# Redefining Filter Performance

**Advanced NoDrift™ & LowDrift™ Filter Solutions from Qorvo®**

all around you

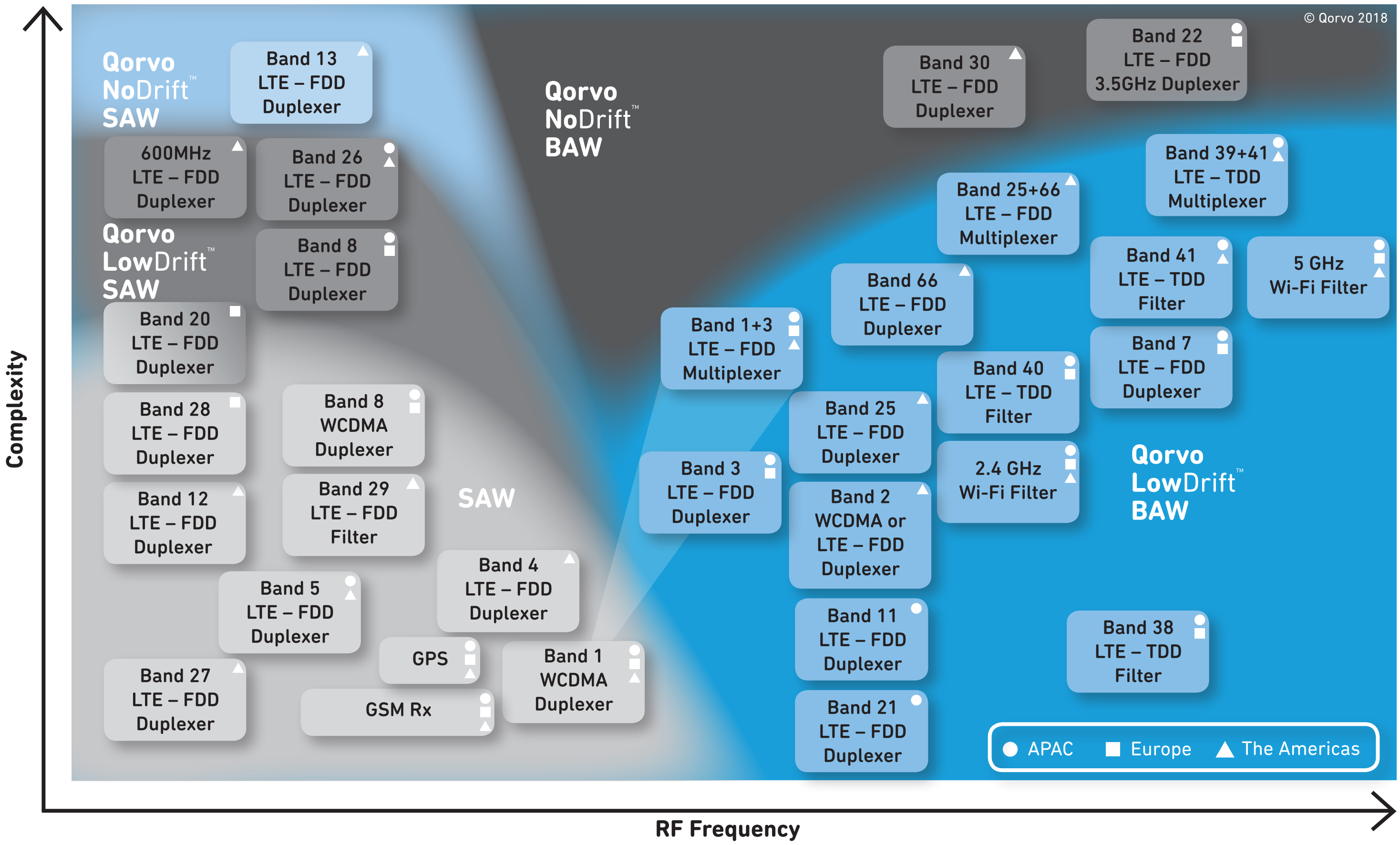
# Tackling the Industry's Toughest Interference Challenges

