

CLAIMS:

1. ~~A vertically stacked array antenna structure comprising:~~
 - a radiating layer (10) comprising an array of radiating elements (11);
 - a passive layer (20) disposed under said radiating layer (10) and having only
 - 5 passive components (27, 261), wherein at least a part of said passive components includes an array of RF duplexers (27) corresponding to the array of radiating elements (11);
 - an active layer (40) disposed under said passive layer and comprising RF amplifiers (48, 49); and
 - 10 an interface assembly (50) configured for providing thermal communication of said active layer (40) with a heat exchanger (80), wherein said interface assembly (50) comprises at least one metallic frame (51 or 52) being in direct thermal coupling with said RF amplifiers (48, 49).
2. The vertically stacked array antenna structure of claim 1 mounted on a heat
- 15 exchanger (80) which thermally communicates with said interface assembly (50).
3. The vertically stacked array antenna structure of claim 1, further comprising the heat exchanger (80) thermally communicating with said interface assembly.
4. The vertically stacked array antenna structure of claim 1, wherein the radiating elements (11) are selected from patch antenna elements, strip antenna elements, stacked
- 20 patch antenna element, microstrip antenna element, horn antenna element, tapered-slot antenna element and dipole antenna element.
5. The vertically stacked array antenna structure of claim 1, wherein said radiating elements (11) are mounted on a radiating elements board (12).
6. The vertically stacked array antenna structure of claim 5, wherein said board
- 25 (12) includes a printed circuit board.
7. The vertically stacked array antenna structure of claim 1, wherein said passive layer (20) includes a board (21) on which said array of duplexers (27) is arranged.
8. The vertically stacked array antenna structure of claim 7, wherein said duplexers board (21) is a printed circuit board.
- 30 9. The vertically stacked array antenna structure of claim 1, wherein said array of duplexers (27) includes an array of RF circulators (22).

- ~~10. The vertically stacked array antenna structure of claim 1, wherein said active layer (40) comprises a plurality of RF amplifiers (48, 49).~~
11. The vertically stacked array antenna structure of claim 10, wherein said plurality of RF amplifiers (48, 49) are in direct thermal coupling with said metallic frame (51).
- 5 12. The vertically stacked array antenna structure of claim 10, wherein said plurality of RF amplifiers (48, 49) is selected from transmission RF amplifiers (48) and reception RF amplifiers (49).
13. The vertically stacked array antenna structure of claim 10, wherein said plurality of RF amplifiers (48, 49) are integrated into RF amplifier modules (44), each RF
- 10 amplifier module including at least two RF amplifiers.
14. The vertically stacked array antenna structure of claim 13, wherein at least one said RF amplifier module (44) comprises at least one transmission RF amplifier (48) and at least one corresponding reception RF amplifier (49).
15. The vertically stacked array antenna structure of claim 14, wherein at least one
- 15 said RF amplifier module (44) comprises four pairs (440) of RF amplifiers (48, 49), each pair comprises one transmission RF amplifier (48) and one reception RF amplifier (49), and corresponds to one corresponding duplexer (27).
16. The vertically stacked array antenna structure of claim 13, wherein at least one RF amplifier module (44) includes a phase shifter (47).
- 20 17. The vertically stacked array antenna structure of claim 1, wherein said interface assembly (50) includes a first frame (51) and a second frame (52), both frames disposed under said passive layer (20).
18. The vertically stacked array antenna structure of claim 17, wherein said active layer (40) is encompassed between the first frame (51) and the second frame (52).
- 25 19. The vertically stacked array antenna structure of claim 17, wherein said first frame (51) and said second frame (52) are rigid frames made of thermally conducting materials and being in direct thermal coupling with each other.
20. The vertically stacked array antenna structure of claim 19, wherein at least one frame selected from said first frame (51) and said second frame (52) has a compartment
- 30 structure comprising at least one compartment (56 or 57), each compartment defining a cavity in which said RF amplifiers (48, 49) are located substantially thereinside, said RF
- ~~amplifiers (48, 49) being in direct thermal coupling with said at least one frame.~~

