EZRadioPRO™ Layout Design Guide

1. Introduction

The purpose of this application note is to help users design EZRadioPRO PCBs using good design practices that allow for good RF performance. The application note also helps the designer by separating TX and RX issues within this document.

2. Design Recommendations when using EZRadioPRO RF ICs

- Extensive testing has been completed using reference designs provided by Silicon Labs. It is recommended to designers to use the reference designs “as-is’” since they minimize de-tuning effects caused by parasitics generated by component placement and PCB routing.
- When layouts as shown in the reference designs cannot be followed due to PCB size and shape limitations of the final product then the layout design rules shown in this document are recommended.

2.1. Guidelines for Layout Design when using Si4431

For reference, examples shown in this section of the guide are based upon the layout of the 4431-DKDB1 testcard (separated TX and RX paths).

- The choke inductor (L1) should be placed as close to the TX pin as possible (even if this means the RX is further away).
- The parallel inductor (L6) in the RX path should be perpendicular to the choke inductor (L1) in the TX path as this will reduce TX to RX coupling.
- The TX and RX sections should be separated by a ground metal on the top layer to reduce coupling.
- The match used for the TX, should be kept to the smallest board space as is possible.

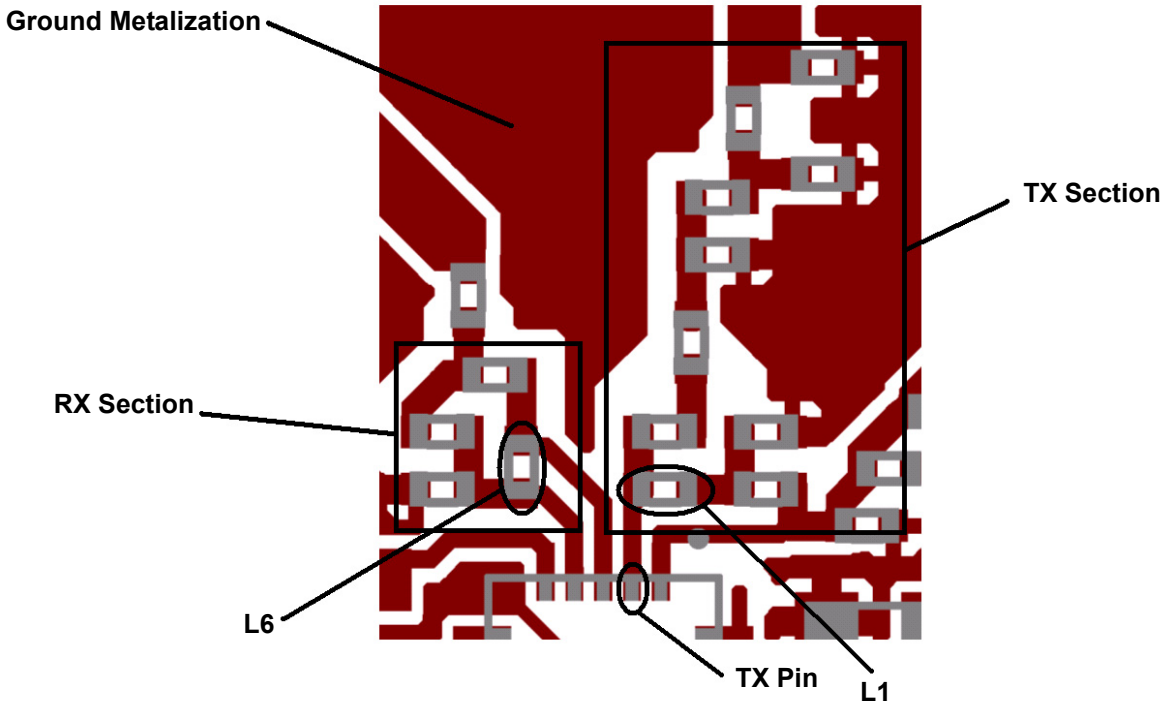


Figure 1. Si4431 Component Orientation, Placement, and GND Metalization (vias suppressed for clarity)

- Inductors close to the TX path should be kept perpendicular to each other to reduce coupling.
- Using at least 0.5 mm in separation in the matching between traces/pads to the ground metal will minimize the parasitic capacitance and reduce the detuning effects.
- Increase the grounding effect in the thermal straps used with capacitors, in addition, thicken the trace near the GND pin of these capacitors. This will minimize series parasitic inductance between the ground pouring and the GND pins. Additional vias placed close to the GND pin of capacitors connecting it to the bottom layer ground plane will further help reduce these effects.

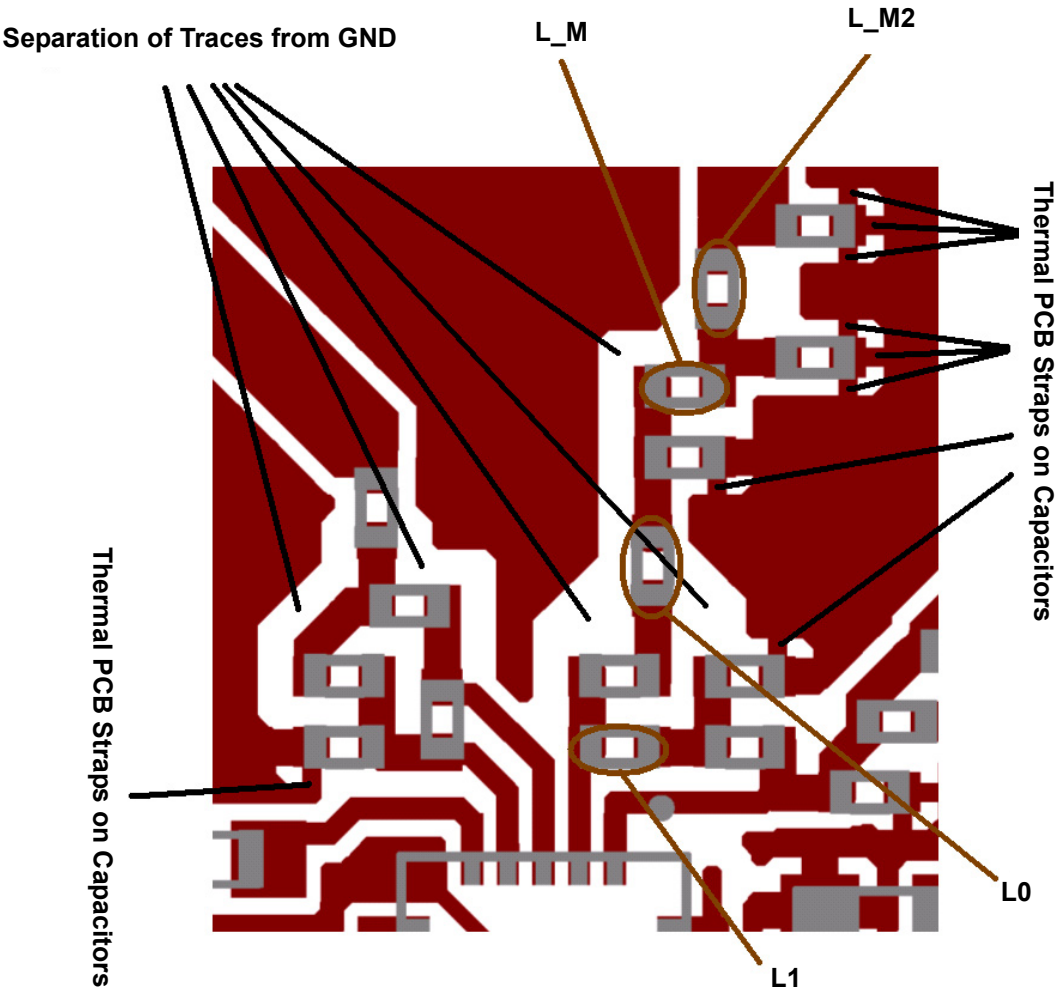


Figure 2. Thermal Strapping and Separations from GND (vias suppressed for clarity)

- The smaller V_{DD} bypass capacitors (C1 = 33 pF and C2 = 100 pF) should be kept as close to the V_{DD} pin as possible.
- The exposed pad footprint should use as many vias as is possible to ensure good grounding and heatsink capability. In the reference design there are 9 vias each 12 mil diameter.
  The ground should also connected to the top layer to further improve RF grounding.
- The crystal should be placed close to the RFIC as possible to ensure wire parasitic capacitances kept as low as possible; this will reduce any frequency offsets that may occur.
- Place ground metal between the crystal and the V_{DD} feed to avoid coupling effects.

Figure 3 demonstrates the positioning and orientation of components, ground flooding and thermal strapping.

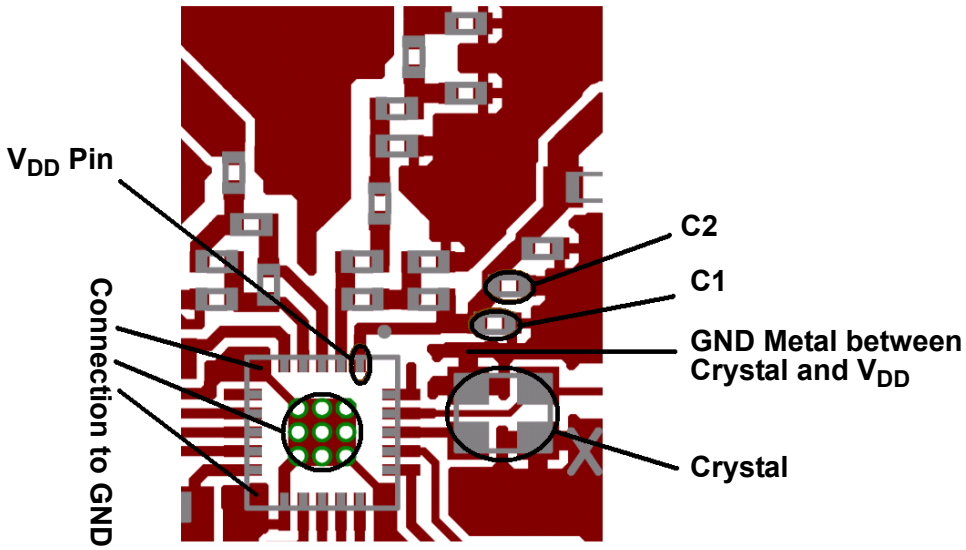


Figure 3. RFIC GND Vias and GND Metalization (vias suppressed for clarity)

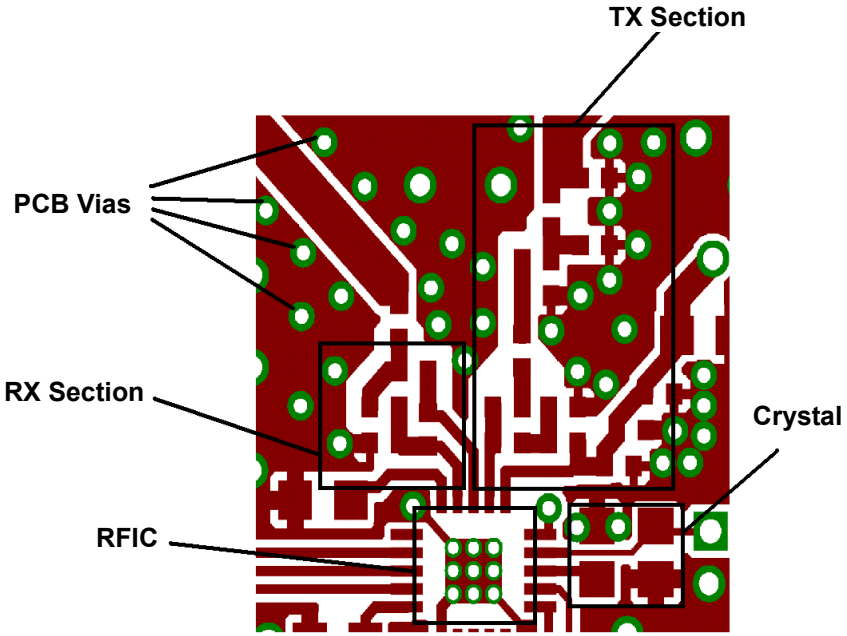


Figure 4. PCB Vias

- To achieve good RF ground on the layout it is recommended to add large ground metallization at least to the RF section. Better performance results may be obtained if this is applied to the entire PCB. To provide a good RF ground, the RF voltage potentials should be equal along the entire GND area as this helps maintain good V_{DD} filtering and also provides a good ground plane for a monopole antenna. Gaps should ideally be filled with metal and the resulted ground sections on top and the bottom layers should be connected with as many vias as possible.
- The area under the matching network (on the bottom layer) should be filled with ground metal as it will help reduce/remove radiation emissions. Board routing and wiring should not be placed in this rejoin to prevent coupling effects with the matching network. It is also recommended that the GND return path between the GND vias of the TX LPF/Match and the GND vias of the RFIC paddle should not be blocked in any way; the return currents should see a clear unhindered pathway through the GND plane to the back of the RFIC.