The complexity of solving LTE interference challenges in next-gen smartphone design is evident in the table below. Every new model requires multiple platforms tailored to different regions. Global roaming must also be considered. The average number of bands in a smartphone has more than doubled in the last few years and will double again over the next two years. As band counts rise and higher filter performance is required, Qorvo is leveraging its advanced filter technologies, such as NoDrift and LowDrift BAW and SAW, to help you tackle the industry's toughest interference problems.

## Key Frequency Bands

| Operating Band | Uplink (UL Operating Band) Base Station (BS) Receive User Equipment (UE) Transmit | | | Downlink (UL Operating Band) Base Station (BS) Transmit User Equipment (UE) Receive | | | Duplex Mode | LTE Bandwidths | Region(s) of Usage |
|---|---|---|---|---|---|---|---|---|---|
| | FDL_Low | - | FDL_High | FDL_Low | - | FDL_High | | | |
| 1 | 1920 MHz | - | 1980 MHz | 2110 MHz | - | 2170 MHz | FDD | 5, 10, 15, 20 | EMEA, Asia, Japan |
| 2 | 1850 MHz | - | 1910 MHz | 1930 MHz | - | 1990 MHz | FDD | 1.4, 3, 5, 10, 15, 20 | North America, Canada, Latin America |
| 3 | 1710 MHz | - | 1785 MHz | 1805 MHz | - | 1880 MHz | FDD | 1.4, 3, 5, 10, 15, 20 | Europe |
| 4 | 1710 MHz | - | 1755 MHz | 2110 MHz | - | 2155 MHz | FDD | 1.4, 3, 5, 10, 15, 20 | North America, Canada, Latin America |
| 5 | 824 MHz | - | 849 MHz | 869 MHz | - | 894 MHz | FDD | 1.4, 3, 5, 10 | North America, Canada, Latin America, Australia |
| 7 | 2500 MHz | - | 2570 MHz | 2620 MHz | - | 2690 MHz | FDD | 5, 10, 15, 20 | Europe |
| 8 | 880 MHz | - | 915 MHz | 925 MHz | - | 960 MHz | FDD | 1.4, 3, 5, 10 | Europe, Latin America |
| 9 | 1749.9 MHz | - | 1784.9 MHz | 1844.9 MHz | - | 1879.9 MHz | FDD | 5, 10, 15, 20 | Japan |
| 10 | 1710 MHz | - | 1770 MHz | 2110 MHz | - | 2170 MHz | FDD | 5, 10, 15, 20 | - |
| 11 | 1427.9 MHz | - | 1447.9 MHz | 1475.9 MHz | - | 1495.9 MHz | FDD | 5, 10 | Japan |
| 12 | 698 MHz | - | 716 MHz | 728 MHz | - | 746 MHz | FDD | 1.4, 3, 5, 10 | North America |
| 13 | 777 MHz | - | 787 MHz | 746 MHz | - | 756 MHz | FDD | 5, 10 | North America |
| 14 | 788 MHz | - | 798 MHz | 758 MHz | - | 768 MHz | FDD | 5, 10 | North America |
| 17 | 704 MHz | - | 716 MHz | 734 MHz | - | 746 MHz | FDD | 5, 10 | North America |
| 18 | 815 MHz | - | 830 MHz | 860 MHz | - | 875 MHz | FDD | 5, 10, 15 | Japan |
| 19 | 830 MHz | - | 845 MHz | 875 MHz | - | 890 MHz | FDD | 5, 10, 15 | Japan |
| 20 | 832 MHz | - | 862 MHz | 791 MHz | - | 821 MHz | FDD | 5, 10, 15, 20 | Europe |
| 21 | 1447.9 MHz | - | 1462.9 MHz | 1495.9 MHz | - | 1510.9 MHz | FDD | 5, 10, 15 | - |
| 22 | 3410 MHz | - | 3490 MHz | 3510 MHz | - | 3590 MHz | FDD | 5, 10, 15, 20 | - |
| 24 | 1626.5 MHz | - | 1660.5 MHz | 1525 MHz | - | 1559 MHz | FDD | 5, 10 | North America |