21. The vertically stacked array antenna structure of claim 20, wherein said at least one frame is made from an electrically conducting material.
22. The vertically stacked array antenna structure of claim 1, further comprising an antenna frame (30) disposed under said radiating layer (10), said antenna frame (30) having holes passing through the antenna frame (30) for RF interconnections.
23. The vertically stacked array antenna structure of claim 22, wherein the antenna frame (30) is metallic.
24. The vertically stacked array antenna structure of claim 23, wherein the antenna frame (30) has a compartment structure comprising at least one compartment (36), each compartment defining a cavity in which RF duplexers (27) are located substantially thereinside.
25. The vertically stacked array antenna structure of claim 1, further comprising a distribution network (60) comprising electric connectors (85) configured to establish electric connection between said vertically stacked array antenna structure and external devices, said distribution network configured for distribution of electric signals selected from DC supply signal, control signals, transmission RF signals and Reception RF signals.
26. The vertically stacked array antenna structure of claim 25 wherein said distribution network (60) is arranged within the active layer (40).
27. The vertically stacked array antenna structure of claim 25 wherein said distribution network (60) is arranged within the interface assembly (50).
28. The vertically stacked array antenna structure of claim 25 wherein said distribution network (60) is arranged between the active layer (40) and the interface assembly (50).
29. The vertically stacked array antenna structure of claim 25 wherein said distribution network (60) is arranged under the interface assembly (50).
30. The vertically stacked array antenna structure of claim 25, wherein said distribution network (60) is implemented on a primary distribution board (61) arranged within said active layer (40) and on a secondary distribution board (71) arranged within the interface assembly (50).
31. The vertically stacked array antenna structure of claim 30, wherein said primary distribution board (61) comprises fuzz buttons (73) for connecting said primary distribution board (61) to said secondary distribution board (71), and said secondary

~~distribution board (71) comprises electric connectors (75, 76, 77, 78) passing through the heat exchanger (80), and configured for connecting to external devices.~~

32. The vertically stacked array antenna structure of claim 30, wherein said interface assembly (50) includes a first frame (51) and a second frame (52), each frame having
5 corresponding front side and back side; said second frame (52) features a shallow depression (54) on its back side; and wherein said secondary distribution board (71) is disposed substantially inside said shallow depression (54) of the second frame (52).

33. The vertically stacked array antenna structure of claim 17 further comprising a distribution network (60) wherein said distribution network (60) is implemented on a
10 primary distribution board (61) arranged within said active layer (40) and on a secondary distribution board (71) arranged under the second frame (52), said secondary distribution board (71) further comprises electric connectors (75, 76, 77, 78) passing through the heat exchanger (80), and configured for connecting to external devices.

34. The vertically stacked array antenna structure of claim 1 wherein said passive
15 layer (20) is interconnected directly to said radiating layer (10) by a first set of RF connectors (26).

35. The vertically stacked array antenna structure of claim 1 wherein said passive layer (20) is interconnected directly to said active layer (40) by a second set of RF connectors (28).

20 36. The vertically stacked array antenna structure of claim 34 wherein electrical communication between said radiating layer (10), said passive layer (20) and said active layer (40) includes only RF signals.

37. A method for production of a vertically stacked array antenna structure comprising:

25 providing a radiating layer (10) comprising an array of radiating elements (11);
providing a passive layer (20) consisting of passive components (27, 261),
wherein at least a part of said passive components includes an array of RF duplexers (27) corresponding to the array of radiating elements (11);
disposing said passive layer (20) under said radiating layer (10);
30 providing an active layer (40) comprising RF amplifiers (48, 49);
disposing the active layer (40) under said passive layer (20);
providing an interface assembly (50) comprising at least one metallic frame (51

~~or 52);~~

~~establishing direct thermal coupling of said metallic frame (51) with said RF
amplifiers (48, 49); and~~

~~— configuring said interface assembly for providing thermal communication of the
active layer (40) with a heat exchanger (80). —~~