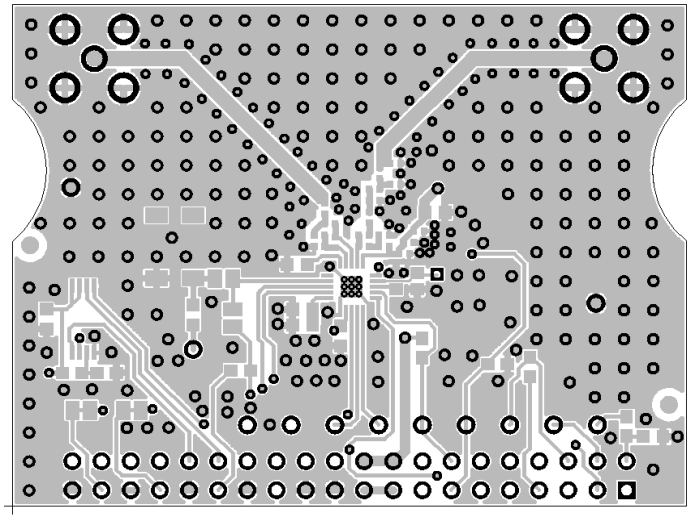


Figure 5. Ground Poured Sections with Vias to the Bottom Layer

- Use 50 Ω grounded coplanar lines where possible for connecting the matching network, the switch and/or the SMA connector(s) to reduce sensitivity to PCB thickness variation. This will also reduce radiation and coupling effects. An example based on 1.5 mm thick substrate can be seen in Table 1.

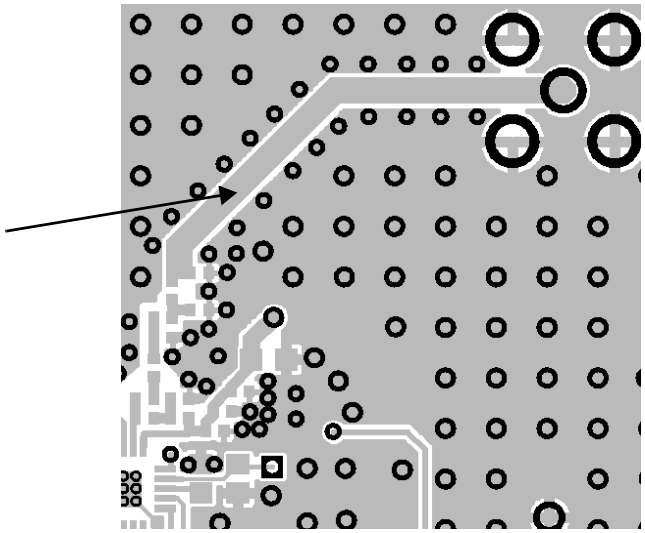


Figure 6. 50 W Grounded Coplanar Line

Table 1. Parameters for 50 W Grounded Coplanar Lines Based on 1.5 mm Thick Substrate

f	240–930 MHz
T	0.035 mm
Er	4.5
G0	.25 mm
H1	.5 mm
W1	.26 mm

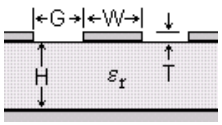


Figure 7. Grounded Coplanar Line Parameters

2.2. Guidelines for Layout Design When Using the Si4432

For the Si4432 high power PA versions similar guidelines can be applied as explained for the lower power PA, Si4431, however some small additional levels of filtering should be implemented.

For reference, examples shown in this section are based upon the layout of the 4432-DKDB2 test card (single antenna using a TX/RX switch).

- When designing with the Si4432 additional harmonic filtering is recommended. This is achieved through an additional LC resonant circuit in parallel to the TX path.
- When using a TX/RX switch or a switch to select antennas in an antenna diversity implementation, a series capacitor is required in the TX path to block the dc patch between the switch and the ground.

Figure 8 demonstrates the positioning and orientation of components, ground flooding, and thermal strapping.

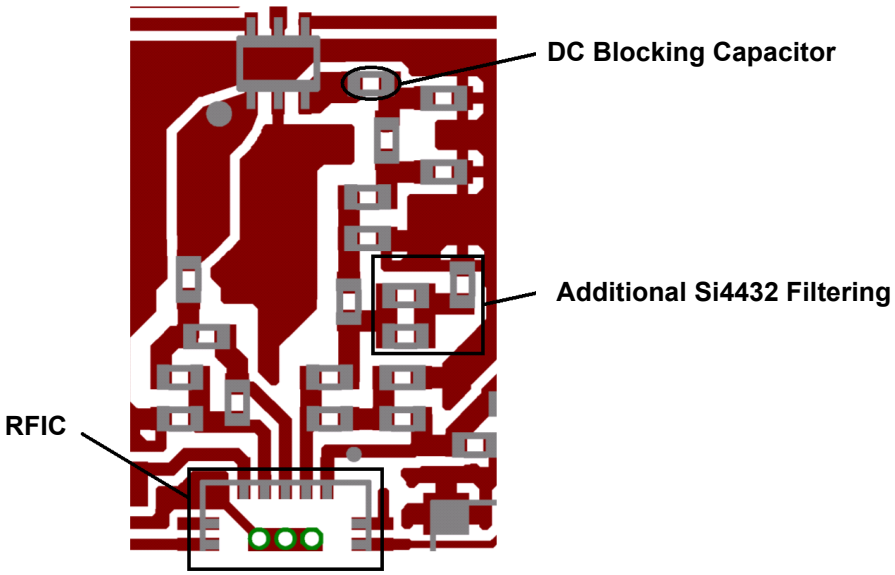


Figure 8. Additional RF Switch and Filtering for the Si4432

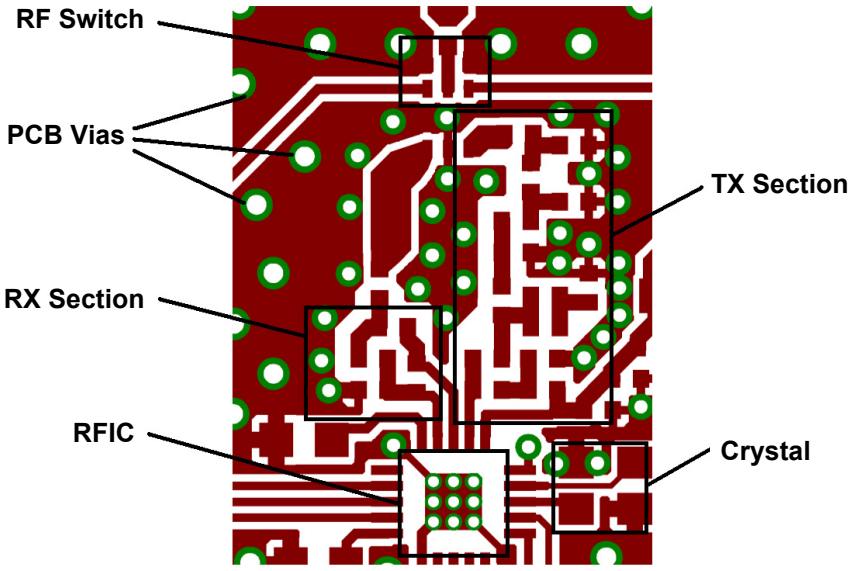


Figure 9. PCB Vias and Additional RF Switch for the Si4432

3. Reference Designs for Si4431

3.1. Split RF I/Os with Separated TX and RX Connectors

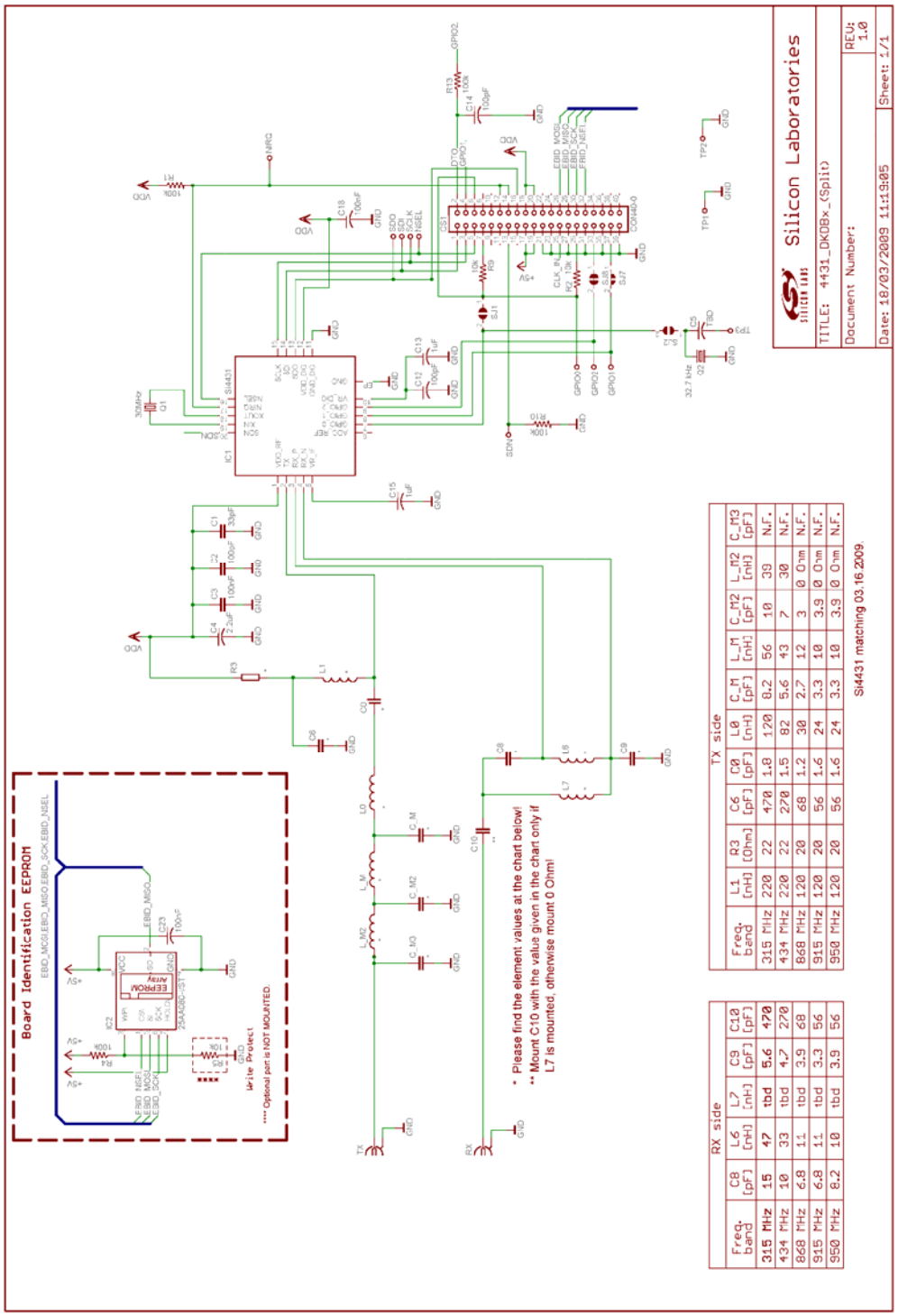


Figure 10. Si4431 Split RF I/Os with Separated TX and RX Connectors

Table 2. Si4431 Split RF I/Os Bill of Materials

Part	Value	Device	Package	Description
C0	*	Capacitor	0402	Murata GRM15 series
C1	33 pF	Capacitor	0402	Murata GRM15 series
C2	100 pF	Capacitor	0402	Murata GRM15 series
C3	100 nF	Capacitor	0402	Murata GRM15 series
C4	2.2 µF	Capacitor	0603	Murata GRM18 series
C5	N.F.	Capacitor	0603	Murata GRM18 series
C6	*	Capacitor	0402	Murata GRM15 series
C8	*	Capacitor	0402	Murata GRM15 series
C9	*	Capacitor	0402	Murata GRM15 series
C10	*	Capacitor	0402	Murata GRM15 series
C12	100 pF	Capacitor	0603	Murata GRM18 series
C13	1 µF	Capacitor	0603	Murata GRM18 series
C14	100 pF	Capacitor	0603	Murata GRM18 series
C15	1 µF	Capacitor	0603	Murata GRM18 series
C18	100 nF	Capacitor	0603	Murata GRM18 series
C23	100 nF	Capacitor	0603	Murata GRM18 series
CS1	CON40-0	CON40-0	Molex 0702474051	40-PIN male connector, 90°
C_M	*	Capacitor	0402	Murata GRM15 series
C_M2	*	Capacitor	0402	Murata GRM15 series
C_M3	*	Capacitor	0402	Murata GRM15 series
IC1	Si4431	Si4431 Rev A0	QFN-20	Radio IC
IC2	25AA080-I/ST	25AA080ST	TSSOP8	Serial EEPROM
L0	*	Inductor	0402	Coilcraft 0402HP series
L1	*	Inductor	0402	Coilcraft 0402HP series
L6	*	Inductor	0402	Coilcraft 0402HP series
L7	*	Inductor	0402	Coilcraft 0402HP series
L_M	*	Inductor	0402	Coilcraft 0402HP series
L_M2	*	Inductor	0402	Coilcraft 0402HP series
Q1	30 MHz	Crystal	4 pin	TST TZ1430A
Q2	32.7 kHz	Crystal	SMQ32SL	SMQ32SL
R1	100k	Resistor	0603	Resistor
R2	10k	Resistor	0603	Resistor
R3	*	Resistor	0402	Resistor
R4	100k	Resistor	0603	Resistor
R5	N.F.	Resistor	0603	Resistor
R9	10k	Resistor	0603	Resistor
R10	100k	Resistor	0603	Resistor
R13	100k	Resistor	0603	Resistor
RX	Horizontal	SMA connector	BU-SMA-H	90° bent, female SMA connector
TX	Horizontal	SMA connector	BU-SMA-H	90° bent, female SMA connector
***Note:** For exact values please find the schematic's table with the appropriate matching network values.				