| 25 | 1850 MHz | - | 1915 MHz | 1930 MHz | - | 1995 MHz | FDD | 1.4, 3, 5, 10, 15, 20 | North America |
| 26 | 814 MHz | - | 849 MHz | 859 MHz | - | 894 MHz | FDD | 1.4, 3, 5, 10, 15 | Japan, North America |
| 27 | 807 MHz | - | 824 MHz | 852 MHz | - | 869 MHz | FDD | 1.4, 3, 5, 10 | Latin America |
| 28 | 703 MHz | - | 748 MHz | 758 MHz | - | 803 MHz | FDD | 3, 5, 10, 15, 20 | APAC, Latin America |
| 29 | N/A | - | N/A | 717 MHz | - | 728 MHz | FDD | 3, 5, 10 | North America |
| 30 | 2305 MHz | - | 2315 MHz | 2350 MHz | - | 2360 MHz | FDD | 5, 10 | North America |
| 31 | 452.5 MHz | - | 457.5 MHz | 462.5 MHz | - | 467.5 MHz | FDD | 1.4, 3, 5 | Brazil |
| 32 | N/A | - | N/A | 1452 MHz | - | 1496 MHz | FDD | 5, 10, 15, 20 | Japan, EMEA |
| 65 | 1920 MHz | - | 2010 MHz | 2110 MHz | - | 2200 MHz | FDD | 5, 10, 15, 20 | Europe, Japan, Korea |
| 66 | 1710 MHz | - | 1780 MHz | 2110 MHz | - | 2200 MHz | FDD | 1.4, 3, 5, 10, 15, 20 | North America |
| 67 | N/A | - | N/A | 738 MHz | - | 758 MHz | FDD | 5, 10, 15, 20 | Europe |
| 68 | 698 MHz | - | 728 MHz | 753 MHz | - | 783 MHz | FDD | 5, 10, 15 | Middle East |
| 69 | N/A | - | N/A | 2570 MHz | - | 2620 MHz | FDD | 5, 10, 15, 20 | Europe |
| 70 | 1695 MHz | - | 1710 MHz | 1995 MHz | - | 2020 MHz | FDD | 5, 10, 15, 20 | North America |
| 71 | 663 MHz | - | 698 MHz | 617 MHz | - | 652 MHz | FDD | 5, 10, 15, 20 | 600 MHz Band / North America |
| 33 | 1900 MHz | - | 1920 MHz | 1900 MHz | - | 1920 MHz | TDD | 5, 10, 15, 20 | - |
| 34 | 2010 MHz | - | 2025 MHz | 2010 MHz | - | 2025 MHz | TDD | 5, 10, 15 | China |
| 35 | 1850 MHz | - | 1910 MHz | 1850 MHz | - | 1910 MHz | TDD | 1.4, 3, 5, 10, 15, 20 | - |
| 36 | 1930 MHz | - | 1990 MHz | 1930 MHz | - | 1990 MHz | TDD | 1.4, 3, 5, 10, 15, 20 | - |
| 37 | 1910 MHz | - | 1930 MHz | 1910 MHz | - | 1930 MHz | TDD | 5, 10, 15, 20 | - |
| 38 | 2570 MHz | - | 2620 MHz | 2570 MHz | - | 2620 MHz | TDD | 5, 10, 15, 20 | Asia, EMEA |
| 39 | 1880 MHz | - | 1920 MHz | 1880 MHz | - | 1920 MHz | TDD | 5, 10, 15, 20 | China |
| 40 | 2300 MHz | - | 2400 MHz | 2300 MHz | - | 2400 MHz | TDD | 5, 10, 15, 20 | China, Others |
| 41 | 2496 MHz | - | 2690 MHz | 2496 MHz | - | 2690 MHz | TDD | 5, 10, 15, 20 | North America, China |
| 42 | 3400 MHz | - | 3600 MHz | 3400 MHz | - | 3600 MHz | TDD | 5, 10, 15, 20 | Japan, EMEA |
| 43 | 3600 MHz | - | 3800 MHz | 3600 MHz | - | 3800 MHz | TDD | 5, 10, 15, 20 | APAC, EMEA |
| 44 | 703 MHz | - | 803 MHz | 703 MHz | - | 803 MHz | TDD | 3, 5, 10, 15, 20 | APAC |
| 45 | 1447 MHz | - | 1467 MHz | 1447 MHz | - | 1467 MHz | TDD | 5, 10, 15, 20 | China |
| 46 | 5150 MHz | - | 5925 MHz | 5150 MHz | - | 5925 MHz | TDD | 20 | Worldwide |
| 47 | 5855 MHz | - | 5925 MHz | 5855 MHz | - | 5925 MHz | TDD | 10, 20 | North America, Europe |
| 48 | 3550 MHz | - | 3700 MHz | 3550 MHz | - | 3700 MHz | TDD | 5, 10, 15, 20 | North America |
| XGP | 2545 MHz | - | 2575 MHz | 2545 MHz | - | 2575 MHz | TDD | - | Japan |

