2EAD 026 SG amended claims, marked up copy

CLAIMS

1. Configurable nested patch antenna (10), comprising
- a substrate (34), the substrate (34) comprising a metallic upper surface (33) and a metallic ground surface (35), wherein the upper surface (33) of the substrate (34) comprises
- an inner patch (11) and
- an outer patch (12), wherein the outer patch (12) surrounds the inner patch (11) and is separated from the inner patch (11) by a gap (14),
the nested patch antenna (10) further comprising
- a feed line (29) which is connected to a feed point (30) of the inner patch (11),
- at least one switching element(17, 18, 19, 20, 21, 22), which is provided between an outer circumference (15) of the inner patch (11) and an inner circumference (16) of the outer patch (12),
- a first DC bias via (26) which is connected to the inner patch (11),
- a second DC bias via (27) which is connected to the outer patch (12), wherein at least one of the inner patch (11) or the outer patch (12) is connected to a metallic DC bias pad (39, 42) that is separated from the ground surface (35) by a surrounding gap (46), wherein the second DC bias via (27) is connected to a bias pad (42), the bias pad (42) being separated from the ground surface (35) by a gap (46) which surrounds the bias pad (42).

2. Configurable nested patch antenna (10) according to claim 1, wherein the first DC bias via (26) is connected to a bias pad (39), the bias pad (39) being separated from the ground surface (35) by a gap (40) which surrounds the bias pad (39).

3. Configurable nested patch antenna (10) according to ~~one of the~~ claim 1 or claim 2, wherein the first DC bias via (26) is connected to a centre point ~~(30)~~(24) of the inner patch (11).

4. Configurable nested patch antenna (10) according to one of the claims 1 to 3, wherein the inner patch (11) has a rectangular shape, and wherein the outer patch (12) has the shape of a rectangular frame.

5. Configurable nested patch antenna (10) according to one of the claims 1 to 3, wherein the inner patch (11) has a quadratic shape, and wherein the outer patch (12) has the shape of a quadratic frame.

6. Configurable nested patch antenna (10) according to claim 5, wherein a dimension of the inner patch (11) is approximately 3.5 x 3.5 cm and a dimension of the outer patch (12) is approximately 10 cm x 10 cm.

7. Configurable nested patch antenna (10) according to one of the claims 4 to 6, wherein the second DC bias via (26) is connected to a mid-point (28) of a side of the outer patch (12).

8. Configurable nested patch antenna (10) according to claim 7, wherein the second DC bias via (26) is connected to a mid-point of an outer edge of the outer patch (12).

9. Configurable nested patch antenna (10) according to one of the preceding claims, wherein the at least one switching element (17, 18, 19, 20, 21, 22) comprises a diode.

10. Configurable nested patch antenna (10) according to one of the claims 4 to 6, wherein at least four switching elements (17, 18, 19, 20, 21, 22) are provided, and wherein two of the switching elements (19, 22) are aligned along the connecting line between the centre point (24) of the inner patch (11) and the feed point (30) of the inner patch (11), and wherein a distance between each pair of two adjacent switching elements (17, 18, 19, 20, 21, 22) is different from a pre-determined resonant wavelength of the inner patch (11).

11. Configurable nested patch antenna (10) according to claim 10, wherein at least six switching elements (17, 18, 19, 20, 21, 22) are provided, and wherein a distance between each pair of two adjacent switching elements (17, 18, 19, 20, 21, 22) is different from a pre-determined resonant wavelength of the inner patch (11).

12. Configurable nested patch antenna (10) according to one of the claims 1 to 11, wherein a controllable voltage source (48) is connected to at least one of the first DC bias via (26) and the second DC bias via (27).

13. Multiple patch antenna (10') comprising a configurable nested patch antenna (10) according to one of the claims 1 to 11, the multiple patch antenna (10') further comprising at least a third patch (41) which surrounds the outer patch (12) of the nested patch antenna (10), wherein the third patch (41) is separated from the outer patch (12) by a second gap (43) and wherein at least one switching element is provided in the second gap (43) and between the outer patch (12) and the third patch.

14. Antenna device comprising a nested patch antenna (10) according to one of the claims 1 to 13, wherein the nested patch antenna is arranged within a plastic housing of the antenna device.

15. Electronic device comprising a nested patch antenna (10) according to one of the claims 1 to 13, wherein an antenna connector of the electronic device is connected with the feeder section of the antenna and wherein the at least one switching element is connected with a control section of the electronic device.

16. Motor vehicle with a nested patch antenna (10) according to one of the claims 1 to 12, wherein the nested patch antenna is attached to an outer body of the motor vehicle and connected to a battery of the motor vehicle.

17. Flying apparatus with a nested patch antenna (10) according to one of the claims 1 to 13, wherein the nested patch antenna is attached to an outer shell of the flying apparatus and connected to a power supply of the flying apparatus.

18. Method for designing a configurable nested patch antenna (10, 10'), the nested patch antenna (10, 10') comprising an inner patch (11) and an outer patch (12), the outer patch (12) surrounding the inner patch ~~(12)~~(11) and being separated from the outer patch by a gap (14),
the method comprising
- choosing a first operating frequency for the inner patch (11),
- choosing a second operating frequency for the outer patch (12),

- performing a parameter sweep for a distance d_GSM of a feed location (30') from a centre of the outer patch (12),
- performing a parameter sweep for a distance d_WLAN of a feed location (30) from a centre of the inner patch (11),
- choosing values for the distances d_GSM and d_WLAN such that an impedance match is within a predetermined interval around a pre-determined suitable impedance match for the respective patches (11, 12),
- aligning the inner patch (11) and the outer patch (12) such that the feed locations (30, 30') ~~essentially~~ coincide,
- forming an inner patch (11) and an outer patch (12) from a surface layer (33) of a substrate (34) according to the determined design parameters,
- forming a bias pad (42) on a ground surface layer (35) of the substrate (34),
- connecting the bias pad (42) to the outer patch (12).

19. Design method according to claim 18, comprising
- performing a parameter sweep for a gap width d of the gap (14) between the inner patch (11) and the outer patch (12),
- choosing the gap width d such that a parasitic coupling between the inner patch (11) and the outer patch (12) is lowest under the condition that the size of the inner patch (11) is larger than a pre-determined minimum admissible size of the inner patch (11).