

What is Claimed:

1. A printed circuit board comprising:
 - a printed circuit board body defining a front surface configured to be inserted into a receptacle of a complementary electrical connector along a mating direction;
 - a plurality of signal conductors supported by the printed circuit board body and elongated along the mating direction;
 - a plurality of ground conductors elongated along the mating direction and supported by the printed circuit board body at a location between adjacent ones of the signal conductors, each of the plurality of ground conductors and signal conductors configured to mate with respective complementary electrical ground contacts and electrical signal contacts of the complementary electrical connector; and
 - an electrically conductive trace that is supported by the printed circuit board body and is in electrical communication with at least two of the ground conductors so as to electrically connect the at least two of the ground conductors to each other.
2. The printed circuit board of claim 1, wherein the electrically conductive trace contacts the ground conductors
3. The printed circuit board of claim 2, wherein the electrically conductive trace is a first electrically conductive trace, the printed circuit board further comprising a second electrically conductive trace that is spaced from the first electrically conductive trace along a second direction that is perpendicular to the mating direction, wherein the second electrically conductive trace is in electrical communication with the first electrically conductive trace.
4. The printed circuit board of claim 3, wherein the electrically conductive trace is elongate along a third direction that is perpendicular to both the mating direction and the second direction, the second direction being perpendicular to the mating direction.
5. The printed circuit board of claim 3, further comprising a via and an electrically conductive ground mass located inside the via, the via and conductive ground mass extending between the first electrically conductive trace and the second electrically conductive trace.

6. The printed circuit board of claim 5, wherein the vias are spaced a center-to-center distance along a row direction that is equal to that of the distance between adjacent signal conductors and ground conductors along the row direction.
7. The printed circuit board of claim 1, wherein the electrically conductive trace is elongate along a direction that is perpendicular to the mating direction.
8. The printed circuit board of claim 1, wherein the printed circuit board body defines an upper surface and a lower surface that are spaced from each other along a direction perpendicular to the mating direction, wherein each of the upper surface and the lower surface each extends along the mating direction and a row direction, and the ground conductors and signal conductors are spaced from each other along the row direction.
9. The printed circuit board of claim 8, wherein the electrically conductive trace extends along the upper surface.
10. The printed circuit board of claim 8, wherein the electrically conductive trace extends along the lower surface.
11. The printed circuit board of claim 8, wherein the electrically conductive trace is embedded between the upper surface and the lower surface.
12. The printed circuit board of claim 1, wherein the electrically conductive trace is in electrical communication with all of the ground conductors.
13. The printed circuit board of claim 1, wherein the electrically conductive trace and the ground conductors are integral and monolithic with each other.
14. The printed circuit board of claim 1, wherein adjacent signal conductors define differential signal pairs, and the least two of the ground conductors are each disposed between adjacent differential signal pairs.
15. A printed circuit board comprising:
 - a printed circuit board body defining a front surface that is configured to be inserted into a receptacle of a complementary electrical connector along a mating direction, the printed circuit board body further defining a rear surface opposite the front surface along the mating direction;
 - a plurality of signal conductors supported by the printed circuit board body;

a plurality of ground conductors supported by the printed circuit board body at a location between adjacent ones of the signal conductors, each of the plurality of ground conductors and signal conductors configured to mate with respective complementary electrical ground contacts and electrical signal contacts of the complementary electrical connector; and

a ground coupling assembly that is in electrical contact with at least two of the ground conductors at a location forward of the signal conductors along a direction from the rear surface toward the front surface.

16. The printed circuit board of claim 15, wherein the printed circuit board body defines an upper surface and a lower surface that are spaced from each other along a direction perpendicular to the mating direction, wherein each of the upper surface and the lower surface each extends along the mating direction and a row direction, the ground conductors and signal conductors are spaced from each other along the row direction, and each of the front and rear surfaces extends between the upper and lower surfaces.

17. The printed circuit board of claim 16, wherein each of the front and rear surfaces extends along the row direction.

18. The printed circuit board of claim 15, wherein the ground coupling assembly comprises an electrically conductive trace that contacts the at least two ground conductors.

