IMPEDANCE CONTROLLED ELECTRICAL CONTACT

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This claims priority to U.S. Patent Application Serial No. 62/816,865 filed March 11, 2019, the disclosure of which is hereby incorporated by reference as if set forth in its entirety herein.

BACKGROUND

[0002] Electrical connectors include an electrically conductive electrical contact that is configured to be placed in electrical communication with first and second electrical components so as to allow data transfer between the first and second electrical components. A radio frequency (RF) electrical contact has a mounting end that is typically mounted to a coaxial cable, and a mating end that typically mates to a printed circuit board, thereby placing the coaxial cable and the printed circuit board in electrical communication with each other. The RF electrical contact can form a separable interface with the printed circuit board.

[0003] Certain types of RF contacts include an outer electrical conductor, an inner electrical conductor, and an electrically insulative spacer disposed between the inner and outer electrical conductors. The inner electrical conductor is configured to mate with the printed circuit board, and further configured to be mounted to the electrical signal conductor of the coaxial cable. The outer electrical conductor is configured to mount to an outer electrical shield or ground of the coaxial cable. In some RF contacts, the inner conductor is movable and spring biased. Accordingly, as the mating end of the inner conductor is placed against the printed circuit board, the spring becomes compressed, thereby applying a biasing force to the inner conductor against the printed circuit board.

[0004] However, movement of the inner electrical conductor of conventional RF contacts can cause impedance to vary along the length of the electrical contact. It is therefore desired to provide an electrical RF contact having a movable inner conductor while achieving a substantially constant impedance profile along its length.

SUMMARY OF THE INVENTION

[0004a] According to a first aspect of the present invention, there is provided an electrical contact comprising:

a stationary electrical contact member; and

a movable electrical contact member that is movable with respect to the stationary electrical contact member from an initial position to a mated position, wherein the movable electrical contact member is biased toward the initial position, and a tapered inner surface of the stationary electrical contact member defines a contact location that is in contact with the

movable electrical contact member that is in contact with the stationary electrical contact member both in the initial position and the mated position, and the tapered inner surface tapers inwardly as it extends in a mating direction of the electrical contact,

wherein the electrical contact is configured to conduct RF signals within 10 percent of a target impedance both when the movable electrical contact member is in the initial position and when the movable electrical contact member is in the mated position.

[0004b] There is disclosed an electrical contact comprising:

a stationary electrical contact member; and

a movable electrical contact member that is movable with respect to the stationary electrical contact member from an initial position to a mated position,

wherein the movable electrical contact member contacts a contact location of the stationary electrical contact member as the movable electrical contact member moves from the initial position to the mated position, and the contact location of the stationary electrical contact member is stationary as the movable electrical contact member moves from the initial position to the mated position, and

wherein the electrical contact is configured to transmit RF signals through approximately 67 GHz.

[0004c] There is disclosed an electrical contact comprising:

a stationary electrical contact member; and

a movable electrical contact member that is movable with respect to the stationary electrical contact member in a rearward direction from an initial position to a mated position, wherein the movable electrical contact member is in contact with the stationary electrical contact member both in the initial position and the mated position, and at all positions between the initial position and the mated position,

wherein the movable electrical contact member tapers as it extends in a forward direction to a front end that defines a signal mating end of the electrical contact, and the forward direction is opposite the rearward direction, and

wherein the electrical contact is configured to transmit RF signals through approximately 67 GHz.

[0004d]There is disclosed an electrical contact comprising:

an electrically conductive outer housing having a front end; and

an inner electrical contact including:

a stationary inner electrical contact member that defines first and second cantilevered arms that terminate at a distal end of the stationary inner electrical contact member; and

a movable inner electrical contact member that projects from the front end of the electrically conductive outer housing, wherein the movable inner electrical contact member is movable with respect to the stationary electrical contact member in a rearward direction from an initial position to a mated position, wherein the movable electrical contact member is in contact with the first and second cantilevered arms both in the initial position and the mated position, and at all positions between the initial position and the mated position,

wherein the electrically conductive outer housing defines a first zone having a first inner cross-sectional dimension, and a second zone having a second inner cross-sectional dimension that is greater than the first inner cross-sectional dimension, wherein the first zone is disposed forward of the second zone, and the first zone defines the front end of the electrically conductive outer housing, and

wherein the distal end of the stationary inner electrical contact member is disposed in the second zone of the electrically conductive outer housing.

[0004e]There is disclosed an electrical contact comprising:

a stationary electrical contact member;

a movable electrical contact member that defines a signal mating end and is movable with respect to the stationary electrical contact member from an initial position to a mated position, wherein the movable electrical contact member is in contact with the stationary electrical contact member both in the initial position and the mated position; and

an electrically conductive outer housing that defines a ground mating end,

wherein the electrical contact is configured to conduct RF signals within 10 percent of a target impedance both when the movable electrical contact member is in the initial position and when the movable electrical contact member is in the mated position, and

wherein the signal mating end and the ground mating end are configured to be brought against a substrate so as to place the electrical contact in electrical communication with the substrate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] Fig. 1 is a perspective view of an array of RF electrical contacts supported by an array housing;

[0006] Fig. 2A is a perspective view of an RF electrical contact of the RF electrical contacts of Fig. 1 shown in an initial configuration prior to being mated with a printed circuit board;

[0007] Fig. 2B is a perspective view of the RF electrical contact illustrated in Fig. 2A, but shown in a mated configuration when mated with a printed circuit board;

What is Claimed:

1. An electrical contact comprising:

a stationary electrical contact member; and

a movable electrical contact member that is movable with respect to the stationary electrical contact member from an initial position to a mated position, wherein the movable electrical contact member is biased toward the initial position, and a tapered inner surface of the stationary electrical contact member defines a contact location that is in contact with the movable electrical contact member both in the initial position and the mated position, and the tapered inner surface tapers inwardly as it extends in a mating direction of the electrical contact,

wherein the electrical contact is configured to conduct RF signals within 10 percent of a target impedance both when the movable electrical contact member is in the initial position and when the movable electrical contact member is in the mated position.