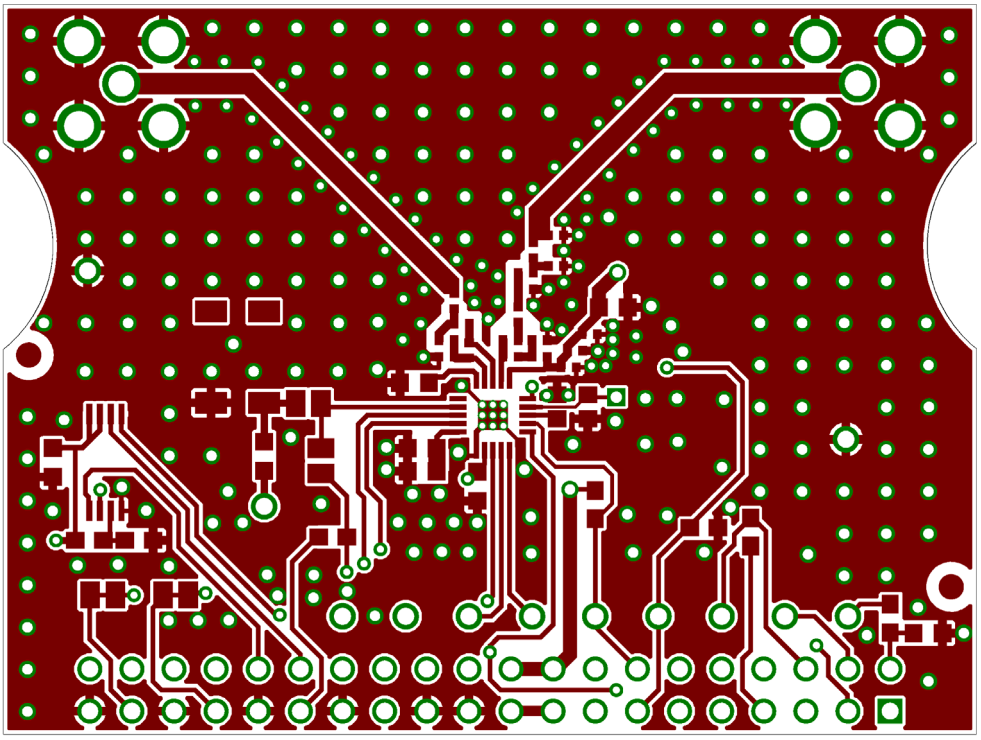


Figure 11. Si4431 Split RF I/Os with Separated TX and RX Connectors—Top

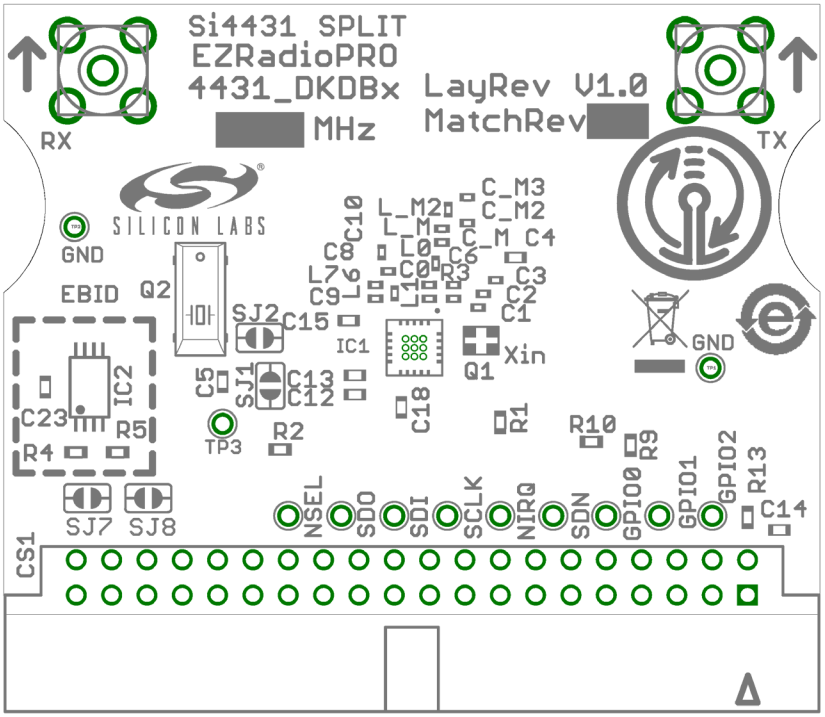


Figure 12. Si4431 Split RF I/Os with Separated TX and RX Connectors—Top Silkscreen

