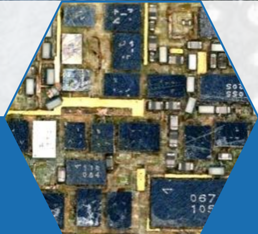
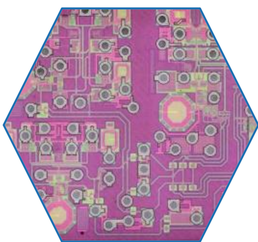
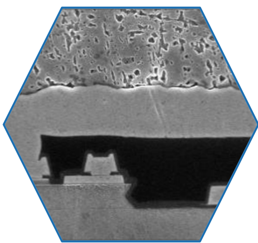
Broadcom AFEM-8200 PAMiD in the Apple iPhone 12 Series

Deep dive analysis of the fourth generation of mid/high band front-end module for 4G and 5G from Broadcom.







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Staying true to its choices for each previous iPhone series iteration Apple has again selected an innovative Radio Frequency (RF) Front-End Module (FEM) for its flagship. Each year Broadcom/Avago, its faithful supplier, has advanced its filters and innovative packaging technology in order to compete with the other market players and maintain its contract. This year, for the second time, Broadcom chose dual side molding Ball Grid Array (BGA) packaging coupled to new ElectroMagnetic Interference (EMI) shielding to enable a very high density System-in-Package (SiP) with frequency band sharing.

In 2020, Broadcom remains the only supplier of the same module for several versions of the latest Apple iPhone series 12, 12 Mini, 12 Pro and 12 Pro Max. Like its predecessor, the AFEM-8100, the AFEM-8200 is a Mid- and High-Band (MB and HB) Long Term Evolution (LTE) and 5G FEM. It features several dies including a Power Amplifier (PA), Silicon-on-Insulator (SOI) Switch and Film Bulk Acoustic Resonator (FBAR) filters. The filters are still using Avago's Microcap bonded wafer Chip-Scale Packaging (CSP) technology with Through-Silicon Vias (TSVs) enabling electrical contacts and Scandium Doped Aluminum Nitride (AlScN) as a piezoelectric material.

For this special version, Broadcom has innovated on several points. Thanks to the dual-side molding BGA technology, the density of the packaging has increased. The critical dies, master switches, Power Management Integrated Circuits (PMICs) and Low-Noise Amplifier (LNAs), have been completely isolated from the filtering parts. In EMI management, a novel compartmental shield using silver wire bonds has reduced the packaging cost greatly. Finally, with the latest GaAs PA technology using a flip-chip configuration, only two PAs remains in the module. Thanks to all these innovations, Broadcom manages to deliver a miniaturized package despite the complexity added with 5G, revealed by a precise CT scan.

This report contains a complete analysis of the FEM SiP, including a detailed analysis of the PA, the switches, the LNA, the filtering dies, and the internal/external EMI shielding. The report also features a cost analysis and a price estimation of the component. Finally, it also integrates a comparison with the AFEM-8072, MB/HB LTE FEM in the Apple iPhone X, the AFEM-8092, MB/HB LTE FEM in the Apple iPhone Xs and the AFEM-8100, MB/HB LTE FEM in the Apple 11 series.

COMPLETE TEARDOWN WITH

- Detailed photos
- Module CT scan
- Module level block diagram
- Precise measurements
- Materials analysis
- Manufacturing process flow
- Supply chain evaluation
- Manufacturing cost analysis
- Estimated sales price
- Technical and cost comparison with the AFEM-8072, AFEM-8092 and AFEM-8100

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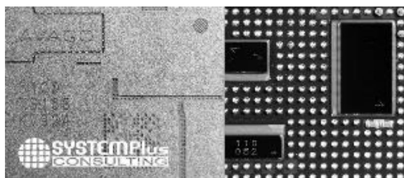

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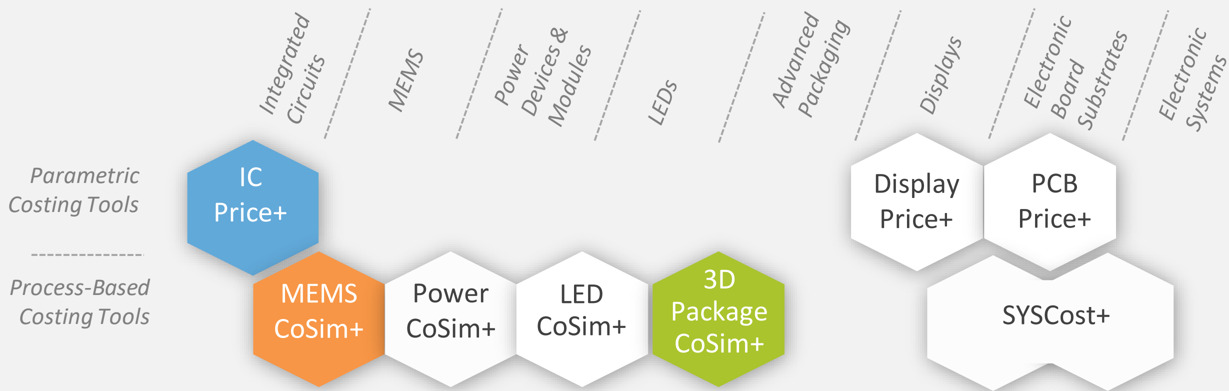

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