2. The electrical contact as recited in claim 1, wherein the target impedance is 50 Ω.

3. The electrical contact as recited in any one of the preceding claims, wherein the electrical contact is configured to conduct RF signals within 3 Ω of the target impedance.

4. The electrical contact as recited in any one of the preceding claims, wherein the electrical contact is configured to conduct RF signals within 1 Ω of the target impedance.

5. The electrical contact as recited in any one of the preceding claims, wherein the movable electrical contact member contacts the contact location of the stationary electrical contact member as the movable electrical contact member moves from the initial position to the mated position, and the contact location of the stationary electrical contact member is stationary as the movable electrical contact member moves from the initial position to the mated position.

6. The electrical contact as recited in claim 5, further comprises an electrically conductive outer housing that is electrically isolated from each of the movable and stationary electrical contact members.

7. The electrical contact as recited in claim 6, wherein the electrically conductive housing defines a first zone having a first inner cross-sectional dimension, and a second zone having a second inner cross-sectional dimension that is greater than the first inner cross-sectional dimension.

8. The electrical contact as recited in claim 7, wherein the second zone is aligned with a distal free end of the stationary electrical contact member.

9. The electrical contact as recited in any one of claims 6 to 8, wherein the contact defines a gap that extends from the movable inner contact member to the outer housing, and the gap is at least approximately 5 mils.

10. The electrical contact as recited in any one of claims 7 to 9, further comprising an electrically insulative spacer that extends from the stationary electrical contact member to the outer housing.

11. The electrical contact as recited in any one of the preceding claims, wherein the outer surface of the movable inner contact member is tapered from a first region to a front end that is configured to mate with an electrical contact pad of a substrate.

12. The electrical contact as recited in claim 11, wherein the outer surface of the movable inner member tapers from a first cross-sectional dimension to a second cross-sectional dimension that ranges from 50 percent to 90 percent of the first cross-sectional dimension.

13. The electrical contact as recited in claim 12, wherein the second cross-sectional dimension is approximately five-sixths of the first cross-sectional dimension.

14. The electrical contact as recited in any one of the preceding claims, wherein the stationary electrical contact member comprises at least one arm that defines a distal end of the stationary electrical contact member, and the movable electrical contact member is in contact with the distal end both in the initial position and the mated position, and at all positions between the initial position and the mated position.

15. The electrical contact as recited in claim 14, wherein the at least one arm of the stationary electrical contact member comprises first and second cantilevered arms.

16. The electrical contact as recited in claim 15, wherein each of the first and second cantilevered arms are resilient and deflected outward, and apply an inward spring force against the movable electrical contact member.

17. The electrical contact as recited in any one of the preceding claims, wherein the electrical contact is an RF electrical contact.

18. The electrical contact as recited in any one of the preceding claims, wherein the electrical contact transmits RF signals through approximately 67 GHz.

19. The electrical contact as recited in any one of the preceding claims, wherein the electrical contact transmits RF signals through approximately 72 GHz.

20. The electrical contact as recited in any one of the preceding claims, wherein the electrical contact transmits RF signals through approximately 108 GHz.

21. The electrical contact as recited in any one of the preceding claims, wherein the movable electrical contact defines a first mating end, the electrical contact is elongate along a central axis, and the electrical contact further comprises a ground contact member that defines a second mating end that at least partially surrounds the first mating end in a plane that is oriented substantially perpendicular to the central axis.

22. The electrical contact as recited in claim 21, wherein the second mating end extends about an entirety of the first mating end in the plane.

23. An array of electrical contacts, comprising:

an array housing; and

the electrical contact as recited in claim 1 supported by the array housing, wherein the array housing includes an internal surface that defines a recess that surrounds an entirety of the ground mating end.

24. The array of electrical contacts as recited in claim 23, wherein the array housing is electrically conductive.

25. The electrical contact as recited in claim 21, wherein the second mating end extends about a portion less than an entirety of the first mating end in the plane.

26. An array of electrical contacts, comprising:

an array housing; and

the electrical contact as recited in claim 24 supported by the array housing, wherein the array housing includes an internal surface that defines a recess that partially surrounds the ground mating end,

wherein the internal surface further defines a channel that extends from the recess toward an outer perimeter of the array housing.

27. The array of electrical contacts as recited in claim 26, wherein the channel extends from the recess to the outer perimeter of the array housing.

28. The array of electrical contacts as recited in any one of claims 26 to 27, wherein the array housing is electrically conductive.

29. A cellular transmission tower comprising the electrical contact as recited in any one of claims 1 to 22 and 25.

30. A chip testing system comprising the electrical contact as recited in any one of claims 1 to 22 and 25.