19. The printed circuit board of claim 18, wherein the electrically conductive trace is a first electrically conductive trace, the ground coupling assembly further comprising a second electrically conductive trace that is spaced from the first electrically conductive trace along a direction that is perpendicular to the mating direction, wherein the second electrically conductive trace is in electrical communication with the first electrically conductive trace.

20. The printed circuit board of claim 19, wherein the ground coupling assembly further comprising a via and a conductive ground mass located inside the via, the via and the conductive ground mass extending between the first electrically conductive trace and the second electrically conductive trace along the direction that is perpendicular to the mating direction.

21. The printed circuit board of claim 15, further comprising a via and a conductive ground mass located inside the via, the via and the conductive ground mass extending along a direction

between the upper and lower surfaces, the via and the conductive ground mass being in electrical communication with the ground conductors.

22. The printed circuit board of claim 21, further comprising an electrically conductive trace that contacts both the electrically conductive ground mass and the at least two ground conductors.

23. A printed circuit board comprising:

- a printed circuit board body defining a front surface that is configured to be inserted into a receptacle of a complementary electrical connector along a mating direction, the printed circuit board body further defining a rear surface opposite the front surface along the mating direction, and a midline disposed equidistantly between the rear surface and the front surface;

- a plurality of signal conductors supported by the printed circuit board body;

- a plurality of ground conductors supported by the printed circuit board body at a location between adjacent ones of the signal conductors along a row direction, each of the plurality of ground conductors and signal conductors configured to mate with respective complementary electrical ground contacts and electrical signal contacts of the complementary electrical connector; and

- a ground coupling member that is in electrical contact with at least two of the ground conductors that are spaced from each other along a row direction, wherein the ground coupling member contacts each of the at least two ground conductors at a location between the midline and the front surface.

24. The printed circuit board of claim 23, wherein the printed circuit board body defines an upper surface and a lower surface that are spaced from each other along a direction perpendicular to the mating direction, wherein each of the upper surface and the lower surface each extends along the mating direction and the row direction, and each of the front and rear surfaces extends between the upper and lower surfaces.

25. The printed circuit board of claim 24, wherein each of the front and rear surfaces extends along the row direction.

CLAIMS

1. A printed circuit board comprising:

an electrically non-conductive substrate body defining a front end configured to be inserted into a receptacle of a complementary electrical connector along a mating direction, an upper surface and a lower surface spaced from the upper surface along a transverse direction, perpendicular to the mating direction;

a plurality of signal conductors supported by the substrate body and elongated along the mating direction;

a plurality of ground conductors elongated along the mating direction and supported by the substrate body, at least one of the plurality of ground conductors disposed at a location between adjacent ones of the signal conductors, each of the plurality of ground conductors and signal conductors supported at one of the upper surface and the lower surface and configured to mate with respective complementary electrical ground contacts and electrical signal contacts of the complementary electrical connector; and

an electrically conductive trace that is supported at the front end at the one of the upper surface and the lower surface of the substrate body, is elongate along a direction angled with respect to the mating direction and the transverse direction, and is in contact with at least two of the ground conductors at the one of the upper surface and the lower surface so as to electrically connect at least two of the ground conductors to each other; and

a second electrically conductive trace that is spaced from the first electrically conductive trace along the transverse direction, that is supported at the front end at the other of the upper surface and the lower surface, and that is in electrical communication with the first electrically conductive trace,

wherein the printed circuit board is a substrate that includes the electrically non-conductive substrate body, the plurality of signal conductors, the plurality of ground conductors, and the electrically conductive trace.

2. The printed circuit board of claim 1, wherein the printed circuit board defines a front surface and a rear surface spaced from the front surface in a direction opposite the mating direction, the

printed circuit board further defines a midline that is equidistant between the front surface and the rear surface, and the electrically conductive trace and the second electrically conductive trace are supported at a location between the midline and the front surface.

3. The printed circuit board of claim 2, wherein the electrically conductive trace is elongate along a third direction that is perpendicular to both the mating direction and the transverse direction.

