[CLAIMS]

1. A duplexer comprising:

a reception filter that is connected between a reception terminal and an antenna terminal and includes one or a plurality of series resonators that are acoustic wave resonators; and

a transmission filter that is connected between a transmission terminal and the antenna terminal and includes one or a plurality of acoustic wave resonators and that has a transmission band,

a resonance frequency of a series resonator that is one of the one or the plurality of series resonators and is closest to the antenna terminal in the reception filter being higher than an upper limit frequency of a reception band of the reception filter and that has a reception band.

2. The duplexer according to claim 1, wherein the series resonator that is one of the one or the plurality of series resonators and is closest to the antenna terminal in the reception filter is not divided into parts, and the resonance frequency of the first series resonator is equal to or higher than 102% of the upper limit frequency of the reception band.

3. The duplexer according to claim 1, wherein the series resonator that is one of the one or the plurality of series resonators and is closest to the antenna terminal in the reception filter is divided into at least two resonators connected in series with each other, and an average resonance frequency of each of the at least two resonators is higher than the upper limit frequency of the reception band.

4. The duplexer according to claim 1, wherein the series resonator that is one of the one or the plurality of series resonators and is closest to the antenna terminal in the reception filter is divided into two resonators connected in series with each other, and an average resonance frequency of each of the two resonators is higher than 100.9% of the upper limit frequency of the reception band.

5. The duplexer according to claim 1, wherein the reception filter includes the plurality of series resonators, and the resonance frequency of a series resonator that is one of the plurality of series resonators of the reception filter and is closest to the antenna terminal is the highest among the plurality of series resonators of the reception filter.

6. The duplexer according to any of claims 1 to 5, wherein the reception filter

includes the plurality of series resonators, and the resonance frequency of a series resonator that is one of the plurality of series resonators of the reception filter that is closest to the reception terminal is the lowest among the plurality of series resonators of the reception filter.

7. The duplexer according to any of claims 1 to 6, wherein the reception filter includes one or a plurality of parallel resonators that are acoustic wave resonators, and a resonance frequency of a parallel resonator that is one of the one or the plurality of parallel resonators and is closest to the antenna terminal in the reception filter and that includes a parasitic ground inductance is equal to or higher than 99.8% of an upper limit frequency of the transmission band of the transmission filter.

8. The duplexer according to claim 7, wherein the resonance frequency of the parallel resonator that is closest to the antenna terminal and includes the parasitic ground inductance is equal to or higher than the upper limit frequency of the transmission band.

9. The duplexer according to any of claims 1 to 6, wherein the reception filter includes one or a plurality of parallel resonators that are acoustic wave resonators, and a parallel resonator that is one of the one or the plurality of parallel resonators and is closest to the antenna terminal in the reception filter is divided into at least two resonators in series, a resonance frequency of at least one of the at least two resonators that does not include a parasitic ground inductance being equal to or higher than an upper limit frequency of the transmission band of the transmission filter.

10. The duplexer according to any of claims 1 to 6, wherein the reception filter includes one or a plurality of parallel resonators that are acoustic wave resonators, and a parallel resonator that is one of the one or the plurality of parallel resonators and is closest to the antenna terminal in the reception filter is divided into at least two resonators in series, an average resonance frequency of each of the at least two resonators that include a parasitic ground inductance being equal to or higher than 99.8% of an upper limit frequency of the transmission band of the transmission filter.

11. The duplexer according to claim 10, wherein the average resonance frequency of each of the at least two resonators that include the parasitic ground inductance is equal to or higher than the upper limit frequency of the transmission band of the transmission filter.

12. The duplexer according to any of claims 1 to 6, wherein the reception filter

includes a plurality of parallel resonators that are acoustic wave resonators, and one of the plurality of parallel resonators that is closest to the antenna terminal in the reception filter is not divided, a resonance frequency of the one of the plurality of parallel resonators that is closest to the antenna terminal and includes a parasitic ground inductance being the highest among the plurality of parallel resonators in the reception filter.

