CLAIMS:

1. An end-fire tapered slot antenna configured for use as an antenna element in a phased array system, comprising:

a conductive ground plane including a pass-through opening recessed therein, the pass-through opening having a predetermined dimension and shape;

a dual tapered slot element (DTSE) passing through the pass-through opening recessed in the conductive ground plane, the DTSE comprising:

a substrate having two surfaces on opposite sides of the substrate, the substrate being made of a nonconductive material;

a radiating portion comprising a first pair of radiating wings symmetrically arranged on the surface located on one side of the substrate, and a second pair of radiating wings symmetrically arranged on the surface, located on another side of the substrate, opposite to the first pair of radiating wings, the radiating wings having flared inner edges, flared lower edges and outer edges orthogonal to the conductive ground plane;

a base portion electrically coupled to the radiating portion, the base portion comprising:

a first pair of legs arranged on one surface of the substrate symmetrically with respect to a symmetry axis orthogonal to the conductive ground plane, and a second pair of legs symmetrically arranged on another surface of the substrate opposite to the first pair of legs, the first and second pairs of the legs passing through the pass-through opening of the conductive ground plane and being coupled to a feed line at a downmost part of the base portion on one of the surfaces, the legs of the first and second pairs having inner edges defining a corresponding slot line therebetween on each side of the substrate along the symmetry axis being orthogonal to said conductive ground plane, the slot line on each side of the substrate having a tapered shape and extending from a downmost part of the base portion towards the radiating portion gradually increasing a distance between the inner edges of the legs in accordance with a predetermined relationship;

a plurality of vias elements arranged at the inner edges of the legs and at the flared inner edges, flared lower edges and outer edges of the radiating wings in a spaced-apart relationship along an entire perimeter of the radiating wings, the

vias elements electrically connecting the radiating wings and the legs arranged on the surfaces of the opposite sides of the substrate , correspondingly; and

at least one pair of electrical shunts located on each surface of the substrate, and configured for connecting the radiating wings of the DTSE to the conductive ground plane.

2. The end-fire tapered slot antenna of claim 1, wherein said substrate has a dielectric constant in the range of 2 to 20 and a thickness in the range of $0.135\lambda_0$ to $0.3\lambda_0$.

3. The end-fire tapered slot antenna of claim 1, wherein the shape of the pass-through opening is a circular shape having a predetermined diameter in the range of $0.1\lambda_0$ to $0.2\lambda_0$.

4. The end-fire tapered slot antenna of claim 1, wherein the flared inner edges and flared lower edges of the radiating wings flare in an exponential manner.

5. The end-fire tapered slot antenna of claim 1, wherein the flared inner edges of the radiating wings define a radiating gap on each side of the substrate, the radiating gap extending from a downmost part of the radiating portion to the distal uppermost part of the radiating portion.

6. The end-fire tapered slot antenna of claim 5, wherein the radiating gap on each side of the substrate progressively widens in an exponential manner from the downmost part towards the distal uppermost part.

7. The end-fire tapered slot antenna of claim 5, wherein the radiating gap on each side of the substrate is configured to provide an impedance matching between the end-fire tapered slot antenna and a wave impedance in a free-space.

8. The end-fire tapered slot antenna of claim 1, wherein the radiating wings have a predetermined length in the range of $0.35\lambda_0$ to $0.45\lambda_0$, where λ_0 is a free-space operating wavelength of the end-fire tapered slot antenna.

9. The end-fire tapered slot antenna of claim 8, wherein the legs have a predetermined length in the range of $0.15\lambda_0$ to $0.25\lambda_0$.

10. The end-fire tapered slot antenna of claim 8, wherein the conductive ground plane is disposed at a predetermined distance L from the radiation portion, the distance L being in the range of $0.025\lambda_0$ to $0.035\lambda_0$.

11. The end-fire tapered slot antenna of claim 1, wherein the legs have bottom edges and outer edges, the outer edges flaring in an exponential manner.

12. The end-fire tapered slot antenna of claim 1, wherein the slot line on each side of the substrate at the downmost part of the base portion has a distance D_0 between the inner

edges of the legs suitable to match an impedance of the slot line on each side of the substrate with an input impedance of the feed line .

13. The end-fire tapered slot antenna of claim 1, wherein the predetermined relationship describing the gradual increase of the distance between the inner edges of the legs and the symmetry axis is $D = ax + D_0$, where a is taper slope of the inner edges of the slot line along the symmetry axis , x is a coordinate along the symmetry axis and D_0 is the distance between the inner edges of the first and second pair of legs and the symmetry axis at the downmost part of the base portion.

14. The end-fire tapered slot antenna of claim 13, wherein the taper slope of the slot line depends on the dielectric constant ε and the thickness s of the substrate.

15. The end-fire tapered slot antenna of claim 1, wherein said at least one pair of electrical shunts located on each surface of the substrate connects any two points selected on the flared lower edges of the wings to any two corresponding points selected on the ground plane.

16. The end-fire tapered slot antenna of claim 1, wherein the feed line is coupled to the base portion on one of the surfaces, the feed line including a coaxial cable having a shield conductor coupled to one of the legs located on one of the surfaces, and a core conductor connected to the other leg.

17. The end-fire tapered slot antenna of claim 1, wherein the plurality of vias elements are arranged at a predetermined distance d from the inner edges of the legs along the inner edges, and from the flared inner edges, the flared lower edges and the outer edges of the radiating wings being along an entire perimeter of the radiating wings.

18. The end-fire tapered slot antenna of claim 17, wherein the predetermined distance d is in the range of $0.01\lambda_o$ to $0.15\lambda_o$.

19. A phased array system including a plurality of the end-fire tapered slot antennas of any one of the preceding claims.