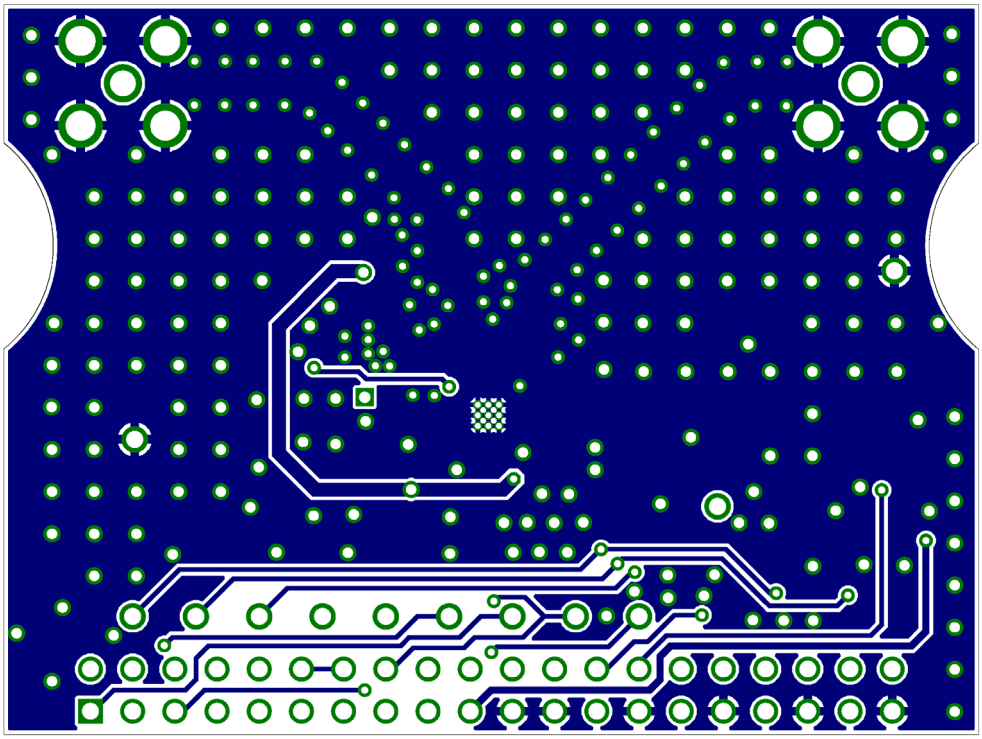


Figure 13. Si4431 Split RF I/Os with Separated TX and RX Connectors—Bottom

3.2. Common TX/RX Connector with RF Switch

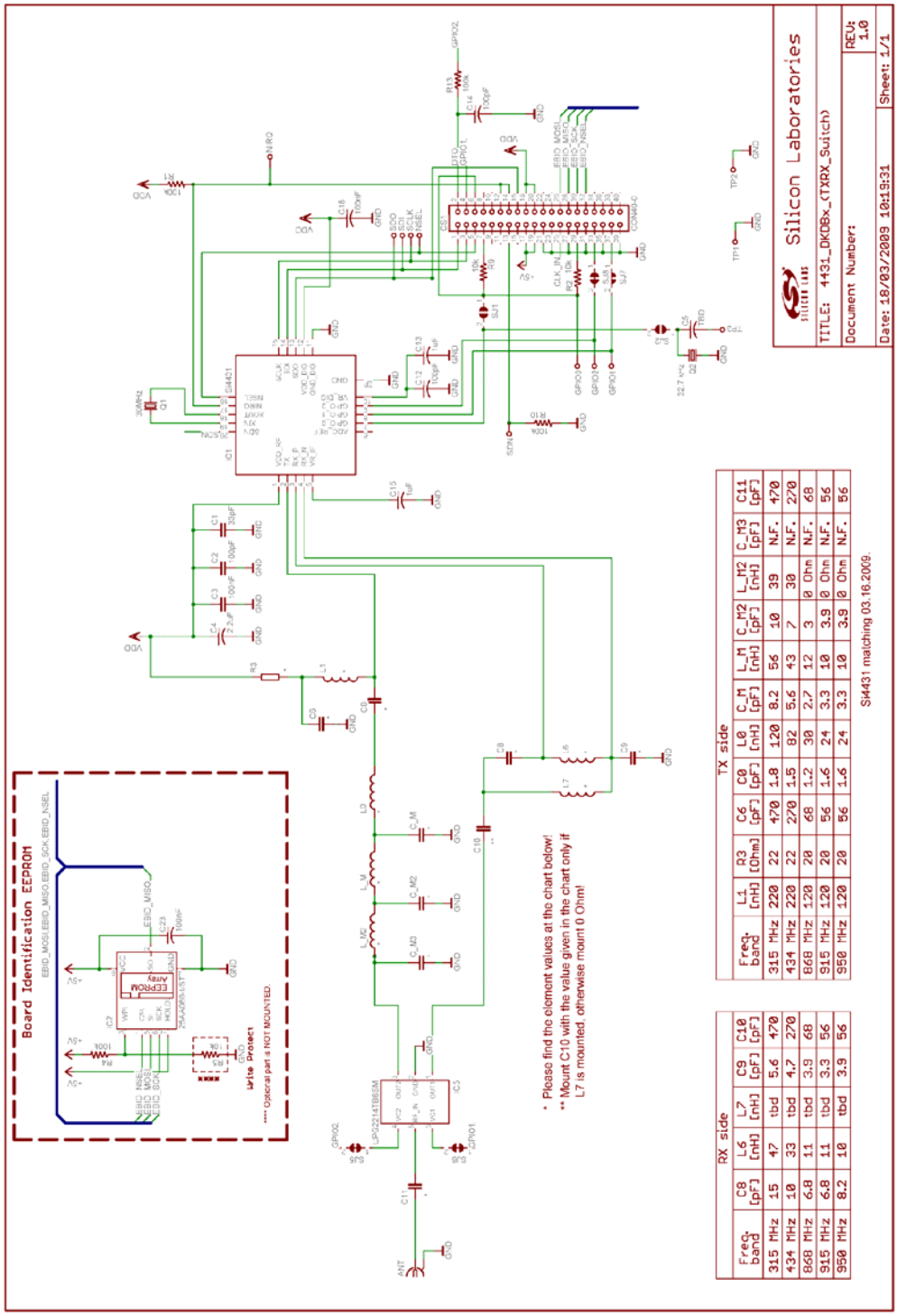


Figure 14. Si4431 Common TX/RX Connector with RF Switch

Table 3. Si4431 Common TX/RX Connector Bill of Materials

Part	Value	Device	Package	Description
ANT	Horizontal	SMA connector	BU-SMA-H	90° bent, female SMA connector
C0	*	Capacitor	0402	Murata GRM15 series
C1	33 pF	Capacitor	0402	Murata GRM15 series
C2	100 pF	Capacitor	0402	Murata GRM15 series
C3	100 nF	Capacitor	0402	Murata GRM15 series
C4	2.2 µF	Capacitor	0603	Murata GRM18 series
C5	N.F.	Capacitor	0603	Murata GRM18 series
C6	*	Capacitor	0402	Murata GRM15 series
C8	*	Capacitor	0402	Murata GRM15 series
C9	*	Capacitor	0402	Murata GRM15 series
C10	*	Capacitor	0402	Murata GRM15 series
C11	*	Capacitor	0402	Murata GRM15 series
C12	100 pF	Capacitor	0603	Murata GRM18 series
C13	1 µF	Capacitor	0603	Murata GRM18 series
C14	100 pF	Capacitor	0603	Murata GRM18 series
C15	1 µF	Capacitor	0603	Murata GRM18 series
C18	100 nF	Capacitor	0603	Murata GRM18 series
C23	100 nF	Capacitor	0603	Murata GRM18 series
CS1	CON40-0	CON40-0	Molex 0702474051	40-PIN male connector, 90°
C_M	*	Capacitor	0402	Murata GRM15 series
C_M2	*	Capacitor	0402	Murata GRM15 series
C_M3	*	Capacitor	0402	Murata GRM15 series
IC1	Si4431	Si4431 Rev A0	QFN-20	Radio IC
IC2	25AA080-I/ST	25AA080ST	TSSOP8	Serial EEPROM
IC5	UPG2214TB6SM	UPG2214TB6SM	6-PIN_SUPER_MINIMOLD	NEC's SPDT RF switch
L0	*	Inductor	0402	Coilcraft 0402HP series
L1	*	Inductor	0402	Coilcraft 0402HP series
L6	*	Inductor	0402	Coilcraft 0402HP series
L7	*	Inductor	0402	Coilcraft 0402HP series
L_M	*	Inductor	0402	Coilcraft 0402HP series
L_M2	*	Inductor	0402	Coilcraft 0402HP series
Q1	30 MHz	Crystal	4 pin	TST TZ1430A
Q2	32.7 kHz	Crystal	SMQ32SL	SMQ32SL
R1	100k	Resistor	0603	Resistor
R2	10k	Resistor	0603	Resistor
R3	*	Resistor	0402	Resistor
R4	100k	Resistor	0603	Resistor
R5	N.F.	Resistor	0603	Resistor
R9	10k	Resistor	0603	Resistor
R10	100k	Resistor	0603	Resistor
R13	100k	Resistor	0603	Resistor