13. The duplexer according to any of claims 1 to 6, wherein the reception filter includes a plurality of parallel resonators that are acoustic wave resonators, and one of the plurality of parallel resonators that is closest to the antenna terminal in the reception filter is divided into at least two resonators in series, a resonance frequency of at least one of the at least two resonators in series that does not include a parasitic ground inductance being the highest among the plurality of parallel resonators in the reception filter.

14. The duplexer according to any of claims 1 to 6, wherein the reception filter includes a plurality of parallel resonators that are acoustic wave resonators, and one of the plurality of parallel resonators that is closest to the reception terminal in the reception filter is not divided, a resonance frequency of the one of the plurality of parallel resonators that is closest to the reception terminal and includes a parasitic ground inductance being the lowest among the plurality of parallel resonators in the reception filter.

15. The duplexer according to any of claims 1 to 6, wherein the reception filter includes a plurality of parallel resonators that are acoustic wave resonators, and one of the plurality of parallel resonators that is closest to the reception terminal in the reception filter is divided into at least two resonators in series, a resonance frequency of at least one of the at least two resonators in series that does not include a parasitic ground inductance being the lowest among the plurality of parallel resonators in the reception filter.

16. The duplexer according to any of claims 1 to 15, wherein the transmission filter includes one or a plurality of series resonators that are acoustic wave resonators, and a series resonator that is one of the one or the plurality of series resonators and is closest to the antenna terminal is not divided, and an anti-resonance frequency of the series resonator that is closest to the antenna terminal being equal to or higher than 100.1% of a lower limit frequency of the reception band and being equal to or lower than 100.4% thereof.

17. The duplexer according to any of claims 1 to 15, wherein the transmission filter includes one or a plurality of series resonators that are acoustic wave resonators, and a series resonator that is one of the one or the plurality of series resonators and is closest to

the antenna terminal is not divided, and an anti-resonance frequency of the series resonator that is closest to the antenna terminal not being the highest among the plurality of series resonators.

18. The duplexer according to any of claims 1 to 15, wherein the transmission filter includes one or a plurality of series resonators that are acoustic wave resonators, and a series resonator that is one of the one or the plurality of series resonators and is closest to the antenna terminal is not divided, and an anti-resonance frequency of the series resonator that is closest to the antenna terminal not being lowest among the plurality of series resonators.

19. The duplexer according to any of claims 1 to 15, wherein the transmission filter includes one or a plurality of series resonators that are acoustic wave resonators, and a series resonator that is one of the one or the plurality of series resonators and is closest to the antenna terminal is divided into at least two resonators in series, and an anti-resonance frequency of at least one of the at least two resonators in series being equal to or higher than 100.1% of a lower limit frequency of the reception band and being equal to or lower than 100.4% thereof.

20. The duplexer according to any of claims 1 to 15, wherein the transmission filter includes a plurality of series resonators that are acoustic wave resonators, and a series resonator that is one of the plurality of series resonators and is closest to the antenna terminal is divided into at least two resonators in series, and an anti-resonance frequency of at least one of the at least two resonators in series not being the highest among the plurality of series resonators.

21. The duplexer according to any of claims 1 to 15, wherein the transmission filter includes a plurality of series resonators that are acoustic wave resonators, and a series resonator that is one of the plurality of series resonators and is closest to the antenna terminal is divided into at least two resonators in series, and an anti-resonance frequency of at least one of the at least two resonators in series not being the lowest among the plurality of series resonators.

22. The duplexer according to any of claims 1 to 15, wherein the transmission filter includes a plurality of series resonators that are acoustic wave resonators, and a series resonator that is one of the plurality of series resonators and is closest to the antenna terminal is not divided. and an anti-resonance frequency of the series resonator closest to the

antenna terminal being the lowest among the plurality of series resonators.

