CLAIMS

~~What is claimed is:~~

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1. An antenna element module comprising:

an antenna element including a feed and a radiating element;

a dielectric substrate having a first surface and a second surface, the dielectric substrate comprising the feed of the antenna element within the dielectric substrate;

an integrated circuit (IC) chip adhered to the first surface the dielectric substrate and coupled to the feed of the antenna element, the IC chip including a circuit configured to adjust a signal communicated with the feed; and

a plastic antenna carrier adhered to the second surface of the dielectric substrate, the plastic antenna carrier comprising:

a body portion comprising:

a first surface;

a second surface opposing the first surface; and

a cavity for the radiating element of the antenna element, the radiating element positioned in the cavity of the body portion of the plastic antenna carrier, wherein the cavity is ~~situated between the first surface and the second surface of the body portion.~~:

formed on the first surface of the body portion such that the cavity is situated between the first surface and the second surface of the body portion; and

shaped for the radiating element.

2. The antenna element module of claim 1, wherein the cavity is a first cavity formed on the first surface of the body portion, the antenna element module further comprising:

a second cavity formed on the second surface of the body portion of the plastic antenna carrier such that the second cavity is situated between the first surface and the second surface of the body portion; and

a parasitic element of the antenna element positioned in the second cavity of the body portion, wherein the parasitic element underlies the radiating element.

3. The antenna element module of claim 1, wherein the plastic antenna carrier is formed of a first polymer and the radiating element is formed of a second polymer.

4. The antenna element module of claim 1, wherein the antenna element is a first antenna element of a plurality of antenna elements, wherein each antenna element of the plurality of antenna elements includes a respective feed of a plurality of feeds and a respective radiating element of ~~the~~a plurality of radiating elements, and the cavity comprises a plurality of cavities formed in the first surface of the body portion, wherein each radiating element is positioned in a respective cavity of the plurality of cavities.

5. The antenna element module of claim 4, wherein the plastic antenna carrier further comprises one or more recessed channels that separates each of the plurality of antenna elements.

6. The antenna element module of claim 1, wherein:

the antenna element is a first antenna element of a plurality of antenna elements wherein each antenna element of the plurality of antenna elements comprises:

a radiating element of a plurality of radiating elements;

a feed of a plurality of feeds; and

a parasitic element of a plurality of parasitic elements;

the cavity comprises a first set of cavities formed on the first surface of the body portion~~;~~ such that each of the first set of cavities is situated between the first surface and the second surface of the body portion; and

the body portion of the plastic antenna carrier comprises a second set of cavities formed on the second surface of the body portion~~;~~ such that each of the second set of cavities is situated between the first surface and the second surface of the body portion;

wherein each radiating element of the plurality of radiating elements is positioned in a respective cavity of the first set of cavities; and

wherein each parasitic element of the plurality of parasitic elements is positioned in a respective cavity in the second set of cavities and each radiating element in the plurality of radiating elements overlays and is spaced apart from a corresponding parasitic element in the plurality of parasitic elements.

7. The antenna element module of claim 6, wherein the body portion of the plastic antenna carrier further comprises one or more recessed channels formed in the first surface of the body portion to separate ~~that separates~~ each of the plurality of antenna elements.

8. The antenna element module of claim 1, wherein the radiating element is a patch antenna.

9. The antenna element module of claim 1, wherein the first surface of the dielectric substrate comprises an array of solder balls for mounting on a circuit board.

10. The antenna element module of claim 1, wherein the plastic antenna carrier further comprises one or more features extending from the second surface of the body portion to the ~~first~~second surface of the dielectric substrate, wherein the one or more features space the body portion apart from the ~~first~~second surface of the dielectric substrate.

11. The antenna element module of claim 10, wherein the one or more features of the plastic antenna carrier extend from the second surface of the body portion at a draft angle.

12. The antenna element module of claim 10, wherein the one or more features of the plastic antenna carrier separates the body portion of the plastic antenna carrier from the feed.

13. The antenna element module of claim 1, wherein the feed of the antenna element comprises a pair of orthogonally arranged slots within the first surface of the dielectric substrate.