## Leveraging Advanced Filter Technology for Regional Demands

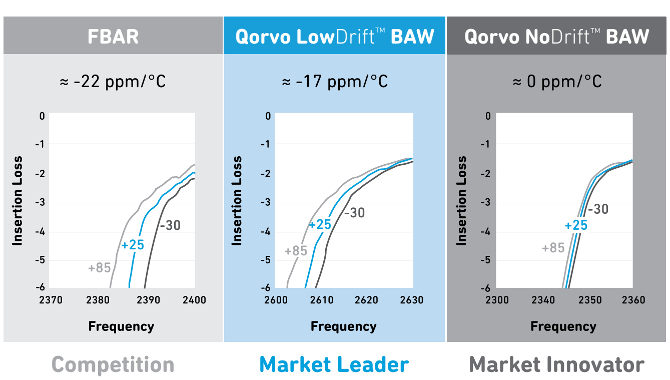


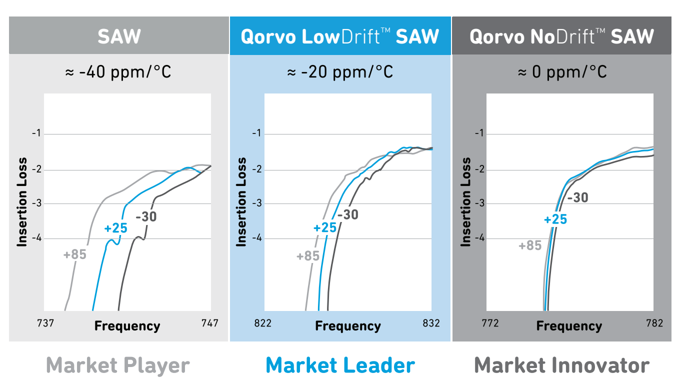

# Delivering Breakthrough Filter Performance

Qorvo's LowDrift and NoDrift filter technologies enable system designers to solve coexistence problems that are unaddressed by any other technology. As more LTE bands are squeezed into the crowded global RF spectrum, the space between bands is shrinking. In some cases, the transition between the passband and stop-band is as small as 2 MHz. This makes it almost impossible to meet requirements using traditional filter technologies. That's because the variation in filter response, which is dominated by temperature drift, can exceed the width of the transition band itself. The result is unacceptable interference, high insertion loss, or both.

