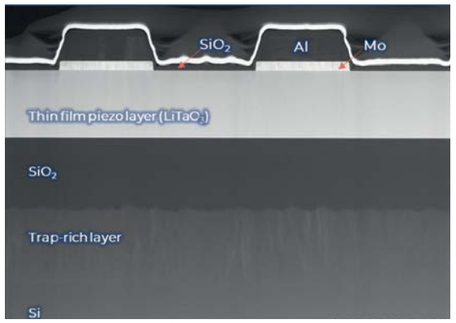
SAW technology remains attractive for lower frequencies and for applications where cost or board area is under pressure. It is important to note that these filters in general have a higher number of resonators per mm2 compared to BAW. Conventional SAW uses bulk lithium tantalate or lithium niobate as both substrate and piezo layer. TC-SAW improves the Thermal Coefficient of Frequency (TCF) by adding compensating films or dopants, reducing the channel drift with temperature. In ML-SAW, a thin $LiTaO_3$ or $LiNbO_3$ film is bonded to an insulating carrier – often silicon with a trap-rich layer or aluminum oxide – while bonding layer refinements cut epitaxial and thermal stress, extending reliable operation to higher bands. Taiyo Yuden and a few other suppliers use $LiTaO_3$ on Al_2O_3, while Qorvo and Skyworks have adopted SOITEC Piezoelectric-on-Insulator (POI) substrates for selected designs.

Taken together, the data shows a clear division between different technologies. Enhanced TCF and stronger bonding layers allow SAW parts to handle the low band and most of the mid bands, sometimes even reaching sub-6 GHz high-band blocks, at the lowest die cost, considering the number of resonators per filter. BAW parts, now using AlN-based thin films, are still required for the most demanding mid- and high-band 5G channels, though their cavity steps force designers to monitor cost closely. Picking the right acoustic platform, piezo film, and bonding stack for each frequency range, therefore, remains the surest way to meet performance targets without blowing the budget or the board area, which is seen in the cases of Qorvo and Skyworks where both SAW and BAW filters of different types are utilized in the same modules.



ML- SAW FIB cross section – TEM view
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Source: www.yolegroup.com

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Ihor Pershukov, PhD, is a Technology & Cost Analyst, Radio Frequency at Yole Group. With a deep expertise in semiconductor manufacturing, materials, and radio frequency (RF) devices, Ihor oversees reverse engineering and costing analyses. Collaborating closely with the laboratory team, he defines the objectives of the analyses and establishes methodologies to unveil the structure of RF devices. Prior to Yole Group, Ihor served as a researcher at CEA-Leti, concentrating on piezoelectric materials for acoustic device manufacturing. Ihor holds a master's degree in nanoscale engineering from École Centrale de Lyon (France) and a master's degree in applied physics and nanomaterials from Taras Shevchenko National University of Kyiv (Ukraine). He has a PhD in Materials Science from École Centrale de Lyon.