***Note:** For exact values please find the schematic's table with the appropriate matching network values.

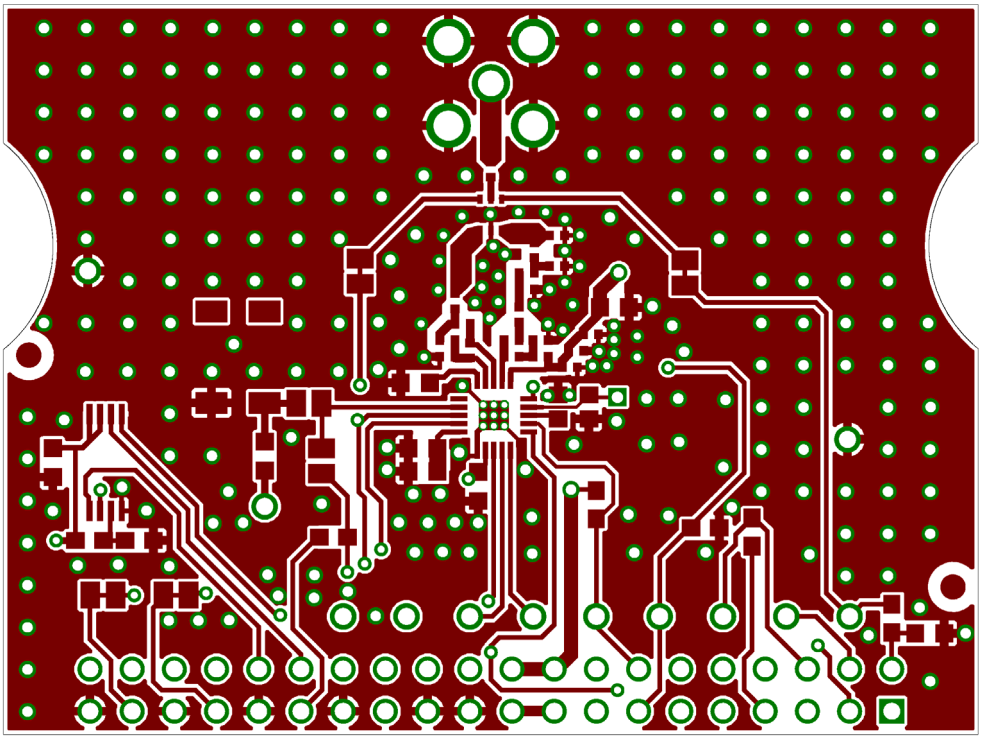


Figure 15. Si4431 Common TX/RX Connector with RF Switch—Top

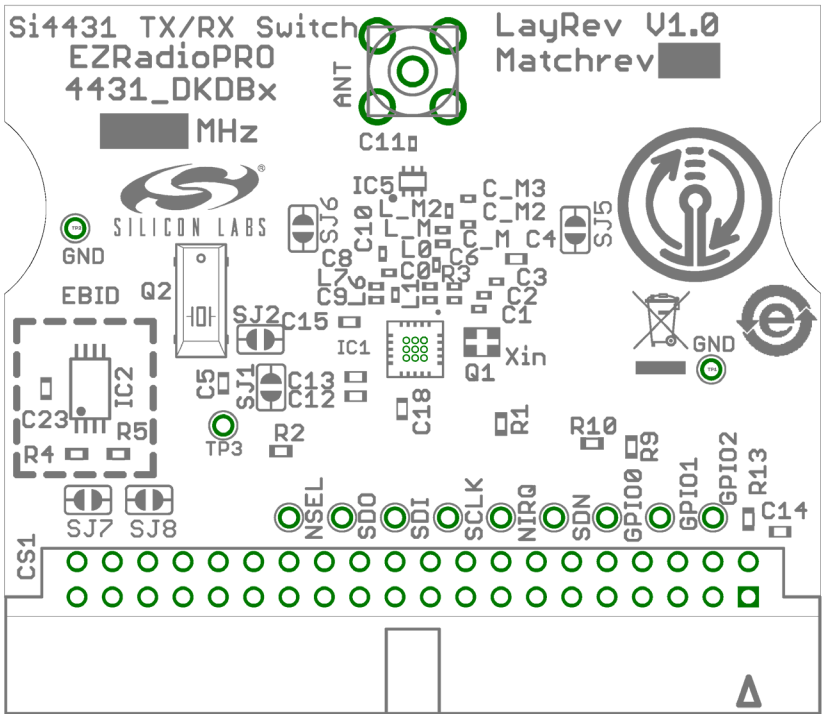


Figure 16. Si4431 Common TX/RX Connector with RF Switch—Top Silkscreen

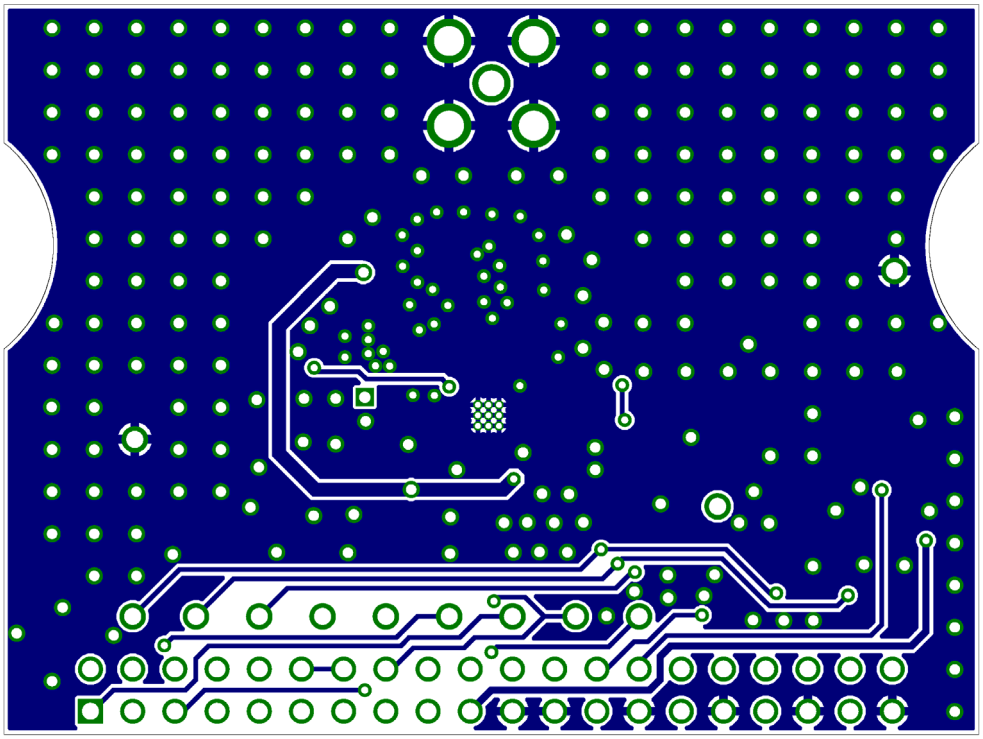


Figure 17. Si4431 Common TX/RX Connector with RF Switch—Bottom

3.3. Antenna Diversity Reference Design

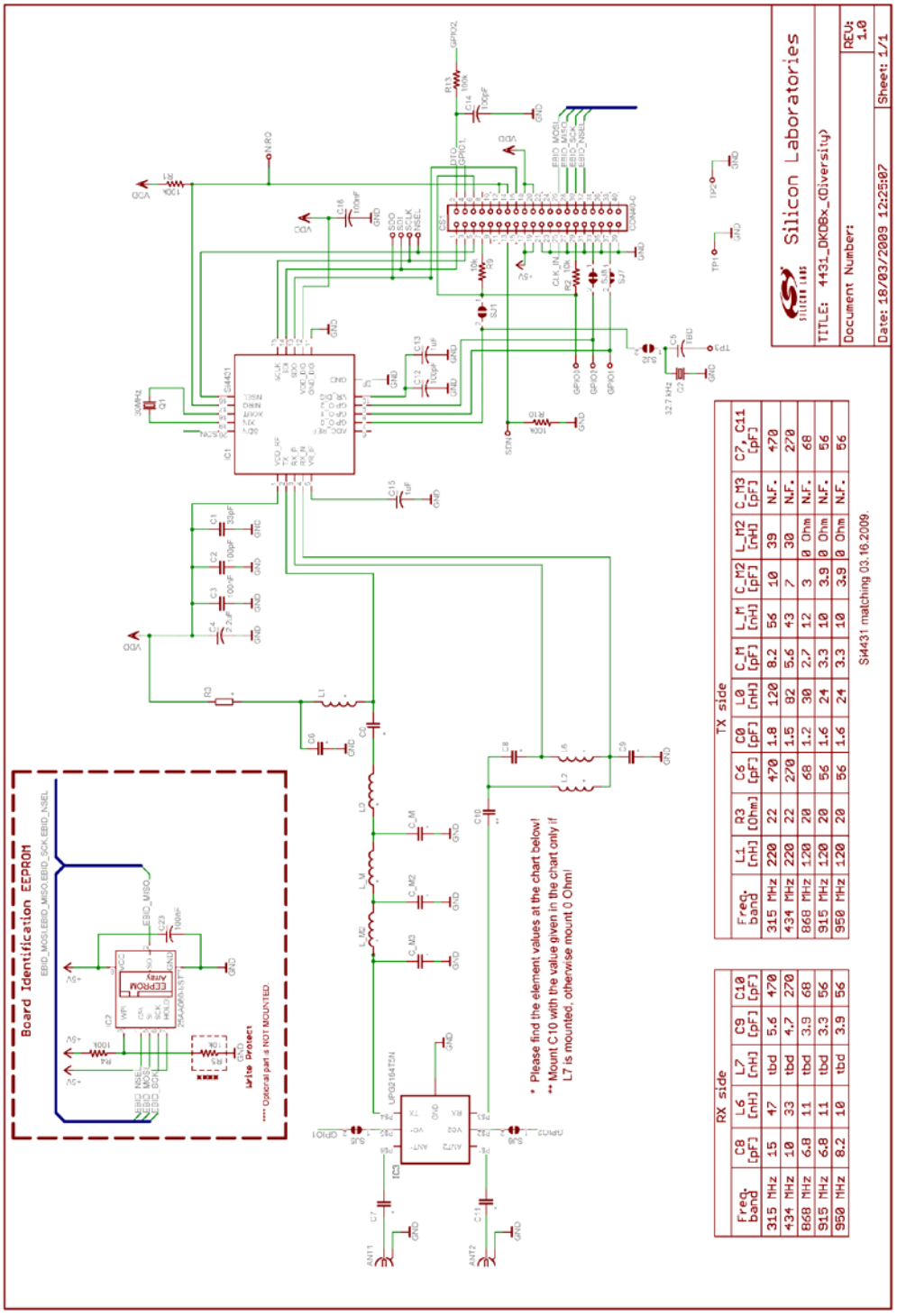


Figure 18. Si4431 Antenna Diversity Reference Design

Table 4. Si4431 Antenna Diversity Bill of Materials

Part	Value	Device	Package	Description
ANT1	Horizontal	SMA connector	BU-SMA-H	90° bent, female SMA connector
ANT2	Horizontal	SMA connector	BU-SMA-H	90° bent, female SMA connector
C0	*	Capacitor	0402	Murata GRM15 series
C1	33 pF	Capacitor	0402	Murata GRM15 series
C2	100 pF	Capacitor	0402	Murata GRM15 series
C3	100 nF	Capacitor	0402	Murata GRM15 series
C4	2.2 µF	Capacitor	0603	Murata GRM18 series
C5	N.F.	Capacitor	0603	Murata GRM18 series
C6	*	Capacitor	0402	Murata GRM15 series
C7	*	Capacitor	0401	Murata GRM15 series
C8	*	Capacitor	0402	Murata GRM15 series
C9	*	Capacitor	0402	Murata GRM15 series
C10	*	Capacitor	0402	Murata GRM15 series
C11	*	Capacitor	0402	Murata GRM15 series
C12	100 pF	Capacitor	0603	Murata GRM18 series
C13	1 µF	Capacitor	0603	Murata GRM18 series
C14	100 pF	Capacitor	0603	Murata GRM18 series
C15	1 µF	Capacitor	0603	Murata GRM18 series
C18	100 nF	Capacitor	0603	Murata GRM18 series
C23	100 nF	Capacitor	0603	Murata GRM18 series
CS1	CON40-0	CON40-0	Molex 0702474051	40-PIN male connector, 90°
C_M	*	Capacitor	0402	Murata GRM15 series
C_M2	*	Capacitor	0402	Murata GRM15 series
C_M3	*	Capacitor	0402	Murata GRM15 series
IC1	Si4431	Si4431 Rev A0	QFN-20	Radio IC
IC2	25AA080-I/ST	25AA080ST	TSSOP8	Serial EEPROM
IC5	UPG2164T5N	UPG2164T5N	6-PIN_SUPER_MINIMOLD	NEC's DPDT RF switch
L0	*	Inductor	0402	Coilcraft 0402HP series
L1	*	Inductor	0402	Coilcraft 0402HP series
L6	*	Inductor	0402	Coilcraft 0402HP series
L7	*	Inductor	0402	Coilcraft 0402HP series
L_M	*	Inductor	0402	Coilcraft 0402HP series
L_M2	*	Inductor	0402	Coilcraft 0402HP series
Q1	30 MHz	Crystal	4 pin	TST TZ1430A
Q2	32.7 kHz	Crystal	SMQ32SL	SMQ32SL
R1	100k	Resistor	0603	Resistor
R2	10k	Resistor	0603	Resistor
R3	*	Resistor	0402	Resistor
R4	100k	Resistor	0603	Resistor
R5	N.F.	Resistor	0603	Resistor
R9	10k	Resistor	0603	Resistor
R10	100k	Resistor	0603	Resistor
R13	100k	Resistor	0603	Resistor