Qorvo's new advanced LowDrift and NoDrift technologies deliver SAW and BAW filters with dramatically reduced temperature sensitivity for some of today's most challenging interference specifications. They combine low insertion loss with extremely precise selectivity. Using temperature-compensated filters, operators and manufacturers can deliver higher speeds and greater bandwidth by utilizing spectrum that might be lost with traditional filtering technologies.

## Qorvo's Filter Technology Reduces TCF (Temperature Coefficient of Frequency) Beyond the Competition

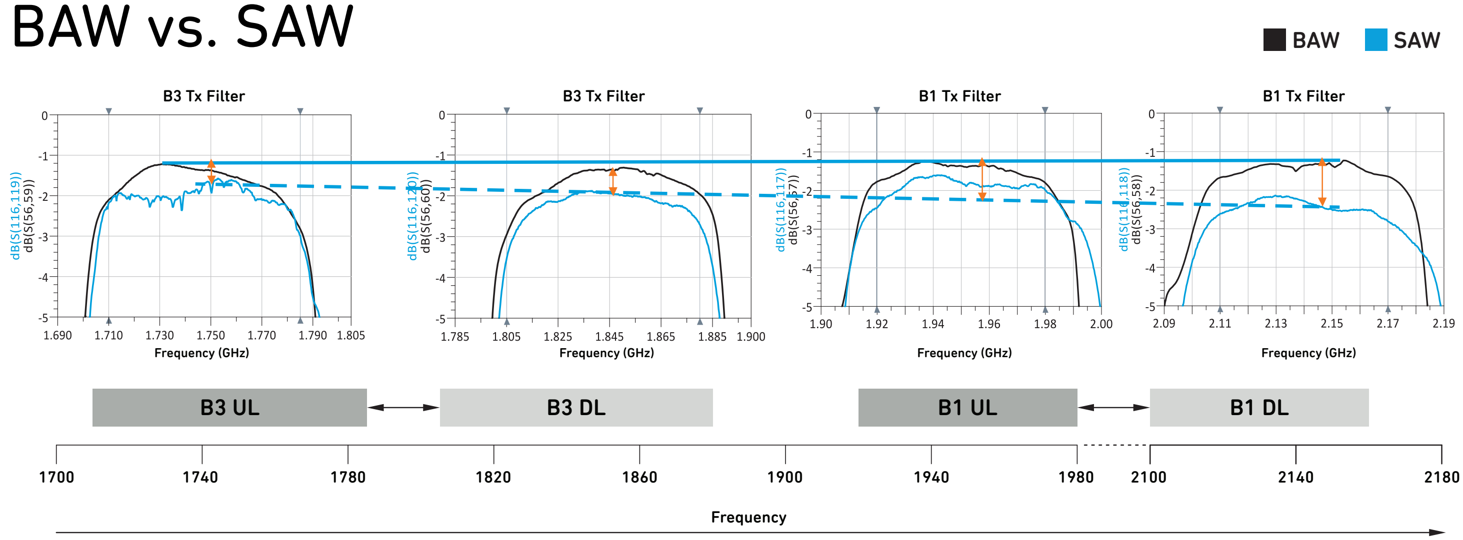


# Higher Q Advantages Using BAW for Multiplexers

There are certain applications where BAW devices have a unique advantage over even the highest-performance SAW technology. One of these is the design of complex multiplexers. As you move above the passband, SAW devices suffer from substantial losses due to radiation of acoustic energy into the bulk of the substrate. With the loading of each filter in a complex multiplexer design, the effect of radiation of acoustic energy increases. BAW technology has an intrinsic performance advantage over SAW for these designs, because the SAW bulk radiation acoustic energy is larger than BAW in the upper frequency spectrum. In the figure below, as you move up (to the right) in frequency, you can see BAW is the best choice for multiplexer filter designs due to this bulk radiation loss effect.

## BAW vs. SAW



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