23. The duplexer according to any of claims 1 to 15, wherein the transmission filter includes a plurality of series resonators that are acoustic wave resonators, and a series resonator that is one of the plurality of series resonators and is closest to the antenna terminal is divided into at least two resonators in series, and an anti-resonance frequency of at least one of the at least two resonators in series being the lowest among the plurality of series resonators.

24. The duplexer according to any of claims 1 to 15, wherein the transmission filter includes a plurality of series resonators that are acoustic wave resonators, and a series resonator that is one of the plurality of series resonators and is closest to the antenna terminal is not divided, and an anti-resonance frequency of the series resonator closet to the antenna terminal being in the reception band of the reception filter.

25. The duplexer according to any of claims 1 to 15, wherein the transmission filter includes a plurality of series resonators that are acoustic wave resonators, and a series resonator that is one of the plurality of series resonators and is closest to the antenna terminal is divided into at least two resonators in series, and an anti-resonance frequency of at least one of the at least two resonators in series being in the reception band of the reception filter.

26. The duplexer according to any of claims 1 to 25, wherein the transmission filter includes a plurality of series resonators that are acoustic wave resonators, and a second series resonator that is one of the plurality of series resonators and is next to a series resonator that is another one of the plurality of series resonators and is closest to the antenna terminal is not divided, and an anti-resonance frequency of the second series resonator is equal to or lower than 102.1% of a lower limit frequency of the reception band.

27. The duplexer according to any of claims 1 to 25, wherein the transmission filter includes a plurality of series resonators that are acoustic wave resonators, and a second series resonator that is one of the plurality of series resonators and is next to a series resonator that is another one of the plurality of series resonators and is closest to the antenna terminal is divided into at least two resonators in series, and an anti-resonance frequency of at least one of the at least two resonators in series is equal to or lower than 102.1% of a lower limit frequency of the reception band.

28. The duplexer according to any of claims 1 to 27, wherein at least one of the reception filter and the transmission filter includes a multimode acoustic wave filter.

29. The duplexer according to claim 28, wherein the multimode acoustic wave filter is divided into at least two filters in series.

30. The duplexer according to any of claims 1 to 29, wherein the reception band is 1930 MHz to 1990 MHz and the transmission band is 1850 MHz to 1910 MHz.

CLAIMS

What is claimed is:

1. A duplexer comprising:

a reception filter that is connected between a reception terminal and an antenna terminal and includes one or a plurality of series resonators that are acoustic wave resonators; and

a transmission filter that is connected between a transmission terminal and the antenna terminal and includes one or a plurality of acoustic wave resonators,

a resonance frequency of a first series resonator that is one of the one or the plurality of series resonators and is closest to the antenna terminal in the reception filter being higher than an upper limit frequency of a reception band of the reception filter.

2. The duplexer according to claim 1, wherein the first series resonator closest to the antenna terminal in the reception filter is not divided into parts, and the resonance frequency of the first series resonator is equal to or higher than 102% of the upper limit frequency of the reception band.

3. The duplexer according to claim 1, wherein the first series resonator closest to the antenna terminal in the reception filter is divided into at least two resonators connected in series with each other, and an average resonance frequency of the at least two resonators is higher than the upper limit frequency of the reception band.

4. The duplexer according to claim 1, wherein the first series resonator closest to the

antenna terminal in the reception filter is divided into two resonators connected in series with each other, and an average resonance frequency of the two resonators is higher than 100.9% of the upper limit frequency of the reception band.

5. The duplexer according to claim 1, wherein the reception filter includes the plurality of series resonators, and the resonance frequency of the first series resonator that is one of the plurality of series resonators of the reception filter is the highest among the plurality of series resonators of the reception filter.

6. The duplexer according to claim 1, wherein the reception filter includes the plurality of series resonators, and the resonance frequency of one of the plurality of series resonators of the reception filter closest to the reception terminal is the lowest among the plurality of series resonators of the reception filter.