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Claims

1. A vertically stacked array antenna structure comprising:
 - 5 a radiating layer (10) comprising an array of radiating elements (11);
 - a passive layer (20) disposed under said radiating layer (10) and having only passive components (27, 261) defined as components which do not include RF amplifiers (48, 49), wherein at least a part of said passive components includes an array of RF duplexers (27) corresponding to the array of radiating elements (11);
 - 10 an active layer (40) disposed under said passive layer and comprising RF amplifiers (48, 49); and
 - an interface assembly (50) configured for providing thermal communication of said active layer (40) with a heat exchanger (80), **characterized in that** said interface assembly
 - 15 (50) comprises at least one metallic frame (51,52) being in direct thermal coupling with said RF amplifiers (48, 49).
2. The vertically stacked array antenna structure of claim 1, further comprising the
- 20 heat exchanger (80) thermally communicating with said interface assembly.
3. The vertically stacked array antenna structure of claim 1, wherein said RF amplifiers (48, 49) are in direct thermal coupling with said metallic frame (51).
- 25 4. The vertically stacked array antenna structure of claim 1, wherein said RF amplifiers (48, 49) are integrated into RF amplifier modules (44), each RF amplifier module including at least two RF amplifiers.
5. The vertically stacked array antenna structure of claim 1, wherein said interface
- 30 assembly (50) includes a first frame (51) and a second frame (52), and both frames (51 and 52) are disposed under said passive layer (20), and wherein said active layer (40) is encompassed between the first frame (51) and the second frame (52).

6. The vertically stacked array antenna structure of claim 5, wherein said first frame (51) and said second frame (52) are rigid frames made of thermally conducting materials and being in direct thermal coupling with each other.

7. The vertically stacked array antenna structure of claim 6, wherein at least one frame selected from said first frame (51) and said second frame (52) has a compartment structure comprising at least one compartment (56 or 57), each compartment defining a cavity in which said RF amplifiers (48, 49) are located substantially thereinside, said RF amplifiers (48, 49) being in direct thermal coupling with said at least one frame.

8. The vertically stacked array antenna structure of claim 1, further comprising an antenna frame (30) disposed under said radiating layer (10), said antenna frame (30) having holes passing through the antenna frame (30) for RF interconnections.

9. The vertically stacked array antenna structure of claim 8, wherein the antenna frame (30) has a compartment structure comprising at least one compartment (36), each compartment defining a cavity in which RF duplexers (27) are located substantially thereinside.

10. The vertically stacked array antenna structure of claim 1, further comprising a distribution network (60) comprising electric connectors (85) configured to establish electric connection between said vertically stacked array antenna structure and external devices, said distribution network configured for distribution of electric signals selected from DC supply signal, control signals, transmission RF signals and Reception RF signals.

11. The vertically stacked array antenna structure of claim 10, wherein said distribution network (60) is implemented on a primary distribution board (61) arranged within said active layer (40) and on a secondary distribution board (71) arranged within the interface assembly (50), wherein said primary distribution board (61) comprises fuz buttons (73) for connecting said primary distribution board (61) to said secondary distribution board (71), and said secondary distribution board (71) comprises electric

connectors (75, 76, 77, 78) passing through the heat exchanger (80), and configured for connecting to external devices.

12. The vertically stacked array antenna structure of claim 5, further comprising a distribution network (60) wherein said distribution network (60) is implemented on a primary distribution board (61) arranged within said active layer (40) and on a secondary distribution board (71) arranged under the second frame (52), said secondary distribution board (71) further comprises electric connectors (75, 76, 77, 78) passing through the heat exchanger (80), and configured for connecting to external devices.

13. The vertically stacked array antenna structure of claim 1 wherein said passive layer (20) is interconnected directly to the radiating layer (10) by a first set of RF connectors (26).

14. The vertically stacked array antenna structure of claim 1 wherein said passive layer (20) is interconnected directly to the active layer (40) by a second set of RF connectors (28).

15. A method for production of a vertically stacked array antenna structure, comprising:

providing a radiating layer (10) comprising an array of radiating elements (11);
 providing a passive layer (20) consisting of passive components (27, 261),
 wherein at least a part of said passive components includes an array of RF duplexers (27) corresponding to the array of radiating elements (11);

disposing said passive layer (20) under said radiating layer (10);
 providing an active layer (40) comprising RF amplifiers (48, 49);
 disposing the active layer (40) under said passive layer (20);
 providing an interface assembly (50) comprising at least one metallic frame (51,52) establishing direct thermal coupling of said metallic frame (51) with said RF amplifiers (48, 49); and

configuring said interface assembly for providing thermal communication of the active layer (40) with a heat exchanger (80).