4. The printed circuit board of claim 2, further comprising a via and an electrically conductive ground mass located inside the via, the via and conductive ground mass extending between the first electrically conductive trace and the second electrically conductive trace.

5. The printed circuit board of claim 4, wherein the vias are spaced a center-to-center distance along a row direction that is equal to that of the distance between adjacent signal conductors and ground conductors along the row direction.

6. The printed circuit board of claim 1, wherein the electrically conductive trace is elongate along a direction that is perpendicular to the mating direction.

7. The printed circuit board of claim 1, wherein each of the upper surface and the lower surface extends along the mating direction and a row direction perpendicular to the mating direction and the transverse direction, and the ground conductors and signal conductors are spaced from each other along the row direction.

8. The printed circuit board of claim 7, wherein the electrically conductive trace is supported at the upper surface.

9. The printed circuit board of claim 7, wherein the electrically conductive trace is supported at the lower surface.

10. The printed circuit board of claim 7, comprising a third electrically conductive trace that is embedded between the upper surface and the lower surface.

11. The printed circuit board of claim 1, wherein the electrically conductive trace is in electrical communication with all of the ground conductors.

12. The printed circuit board of claim 1, wherein the electrically conductive trace and the ground conductors are integral and monolithic with each other.

13. The printed circuit board of claim 1, wherein adjacent signal conductors define differential signal pairs, and the least two of the ground conductors are each disposed between adjacent differential signal pairs.

14. A printed circuit board comprising:

an electrically non-conductive substrate body defining a front surface that is configured to be inserted into a receptacle of a complementary electrical connector along a mating direction, the substrate body further defining a rear surface opposite the front surface along the mating direction, and first and second surfaces that extend between the front and rear surfaces, the second surface spaced from the first surface along a transverse direction that is perpendicular to the mating direction;

a plurality of signal conductors, each supported at one of the first and second surfaces of the substrate body;

a plurality of ground conductors, each supported at one of the first and second surfaces of the substrate body, wherein at least one of the plurality of ground conductors is supported at the first surface at a location between adjacent ones of the signal conductors supported at the first surface, at least one of the plurality of ground conductors is supported at the second surface at a location between adjacent ones of the signal conductors supported at the second surface, and each of the plurality of ground conductors and signal conductors are configured to mate with respective complementary electrical ground contacts and electrical signal contacts of the complementary electrical connector; and

a ground coupling assembly including first and second electrically conductive ground commoning members that is supported at the first and second surfaces of the substrate body, respectively, wherein each of the first and second electrically conductive ground commoning members is in contact with at least two of the ground conductors at a location that is 1) forward

of the signal conductors along a direction from the rear surface toward the front surface, and 2) disposed between the front and rear surfaces of the substrate body,

wherein the printed circuit board is a substrate that includes the electrically non-conductive substrate body, the plurality of signal conductors, the plurality of ground conductors, and the ground coupling assembly.

15. The printed circuit board of claim 14, wherein each of the first surface and the second surface extends along the mating direction and a row direction, the ground conductors and signal conductors are spaced from each other along the row direction, and each of the front and rear surfaces extends between the first and second surfaces.

16. The printed circuit board of claim 15, wherein each of the front and rear surfaces extends along the row direction.

17. The printed circuit board of claim 14, wherein the second electrically conductive ground commoning member is in electrical communication with the first electrically conductive ground commoning member.

18. The printed circuit board of claim 17, wherein the ground coupling assembly further comprises a via and a conductive ground mass located inside the via, the via and the conductive ground mass extending between the first electrically conductive ground coupling member and the second electrically conductive ground coupling member along the transverse direction.

19. The printed circuit board of claim 14, further comprising a via and a conductive ground mass located inside the via, the via and the conductive ground mass extending along a direction between the first and second surfaces, the via and the conductive ground mass being in electrical communication with the ground conductors.

20. The printed circuit board of claim 19, further comprising an electrically conductive trace that contacts both the electrically conductive ground mass and at least two ground conductors.