***Note:** For exact values please find the schematic's table with the appropriate matching network values.

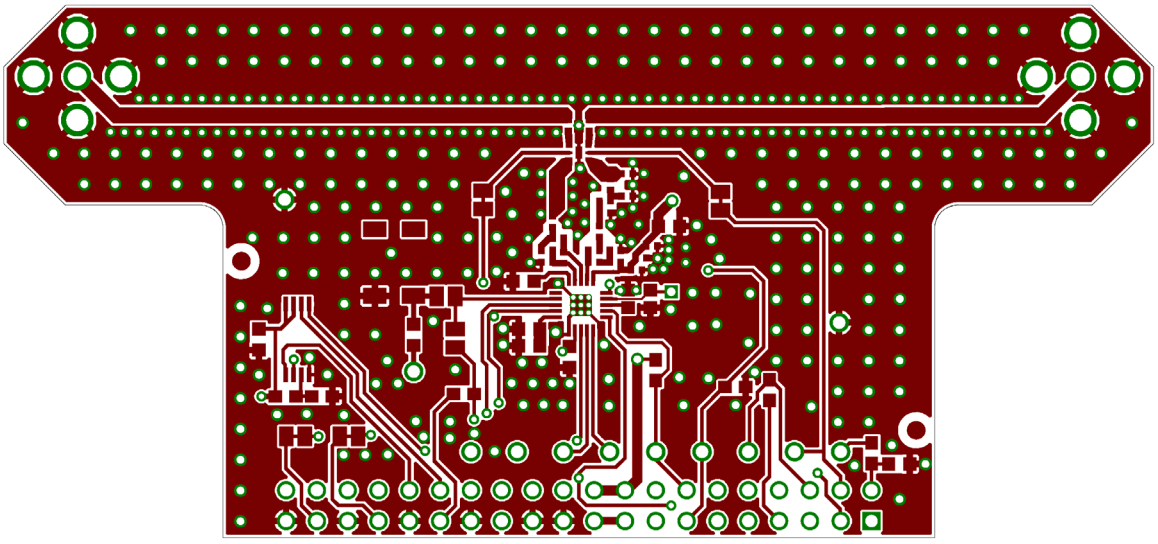


Figure 19. Si4431 Antenna Diversity Reference Design—Top

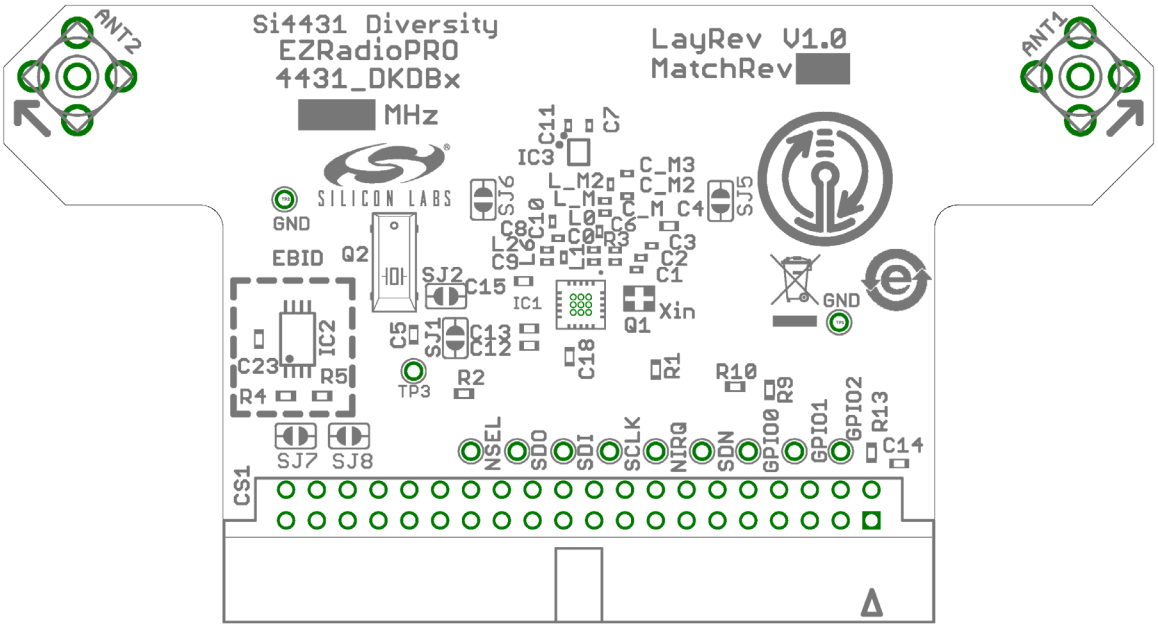


Figure 20. Si4431 Antenna Diversity Reference Design—Top Silkscreen

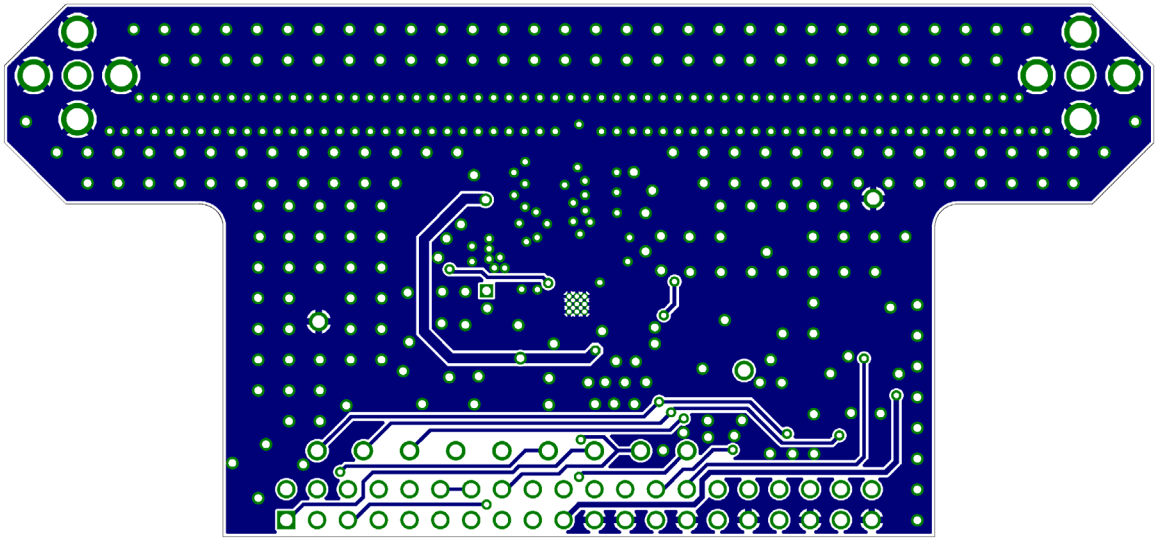


Figure 21. Si4431 Antenna Diversity Reference Design—Bottom

4. Reference Designs for Si4432

4.1. Split RF I/Os with Separated TX and RX Connectors

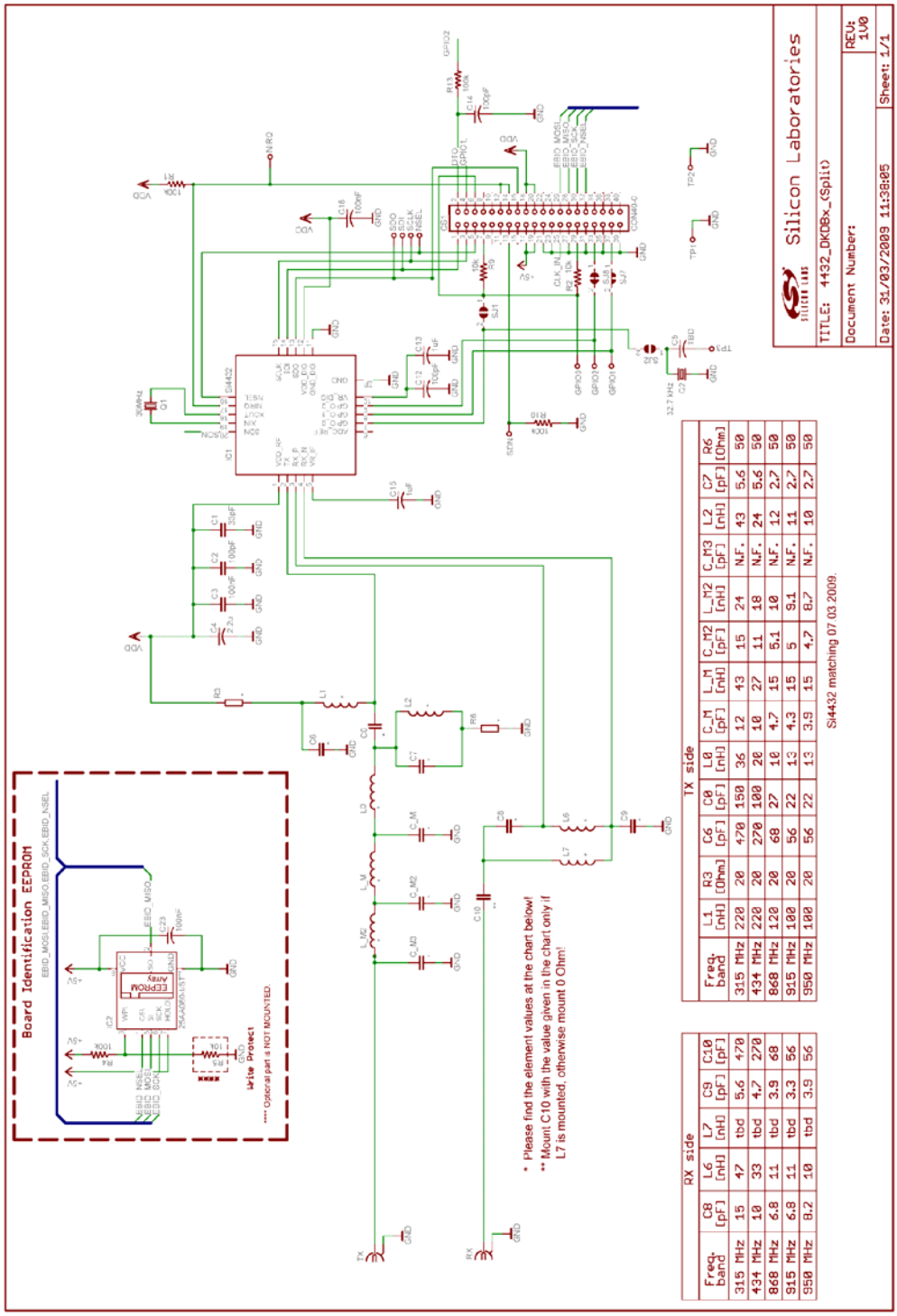


Figure 22. Si4432 Split RF I/Os with Separated TX and RX Connectors

Table 5. Si4432 Split RF I/Os Bill of Materials

Part	Value	Device	Package	Description
C0	*	Capacitor	0402	Murata GRM15 series
C1	33 pF	Capacitor	0402	Murata GRM15 series
C2	100 pF	Capacitor	0402	Murata GRM15 series
C3	100 nF	Capacitor	0402	Murata GRM15 series
C4	2.2 µF	Capacitor	0603	Murata GRM18 series
C5	N.F.	Capacitor	0603	Murata GRM18 series
C6	*	Capacitor	0402	Murata GRM15 series
C7	*	Capacitor	0402	Murata GRM15 series
C8	*	Capacitor	0402	Murata GRM15 series
C9	*	Capacitor	0402	Murata GRM15 series
C10	*	Capacitor	0402	Murata GRM15 series
C12	100 pF	Capacitor	0603	Murata GRM18 series
C13	1 µF	Capacitor	0603	Murata GRM18 series
C14	100 pF	Capacitor	0603	Murata GRM18 series
C15	1 µF	Capacitor	0603	Murata GRM18 series
C18	100 nF	Capacitor	0603	Murata GRM18 series
C23	100 nF	Capacitor	0603	Murata GRM18 series
CS1	CON40-0	CON40-0	Molex 0702474051	40-PIN male connector, 90°
C_M	*	Capacitor	0402	Murata GRM15 series
C_M2	*	Capacitor	0402	Murata GRM15 series
C_M3	*	Capacitor	0402	Murata GRM15 series
IC1	Si4432	Si4432 Rev V2	QFN-20	Radio IC
IC2	25AA080-I/ST	25AA080ST	TSSOP8	Serial EEPROM
L0	*	Inductor	0402	Coilcraft 0402HP series
L1	*	Inductor	0402	Coilcraft 0402HP series
L2	*	Inductor	0402	Coilcraft 0402HP series
L6	*	Inductor	0402	Coilcraft 0402HP series
L7	*	Inductor	0402	Coilcraft 0402HP series
L_M	*	Inductor	0402	Coilcraft 0402HP series
L_M2	*	Inductor	0402	Coilcraft 0402HP series
Q1	30 MHz	Crystal	4 pin	TST TZ1430A
Q2	32.7 kHz	Crystal	SMQ32SL	SMQ32SL
R1	100k	Resistor	0603	Resistor
R2	10k	Resistor	0603	Resistor
R3	*	Resistor	0402	Resistor
R4	100k	Resistor	0603	Resistor
R5	N.F.	Resistor	0603	Resistor
R6	*	Resistor	0603	Resistor
R9	10k	Resistor	0603	Resistor
R10	100k	Resistor	0603	Resistor
R13	100k	Resistor	0603	Resistor
RX	Horizontal	SMA connector	BU-SMA-H	90° bent, female SMA connector
TX	Horizontal	SMA connector	BU-SMA-H	90° bent, female SMA connector
***Note:** For exact values please find the schematic's table with the appropriate matching network values.				

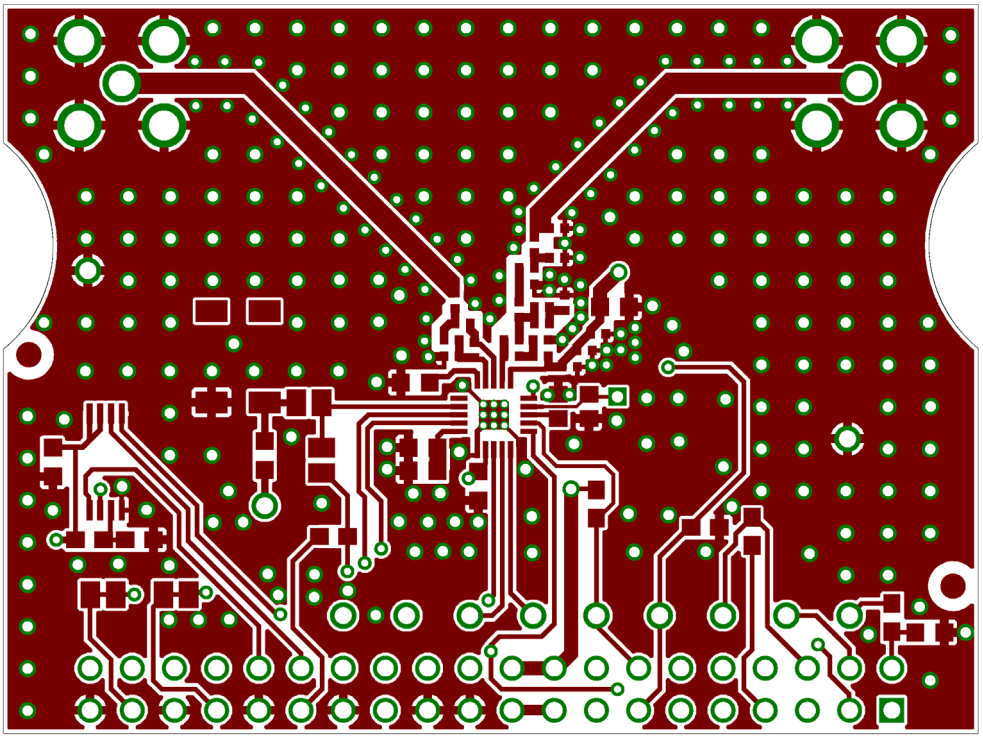


Figure 23. Si4432 Split RF I/Os with Separated TX and RX Connectors—Top

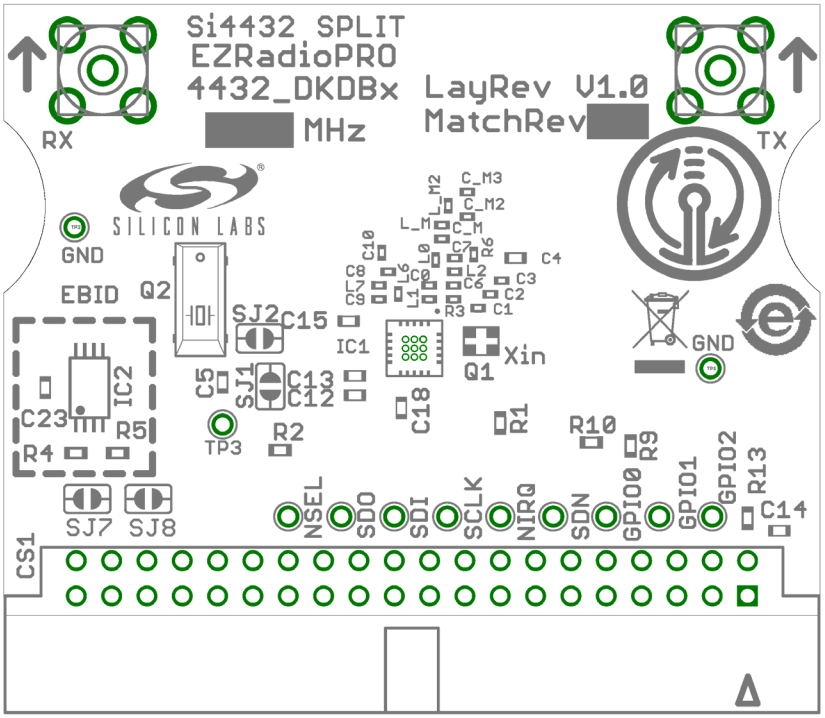


Figure 24. Si4432 Split RF I/Os with Separated TX and RX Connectors—Top Silkscreen

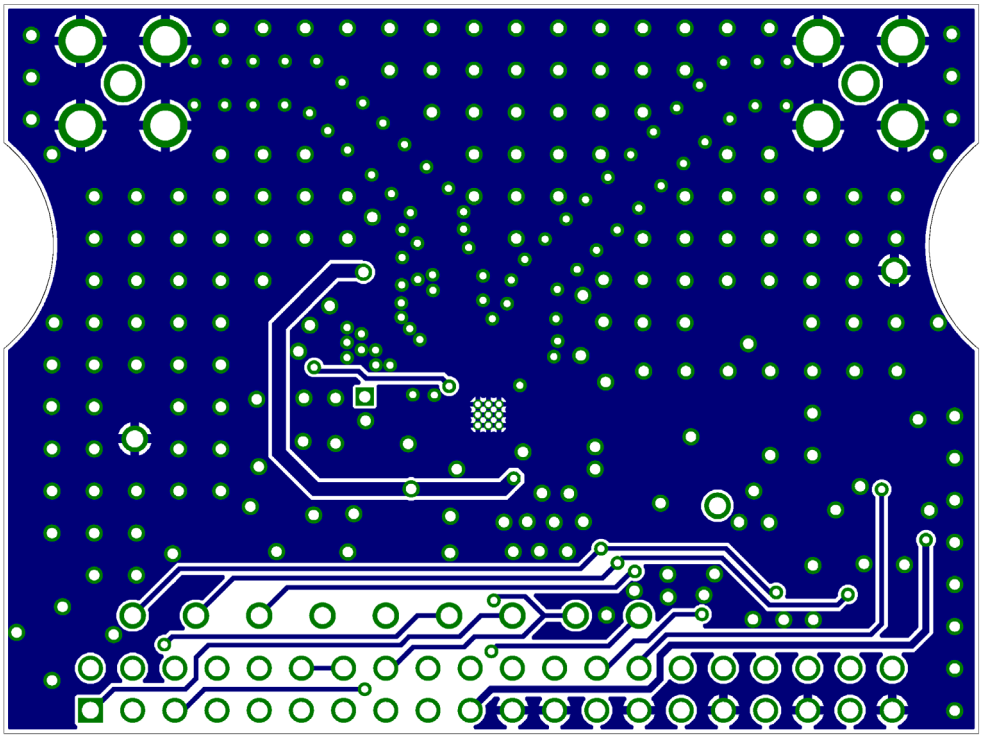
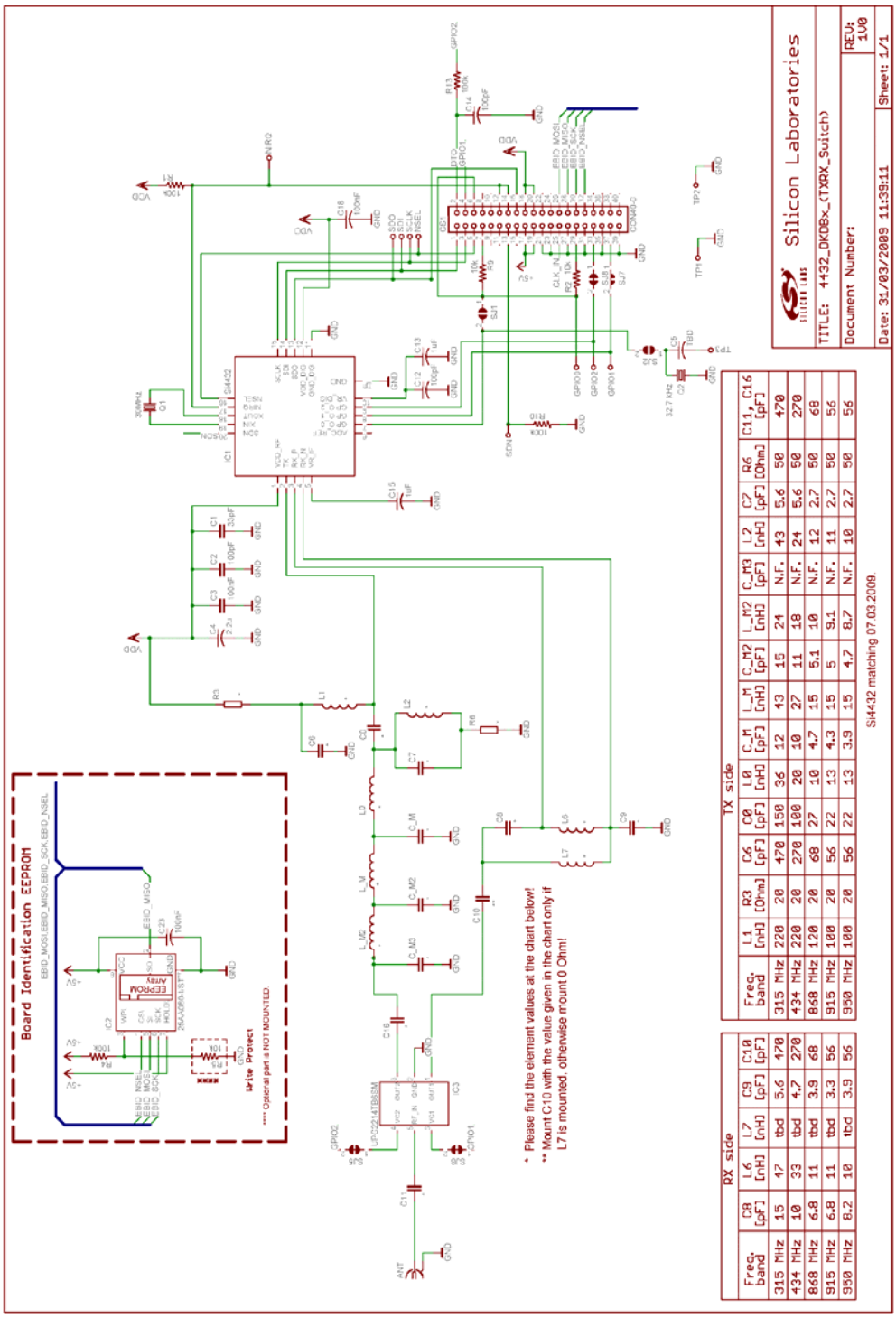


