

RF Acoustic Wave Filters

Patent Landscape Analysis – October 2017

*SAW and BAW filters are key components of today's mobile communication modules thanks to their small size, low cost and high performance.
But who has the best IP position for the upcoming 5G protocol?*

REPORT OUTLINE

- RF Acoustic Filter Patent Landscape
- October 2017
- PDF, >180 slides
- Excel file, >6,550 patent families
- €5,990 for a multi-user license



KEY FEATURES OF THE REPORT

- **IP trends**, including time evolution of published patents and countries of patent filings.
- **Patent segmentation** by technology (SAW, BAW-FBAR, BAW-SMR) and device (duplexers, multiplexers, diplexers).
- **Current legal status** of the patents.
- Ranking of **main patent assignees** by technological segments.
- **Key patents** and granted patents near expiration by technological segments.
- Focus on **packaging** and **thermal drift compensation**.
- **IP position of key players**, and relative **strength** of their patent portfolios.
- **Patents linked to products** of major market players.
- **IP profile** of key players.
- **Excel database** with all patents analyzed in the report, including technology segmentation.

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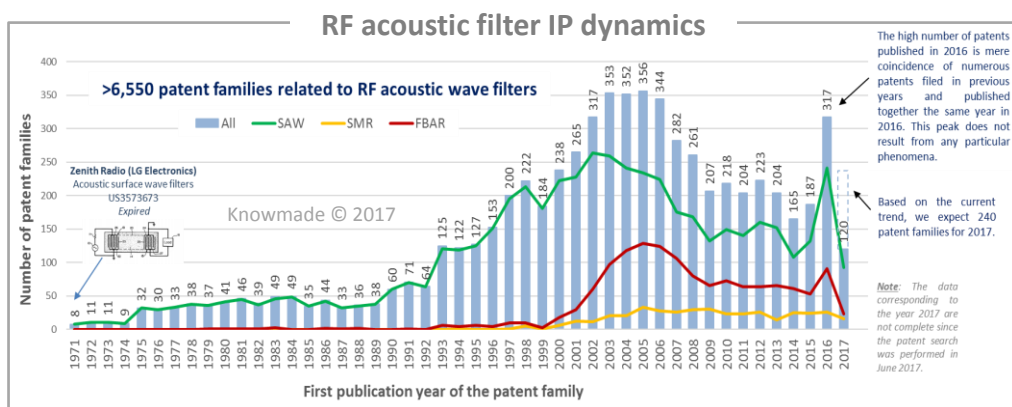
- [RF Front End Modules and Components for Cellphones 2017](#) (Yole Développement)
- [Smartphone RF Front-End Module Review](#) (System Plus Consulting)
- [Taiyo Yuden SAW and BAW Band 7 Duplexer integrated into Skyworks' System in Package](#) (System Plus Consulting)
- [Murata SAW Thermo-Compensated Band 8 Filter in Low Band Front-End Module](#) (System Plus Consulting)
- [Avago AFEM-9040](#) (System Plus Consulting)
- [Qorvo TQF6405 in iPhone 6s Plus](#) (System Plus Consulting)

ACOUSTIC WAVE FILTER IP DYNAMICS ARE CHANGING

Since the development of analog radio frequency (RF) communication in the early 1990's, front end modules have become key components. Among all front end module devices, filtering will be the strongest growing market over the next five years. A compound annual growth rate of 8% is set to make the filter market worth \$16 billion in 2022 according to Yole Développement's March 2017 report, 'RF Front End Modules and Components for Cellphones'. Acoustic wave technology has become the best way to deliver high performance, small and low-cost filters in analog RF communication. And today, as 5G communication protocols take shape, acoustic wave filter players have consolidated their position. They are now developing filters that will address the requirements of the upcoming 5G mass market.

In the 1990s, SAW filter patent publications grew rapidly, heralding the development of the RF acoustic wave filter market in the 2000s. Since 2010, the market has consolidated, while we have witnessed of the flattening of the patent activity growth and the strengthen of the IP position of several companies. It is now essential to understand the RF acoustic filter patent landscape, the key patented technologies and players' IP positions. Such knowledge can help anticipate the upcoming revolution, detect business opportunities, mitigate risks and make strategic decisions to strengthen one's market position.

In this report, Knowmade has thoroughly investigated the patent landscape for RF acoustic wave filters dedicated to mobile applications, including SAW, TC-SAW, BAW-FBAR, BAW-SMR, duplexers, multiplexers and diplexers. We have evaluated the IP position of key players through detailed analysis of their patent portfolios, including the legal status of the patents, their geographic coverage, their claimed inventions and their prior art contribution. We also study their IP strategy and their IP blocking potential.



More than 6,550 RF acoustic filter inventions have been published worldwide up to July 2017 by more than 630 patent applicants. The related patenting activity started in the 1970s in Japan, with the emergence of surface acoustic filters for Intermediate Frequency (IF) TV applications. They have rapidly become a worldwide topic for which the major IP players come from Japan, like Japan Radio and NEC, and the U.S., like Motorola. In the 2000s, the number of BAW-related patent publications increased strongly with the development of applications for smartphones and 3G. Today, IP activity has settled down and Japanese players like Murata or Taiyo Yuden lead the SAW patent landscape, while American players like Qorvo, Qualcomm and Broadcom lead the BAW patent landscape.

COMPANIES MENTIONED IN THE REPORT (NON-EXHAUSTIVE)

Murata Manufacturing, Taiyo Yuden, Skyworks, Kyocera, Broadcom, Hitachi, Qualcomm/NXP, TDK, Toyo Communication Equipment, Samsung, LG, Seiko Epson, Qorvo, Nihon Dempa Kogyo, NEC, Epson, Sanyo, Siemens, Mitsubishi, Japan Radio, NGK, CTS, Intellectual Ventures, Philips, Thomson, UBE Industries, Intel, Wisol, Alps Electric, Zenith Radio, NGK Spark Plug, Sony, STMicroelectronics, CEA, Clarion, Institute of Acoustics - Chinese Academy of Sciences, Texas Instruments, Beijing Zhongxun Sifang Science Technology, Chinese Electronics Technology Research Institute, Motorola, Tianjin University, Jiangsu Changjiang Electronics Technology, MEMS Solution, NTT, Northrop Grumman, Canon, Ericsson, Clarisay, Resonant, etc.

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