7. A duplexer comprising:

a reception filter that is connected between a reception terminal and an antenna terminal and includes one or a plurality of series resonators that are acoustic wave resonators; and

a transmission filter that is connected between a transmission terminal and the antenna terminal and includes one or a plurality of acoustic wave resonators,

a first series resonator that is one of the one or the plurality of series resonators and is closest to the antenna terminal in the reception filter being divided into at least three resonators in series, and an average resonance frequency of the at least three resonators being in a reception band of the reception filter.

8. The duplexer according to any of claims 1 to 7, wherein the reception filter includes one or a plurality of parallel resonators that are acoustic wave resonators, and a resonance frequency of a first parallel resonator that is one of the one or the plurality of parallel resonators and is closest to the antenna terminal in the reception filter and that includes a parasitic ground inductance is equal to higher than 99.8% of an upper limit frequency of a transmission band of the transmission filter.

9. The duplexer according to claim 8, wherein the resonance frequency of the first parallel resonator that is closest to the antenna terminal and includes the parasitic ground inductance is equal to or higher than the upper limit frequency of the transmission band.

10. The duplexer according to any of claims 1 to 7, wherein the reception filter includes one or a plurality of parallel resonators that are acoustic wave resonators, and a first parallel resonator that is one of the one or the plurality of parallel resonators and is closest to the antenna terminal in the reception filter is divided into at least two resonators in series, a resonance frequency of at least one of the at least two resonators that does not include a parasitic ground inductance being equal to or higher than an upper limit frequency of a transmission band of the transmission filter.

11. The duplexer according to any of claims 1 to 7, wherein the reception filter includes one or a plurality of parallel resonators that are acoustic wave resonators, and a first parallel resonator that is one of the one or the plurality of parallel resonators and is closest to the

antenna terminal in the reception filter is divided into at least two resonators in series, an average resonance frequency of the at least two resonators that include a parasitic ground inductance being equal to or higher than 99.8% of an upper limit frequency of a transmission band of the transmission filter.

12. The duplexer according to claim 11, wherein the average resonance frequency of the at least two resonators that include the parasitic ground inductance is equal to or higher than the upper limit frequency of the transmission band of the transmission filter.

13. The duplexer according to any of claims 1 to 7, wherein the reception filter includes a plurality of parallel resonators that are acoustic wave resonators, and one of the plurality of parallel resonators that is closest to the antenna terminal in the reception filter is not divided, a resonance frequency of the one of the plurality of parallel resonators that is closest to the antenna terminal and includes a parasitic ground inductance being the highest among the plurality of parallel resonators in the reception filter.

14. The duplexer according to any of claims 1 to 7, wherein the reception filter includes a plurality of parallel resonators that are acoustic wave resonators, and one of the plurality of parallel resonators that is closest to the antenna terminal in the reception filter is divided into at least two resonators in series, a resonance frequency of at least one of the at least two resonators in series that does not include a parasitic ground inductance being the highest among the plurality of parallel resonators in the reception filter.

15. The duplexer according to any of claims 1 to 7, wherein the reception filter includes a plurality of parallel resonators that are acoustic wave resonators, and one of the plurality of parallel resonators that is closest to the reception terminal in the reception filter is not divided, a resonance frequency of the one of the plurality of parallel resonators that is closest to the reception terminal and includes a parasitic ground inductance being the lowest among the plurality of parallel resonators in the reception filter.

16. The duplexer according to any of claims 1 to 7, wherein the reception filter includes a plurality of parallel resonators that are acoustic wave resonators, and one of the plurality of parallel resonators that is closest to the reception terminal in the reception filter is divided into at least two resonators in series, a resonance frequency of at least one of the at least two resonators in series that does not include a parasitic ground inductance being the lowest among the plurality of parallel resonators in the reception filter.

17. The duplexer according to any of claims 1 to 7, wherein the transmission filter includes one or a plurality of series resonators, and a first series resonator that is one of the one or the plurality of series resonators and is closest to the antenna terminal is not divided, and an anti-resonance frequency of the first series resonator being equal to or higher than 100.1% of a lower limit frequency of the reception band and being equal to or lower than 100.4% thereof.