14. A phased array antenna comprising:

an array of antenna element modules, each of the array of antenna element modules comprising:

an antenna element including a feed and a radiating element;

a dielectric substrate having a first surface and a second surface, the dielectric substrate comprising the feed of the antenna element within the dielectric substrate;

an integrated circuit (IC) chip adhered to the first surface of the dielectric substrate and coupled to the feed of the antenna element, the IC chip including a circuit configured to adjust a signal communicated with the feed; and

a plastic antenna carrier adhered to the second surface of the dielectric substrate, the plastic antenna carrier comprising:

a body portion comprising:

a first surface;

a second surface opposing the first surface; and

a cavity for the radiating element of the antenna element, the radiating element positioned in the cavity of the body portion of the plastic antenna carrier, wherein the cavity is ~~situated between the first surface and the second surface of the body portion; and~~:

formed on the first surface of the body portion such that the cavity is situated between the first surface and the second surface of the body portion; and

shaped for the radiating element; and

a multi-layer substrate underlying the array of antenna element modules, the multi-layer substrate including a beam forming network (BFN) circuit formed on a layer of the multi-layer substrate and the BFN circuit is in electrical communication with the IC chip of each of the array of antenna element modules.

15. The phased array antenna of claim 14, wherein the cavity of each antenna element module of the array of antenna element modules is a first cavity formed on the first surface of the respective body portion, and each antenna element module of ~~the~~a plurality of antenna element modules further comprises:

a second cavity formed on the second surface of the body portion of the respective plastic antenna carrier; and

a parasitic element of a respective antenna element positioned in the second cavity of the body portion of the respective plastic antenna carrier, wherein the parasitic element underlies the respective radiating element.

16. A method for forming a plurality of antenna element modules, the method comprising:

adhering a plurality of integrated circuit (IC) chips to a first surface of a dielectric substrate, wherein the dielectric substrate comprises a plurality of feeds of a plurality of antenna elements within the dielectric substrate;

adhering an array of antenna packages to a second surface of the dielectric substrate to form an array of antenna element modules, wherein each antenna package comprises;

a plastic antenna carrier, the plastic antenna carrier comprising:

a body portion comprising a cavity for a radiating element; and

a radiating element of a respective antenna element of the plurality of antenna elements positioned in the cavity of the body portion of the plastic antenna carrier, wherein the cavity is formed on the first surface of the body portion such that the cavity is situated between the first surface and the second surface of the body portion and is shaped for the radiating element; and

singulating the array of antenna element modules to form the plurality of antenna element modules.

17. The method of claim 16, further comprising:

injecting a first polymer in a mold to form an array of plastic antenna carriers; and

injecting a second polymer into cavities in the array of plastic antenna carriers to form the radiating element in each of the plurality of plastic antenna carriers to form the array of antenna packages.

18. The method of claim 16, wherein the cavity of each antenna package in the array of antenna packages is a first cavity formed on an upper surface of the body portion of the respective plastic antenna carrier ~~and the radiating element is a radiating element~~, each antenna package further comprising:

a second cavity formed on a lower surface of the body portion of the respective plastic antenna carrier; and

a parasitic element positioned in the second cavity of the body portion, and the parasitic element underlies the radiating element of the respective antenna package.

19. The method of claim 16, wherein each antenna module has a regular tile base shape.

20. The method of claim 16, wherein each singulated antenna element module in the plurality of antenna element modules comprises two or more antenna elements.

21. The method of claim 20, wherein a body portion of each plastic antenna carrier comprises or more features extending from the body portion to the ~~first~~second surface of the dielectric substrate, wherein the one or more features space the body portion apart from the ~~first~~second surface of the dielectric substrate.

22. The method of claim 20, wherein the one or more features of each plastic antenna carrier extend from a respective body portion at a draft angle.

23. The method of claim 16, wherein the surface of the dielectric comprises an array of solder balls for mounting on a circuit board.

24. The method of claim 16, wherein the radiating element of each of the plurality of antenna packages is a patch antenna.

25. The method of claim 16, wherein each feed in the plurality of the feeds within the dielectric substrate comprises a pair of orthogonally arranged slots within the first surface of the dielectric substrate.