21. A printed circuit board comprising:

an electrically non-conductive substrate body defining a front surface that is configured to be inserted into a receptacle of a complementary electrical connector along a mating direction, the substrate body further defining a rear surface opposite the front surface along the mating direction, first and second surfaces that extend between the front and rear surfaces, the second surface spaced from the first surface along a transverse direction that is perpendicular to the mating direction, and a midline disposed equidistantly between the rear surface and the front surface;

a plurality of signal conductors, each supported at one of the first and second surfaces the substrate body;

a plurality of ground conductors, each supported at one of the first and second surfaces of the substrate body at a location between adjacent ones of the signal conductors along a row direction, each of the plurality of ground conductors and signal conductors configured to mate with respective complementary electrical ground contacts and electrical signal contacts of the complementary electrical connector;

a ground coupling member that is supported at the first surface of the substrate body and is in electrical contact with at least two of the ground conductors that are spaced from each other along a row direction at the first surface, wherein the ground coupling member contacts each of the at least two ground conductors at the first surface at a location between the midline and the front surface; and

a second ground coupling member that is supported at the second surface of the substrate body and is in electrical contact with at least two of the ground conductors that are spaced from each other along a row direction at the second surface, wherein the ground coupling member contacts each of the at least two ground conductors at the second surface at a location between the midline and the front surface,

wherein the printed circuit board is a substrate that includes the electrically non-conductive substrate body, the plurality of signal conductors, the plurality of ground conductors, and the ground coupling member.

22. The printed circuit board of claim 21, wherein of the first surface and the second surface extends along the mating direction and the row direction, and each of the front and rear surfaces extends between the first and second surfaces.

23. The printed circuit board of claim 22, wherein each of the front and rear surfaces extends along the row direction.

24. The printed circuit board of claim 1, wherein the substrate terminates within a perimeter of the electrically non-conductive substrate body.

25. The printed circuit board of claim 14, wherein the substrate terminates within a perimeter of the electrically non-conductive substrate body.

26. The printed circuit board of claim 21, wherein the substrate terminates within a perimeter of the electrically non-conductive substrate body.

27. The printed circuit board of claim 1, further comprising:

a second plurality of signal conductors elongated along the mating direction and supported by the other of the upper surface and the lower surface of the substrate body; and

a second plurality of ground conductors elongated along the mating direction and supported by the other of the upper surface and the lower surface of the substrate body, at least one of the second plurality of ground conductors disposed at a location between adjacent ones of the signal conductors,

wherein the second electrically conductive trace is in contact with at least two of the ground conductors of the second plurality of ground conductors at the other of the upper surface and the lower surface so as to electrically connect the at least two of the ground conductors of the second plurality of ground conductors to each other.

28. The printed circuit board of claim 27, further comprising a plurality of conductive vias extending between the upper and lower surfaces along the transverse direction, the plurality of conductive vias in contact with the electrically conductive trace and the second electrically

conductive trace so as to electrically connect the electrically conductive trace to the second electrically conductive trace.

29. An electrical connector comprising a printed circuit board configured to mate with an electrical receptacle connector, the printed circuit board comprising:

- an electrically non-conductive substrate body defining a front surface configured to be inserted into the receptacle connector along a mating direction;

- a plurality of signal conductors supported by the substrate body and elongated along the mating direction;

- a plurality of ground conductors supported by the substrate body and elongated along the mating direction, at least one of the plurality of ground conductors disposed at a location between adjacent ones of the signal conductors, each of the plurality of ground conductors and signal conductors configured to mate with respective complementary electrical ground contacts and electrical signal contacts of the receptacle connector; and

- a conductive ground commoning member that is supported by the substrate body and is in contact with at least two of the ground conductors, the conductive ground commoning member configured such that, when the electrical connector is mated with the electrical receptacle connector and the at least two ground conductors are in contact with respective ground contacts of the receptacle connector, the conductive ground commoning member electrically shorts the ground contacts of the receptacle connector to each other, thereby shifting electrical resonance of the receptacle connector and limiting time-domain crosstalk to six percent or less at about 40 ps.