18. The duplexer according to any of claims 1 to 7, wherein the transmission filter includes one or a plurality of series resonators, and a first series resonator that is one of the one or the plurality of series resonators and is closest to the antenna terminal is not divided, and an

anti-resonance frequency of the first series resonator being not the highest among the plurality of series resonators.

19. The duplexer according to any of claims 1 to 7, wherein the transmission filter includes one or a plurality of series resonators, and a first series resonator that is one of the one or the plurality of series resonators and is closest to the antenna terminal is not divided, and an anti-resonance frequency of the first series resonator being not the lowest among the plurality of series resonators.

20. The duplexer according to any of claims 1 to 7, wherein the transmission filter includes one or a plurality of series resonators, and a first series resonator that is one of the one or the plurality of series resonators and is closest to the antenna terminal is divided into at least two resonators in series, and an anti-resonance frequency of at least one of the at least two resonators in series being equal to or higher than 100.1% of a lower limit frequency of the reception band and being equal to or lower than 100.4% thereof.

21. The duplexer according to any of claims 1 to 7, wherein the transmission filter includes a plurality of series resonators, and a first series resonator that is one of the plurality of series resonators and is closest to the antenna terminal is divided into at least two resonators in series, and an anti-resonance frequency of at least one of the at least two resonators in series being not the highest among the plurality of series resonators.

22. The duplexer according to any of claims 1 to 7, wherein the transmission filter

includes a plurality of series resonators, and a first series resonator that is one of the plurality of series resonators and is closest to the antenna terminal is divided into at least two resonators in series, and an anti-resonance frequency of at least one of the at least two resonators in series being not the lowest among the plurality of series resonators.

23. The duplexer according to any of claims 1 to 7, wherein the transmission filter includes a plurality of series resonators, and a first series resonator that is one of the plurality of series resonators and is closest to the antenna terminal is not divided, and an anti-resonance frequency of the first series resonator being the lowest among the plurality of series resonators.

24. The duplexer according to any of claims 1 to 7, wherein the transmission filter includes a plurality of series resonators, and a first series resonator that is one of the plurality of series resonators and is closest to the antenna terminal is divided into at least two resonators in series, and an anti-resonance frequency of at least one of the at least two resonators in series being the lowest among the plurality of series resonators.

25. The duplexer according to any of claims 1 to 7, wherein the transmission filter includes a plurality of series resonators, and a first series resonator that is one of the plurality of series resonators and is closest to the antenna terminal is not divided, and an anti-resonance frequency of the first series resonator being in the reception band of the reception filter.

26. The duplexer according to any of claims 1 to 7, wherein the transmission filter includes a plurality of series resonators, and a first series resonator that is one of the plurality of

series resonators and is closest to the antenna terminal is divided into at least two resonators in series, and an anti-resonance frequency of at least one of the at least two resonators in series being in the reception band of the reception filter.

27. The duplexer according to any of claims 1 to 7, wherein the transmission filter includes a plurality of series resonators, and a second series resonator that is one of the plurality of series resonators and is next to a first series resonator that is another one of the plurality of series resonators and is closest to the antenna terminal is not divided, and an anti-resonance frequency of the second series resonator is equal to or lower than 102.1% of a lower limit frequency of the reception band.

28. The duplexer according to any of claims 1 to 7, wherein the transmission filter includes a plurality of series resonators, and a second series resonator that is one of the plurality of series resonators and is next to a first series resonator that is another one of the plurality of series resonators and is closest to the antenna terminal is divided into at least two resonators in series, and an anti-resonance frequency of at least one of the at least two resonators in series is 0equal to or lower than 102.1% of a lower limit frequency of the reception band.

29. The duplexer according to any of claims 1 to 7, wherein at least one of the reception filter and the transmission filter includes a multimode acoustic wave filter.