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(54) Title: INTEGRATED ANTENNA ARRAY WITH BEAMFORMER IC CHIPS HAVING MULTIPLE SURFACE INTERFACES

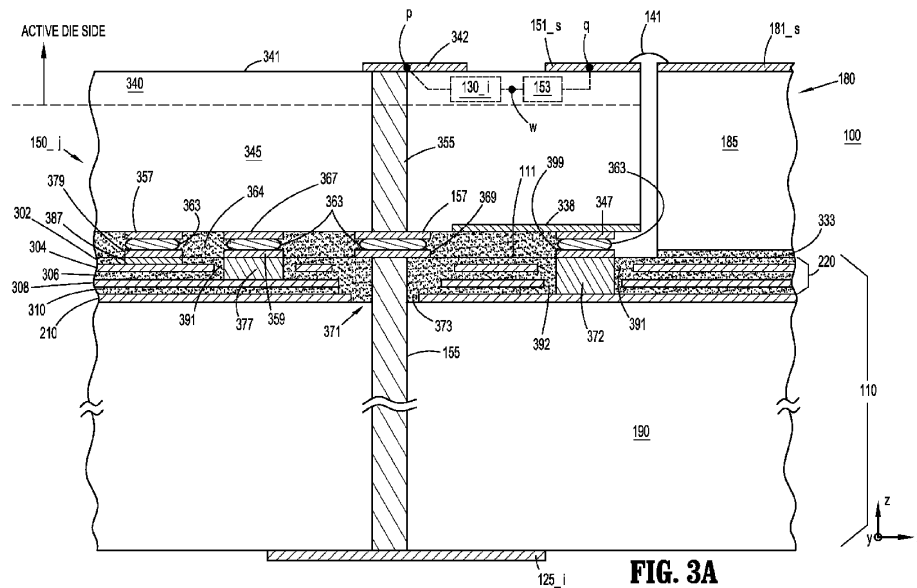


FIG. 3A

(57) Abstract: An antenna apparatus (100, 100') includes an antenna substrate (110) having opposite first (113) and second (111) surfaces, and at least one antenna element (125) disposed at the first surface. At least one radio frequency integrated circuit (RFIC) chip (150_j) has a lower surface attached to the second surface of the antenna substrate and has an RF contact (157) coupled to the at least one antenna element through the antenna substrate. The RFIC chip has an RF signal conductor (151_s) at an upper surface thereof and beamforming circuitry (130_i, 153) coupled between the RF contact and the RF signal conductor. A transmission line section (180) has a lower surface attached to the second surface of the antenna substrate, and has an upper surface at which a transmission line conductor (181_s) is disposed and electrically connected to the RF signal conductor of the RFIC chip through an upper surface interconnect (141).

WO 2022/103402 A1

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