Figure 25. Si4432 Split RF I/Os with Separated TX and RX Connectors—Bottom

4.2. Common TX/RX Connector with RF switch



Freq. band	L1 [nH]	R3 [Ohm]	C6 [pF]	C0 [pF]	L0 [nH]	C_M [pF]	L_M [nH]	C_M2 [pF]	L_M2 [nH]	C_M3 [pF]	L2 [nH]	C7 [pF]	R6 [Ohm]	C11, C16 [pF]
315 MHz	220	20	470	150	36	12	43	15	24	N.F.	43	5.6	50	470
434 MHz	220	20	270	100	20	10	27	11	18	N.F.	24	5.6	50	270
868 MHz	120	20	68	27	10	4.7	15	5.1	10	N.F.	12	2.7	50	68
915 MHz	100	20	56	22	13	4.3	15	5	9.1	N.F.	11	2.7	50	56
950 MHz	100	20	56	22	13	3.9	15	4.7	8.7	N.F.	10	2.7	50	56

Freq. band	C8 [pF]	L6 [nH]	L7 [nH]	C9 [pF]	C10 [pF]
315 MHz	15	47	tbd	5.6	470
434 MHz	10	33	tbd	4.7	270
868 MHz	6.8	11	tbd	3.9	68
915 MHz	6.8	11	tbd	3.3	56
950 MHz	8.2	10	tbd	3.9	56

Figure 26. Si4432 Common TX/RX Connector with RF Switch

Table 6. Si4432 Common TX/RX Connector Bill of Materials

Part	Value	Device	Package	Description
ANT	Horizontal	SMA connector	BU-SMA-H	90° bent, female SMA connector
C0	*	Capacitor	0402	Murata GRM15 series
C1	33 pF	Capacitor	0402	Murata GRM15 series
C2	100 pF	Capacitor	0402	Murata GRM15 series
C3	100 nF	Capacitor	0402	Murata GRM15 series
C4	2.2 µF	Capacitor	0603	Murata GRM18 series
C5	N.F.	Capacitor	0603	Murata GRM18 series
C6	*	Capacitor	0402	Murata GRM15 series
C7	*	Capacitor	0402	Murata GRM15 series
C8	*	Capacitor	0402	Murata GRM15 series
C9	*	Capacitor	0402	Murata GRM15 series
C10	*	Capacitor	0402	Murata GRM15 series
C11	*	Capacitor	0402	Murata GRM15 series
C12	100 pF	Capacitor	0603	Murata GRM18 series
C13	1 µF	Capacitor	0603	Murata GRM18 series
C14	100 pF	Capacitor	0603	Murata GRM18 series
C15	1 µF	Capacitor	0603	Murata GRM18 series
C16	*	Capacitor	0402	Murata GRM15 series
C18	100 nF	Capacitor	0603	Murata GRM18 series
C23	100 nF	Capacitor	0603	Murata GRM18 series
CS1	CON40-0	CON40-0	Molex 0702474051	40-PIN male connector, 90°
C_M	*	Capacitor	0402	Murata GRM15 series
C_M2	*	Capacitor	0402	Murata GRM15 series
C_M3	*	Capacitor	0402	Murata GRM15 series
IC1	Si4432	Si4432 Rev V2	QFN-20	Radio IC
IC2	25AA080-I/ST	25AA080ST	TSSOP8	Serial EEPROM
IC5	UPG2214TB6SM	UPG2214TB6SM	6-PIN_SUPER_MINIMOLD	NEC's SPDT RF switch
L0	*	Inductor	0402	Coilcraft 0402HP series
L1	*	Inductor	0402	Coilcraft 0402HP series
L2	*	Inductor	0402	Coilcraft 0402HP series
L6	*	Inductor	0402	Coilcraft 0402HP series
L7	*	Inductor	0402	Coilcraft 0402HP series
L_M	*	Inductor	0402	Coilcraft 0402HP series
L_M2	*	Inductor	0402	Coilcraft 0402HP series
Q1	30 MHz	Crystal	4 pin	TST TZ1430A
Q2	32.7 kHz	Crystal	SMQ32SL	SMQ32SL
R1	100k	Resistor	0603	Resistor
R2	10k	Resistor	0603	Resistor
R3	*	Resistor	0402	Resistor
R4	100k	Resistor	0603	Resistor
R5	N.F.	Resistor	0603	Resistor
R6	*	Resistor	0603	Resistor
R9	10k	Resistor	0603	Resistor
R10	100k	Resistor	0603	Resistor
R13	100k	Resistor	0603	Resistor

***Note:** For exact values please find the schematic's table with the appropriate matching network values.

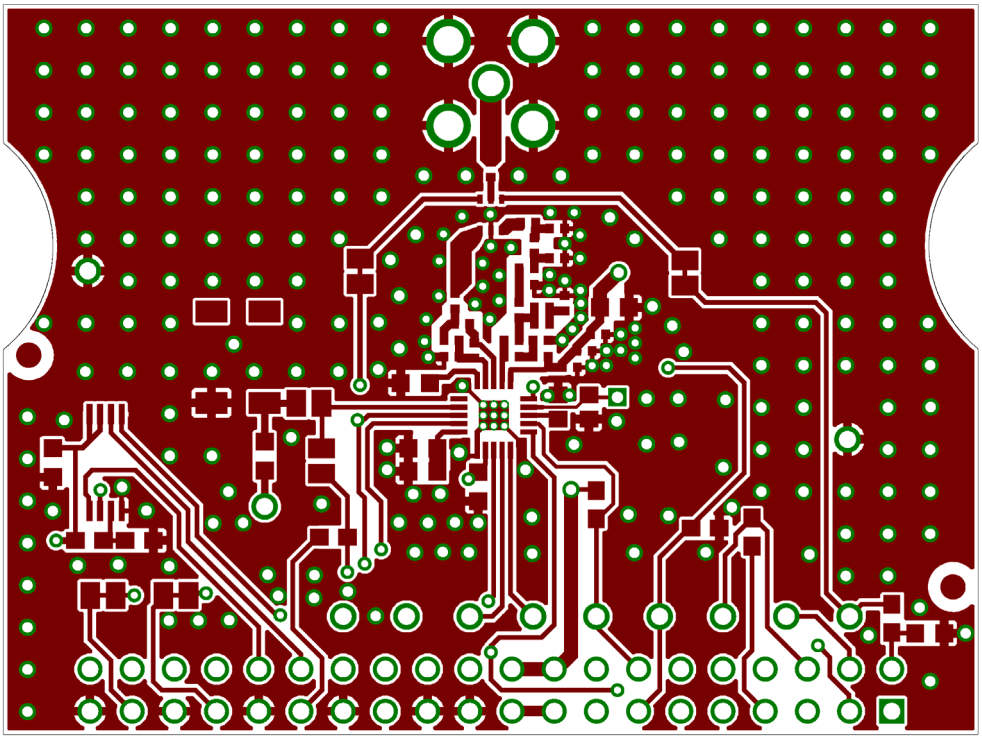


Figure 27. Si4432 Common TX/RX Connector with RF Switch—Top

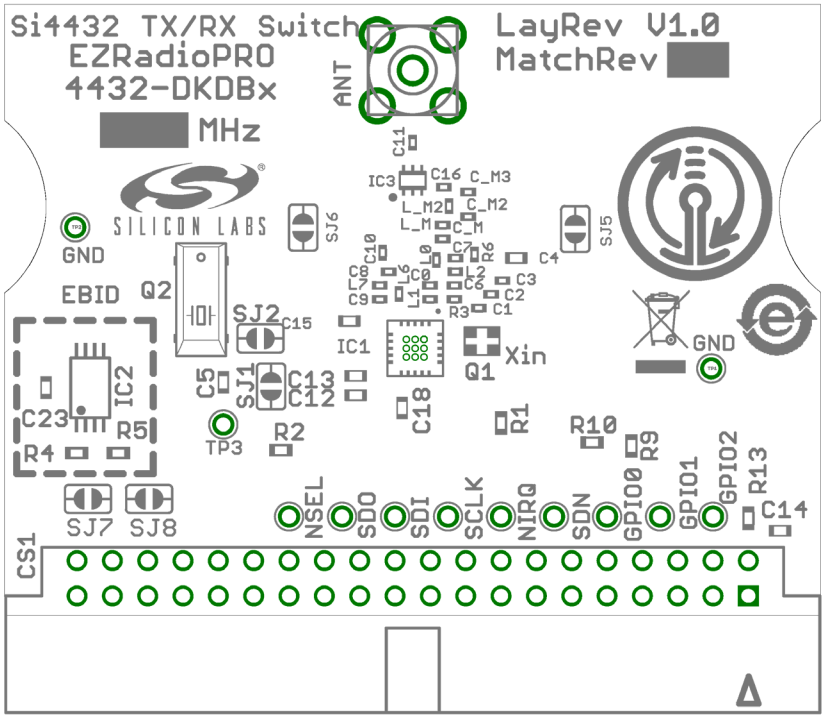


Figure 28. Si4432 Common TX/RX Connector with RF Switch—Top Silkscreen

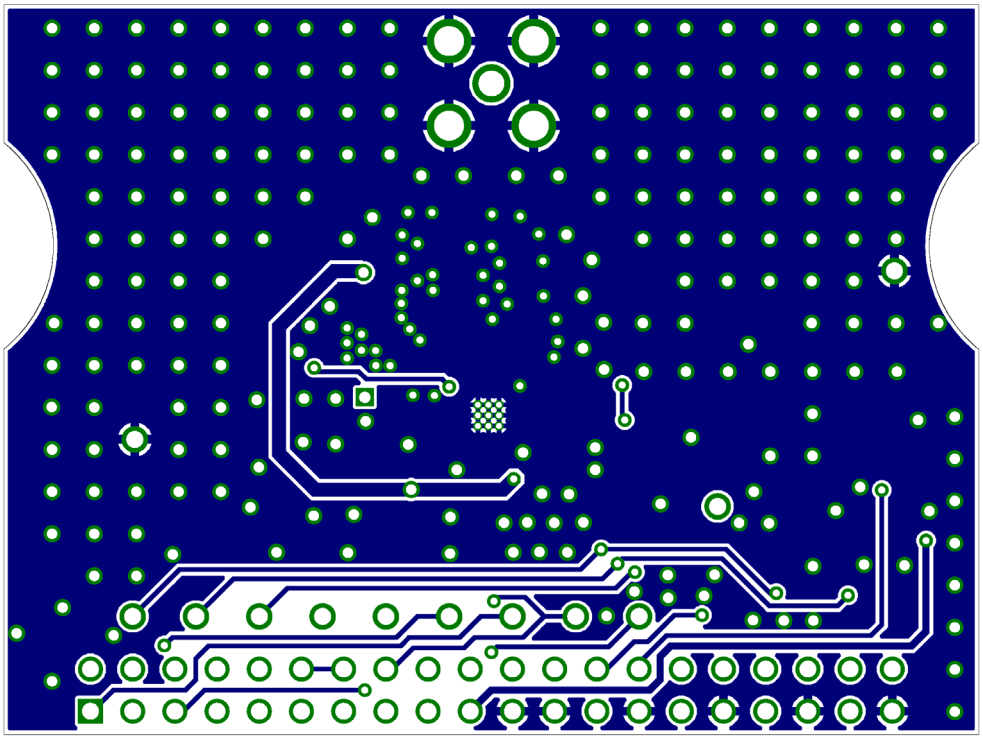


Figure 29. Si4432 Common TX/RX Connector with RF Switch—Bottom

4.3. Antenna Diversity Reference Design

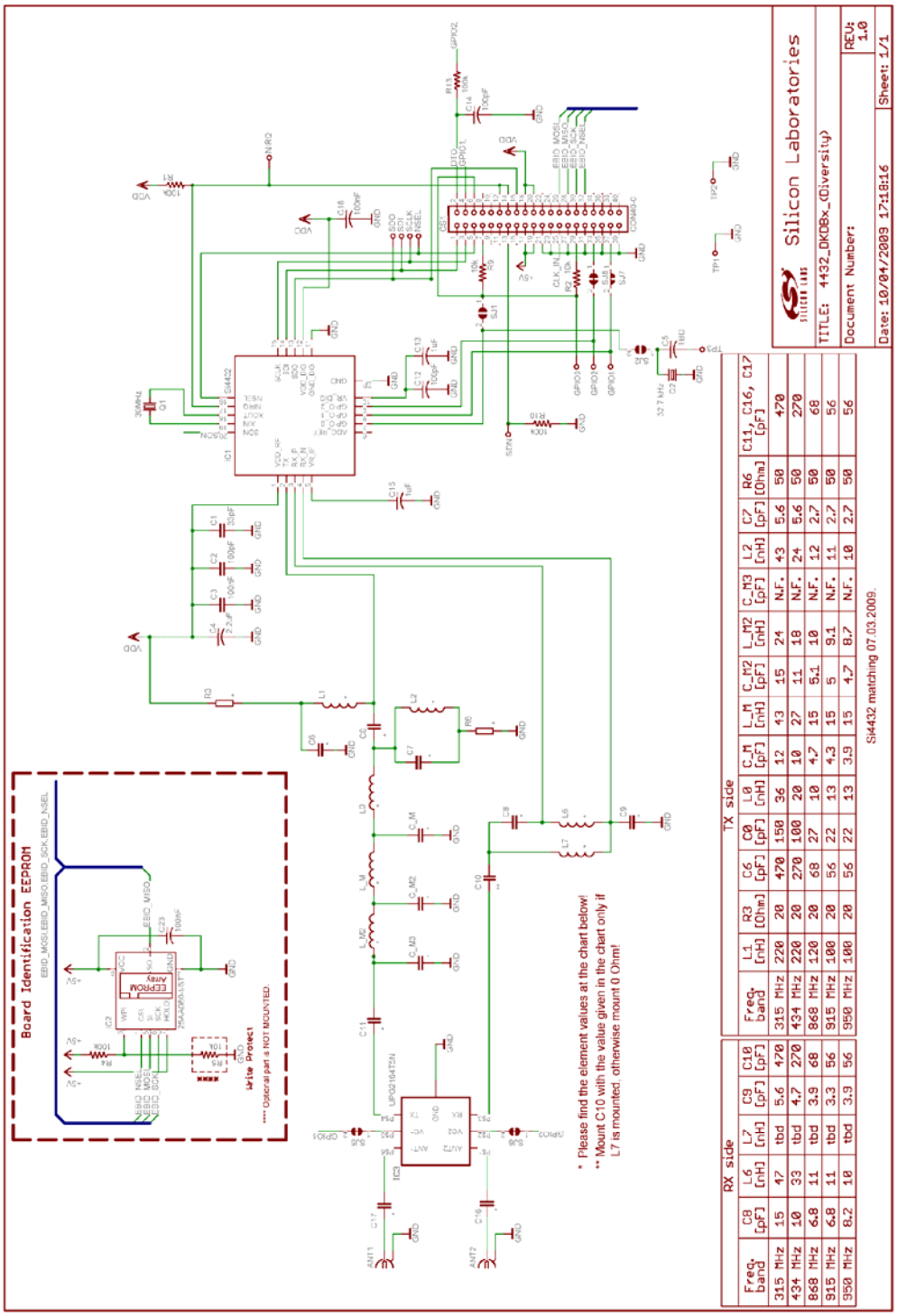


Figure 30. Si4432 Antenna Diversity Reference Design

Table 7. Si4432 Antenna Diversity Bill of Materials

Part	Value	Device	Package	Description
ANT1	Horizontal	SMA connector	BU-SMA-H	90° bent, female SMA connector
ANT2	Horizontal	SMA connector	BU-SMA-H	90° bent, female SMA connector
C0	*	Capacitor	0402	Murata GRM15 series
C1	33 pF	Capacitor	0402	Murata GRM15 series
C2	100 pF	Capacitor	0402	Murata GRM15 series
C3	100 nF	Capacitor	0402	Murata GRM15 series
C4	2.2 µF	Capacitor	0603	Murata GRM18 series
C5	N.F.	Capacitor	0603	Murata GRM18 series
C6	*	Capacitor	0402	Murata GRM15 series
C7	*	Capacitor	0402	Murata GRM15 series
C8	*	Capacitor	0402	Murata GRM15 series
C9	*	Capacitor	0402	Murata GRM15 series
C10	**	Resistor	0402	Resistor
C11	*	Capacitor	0402	Murata GRM15 series
C12	100 pF	Capacitor	0603	Murata GRM18 series
C13	1 µF	Capacitor	0603	Murata GRM18 series
C14	100 pF	Capacitor	0603	Murata GRM18 series
C15	1 µF	Capacitor	0603	Murata GRM18 series
C16	*	Capacitor	0402	Murata GRM15 series
C17	*	Capacitor	0402	Murata GRM15 series
C18	100 nF	Capacitor	0603	Murata GRM18 series
C23	100 nF	Capacitor	0603	Murata GRM18 series
CS1	CON40-0	CON40-0	Molex 0702474051	40-PIN male connector, 90°
C_M	*	Capacitor	0402	Murata GRM15 series
C_M2	*	Capacitor	0402	Murata GRM15 series
C_M3	*	Capacitor	0402	Murata GRM15 series
IC1	Si4432	Si4432 Rev V2	QFN-20	Radio IC
IC2	25AA080-I/ST	25AA080ST	TSSOP8	Serial EEPROM
IC3	UPG2164T5N	UPG2164T5N	6-PIN_PLASTIC_TSON	NEC's DPDT RF switch
L0	*	Inductor	0402	Coilcraft 0402HP series
L1	*	Inductor	0402	Coilcraft 0402HP series
L2	*	Inductor	0402	Coilcraft 0402HP series
L6	*	Inductor	0402	Coilcraft 0402HP series
L7	*	Inductor	0402	Coilcraft 0402HP series
L_M	*	Inductor	0402	Coilcraft 0402HP series
L_M2	*	Inductor	0403	Coilcraft 0402HP series
Q1	30 MHz	Crystal	4 pin	TST TZ1430A
Q2	32.7 kHz	Crystal	SMQ32SL	SMQ32SL
R1	100k	Resistor	0603	Resistor
R2	10k	Resistor	0603	Resistor
R3	*	Resistor	0402	Resistor
R4	100k	Resistor	0603	Resistor
R5	N.F.	Resistor	0603	Resistor
R6	*	Resistor	0603	Resistor
R9	10k	Resistor	0603	Resistor
R10	100k	Resistor	0603	Resistor
R13	100k	Resistor	0603	Resistor

***Note:** For exact values please find the schematic's table with the appropriate matching network values.

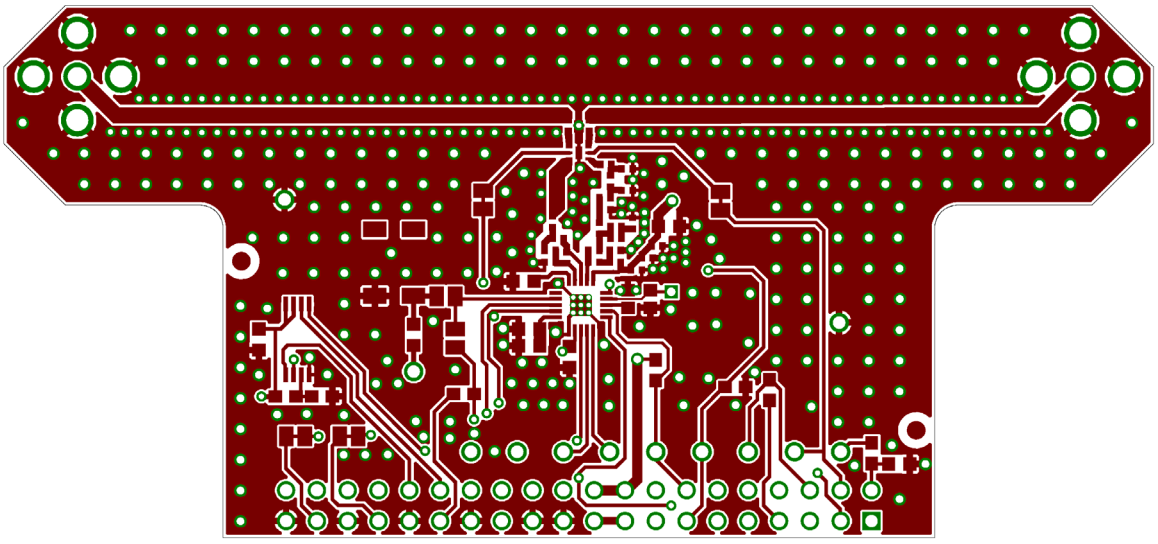


Figure 31. Si4432 Antenna Diversity Reference Design—Top

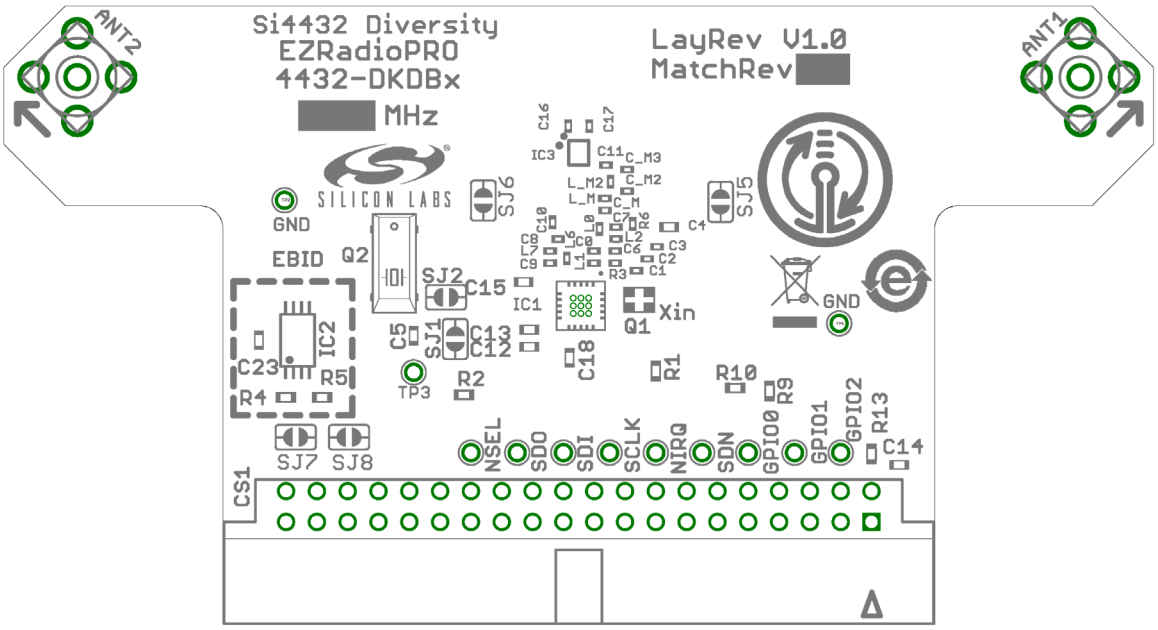


Figure 32. Si4432 Antenna Diversity Reference Design—Top Silkscreen

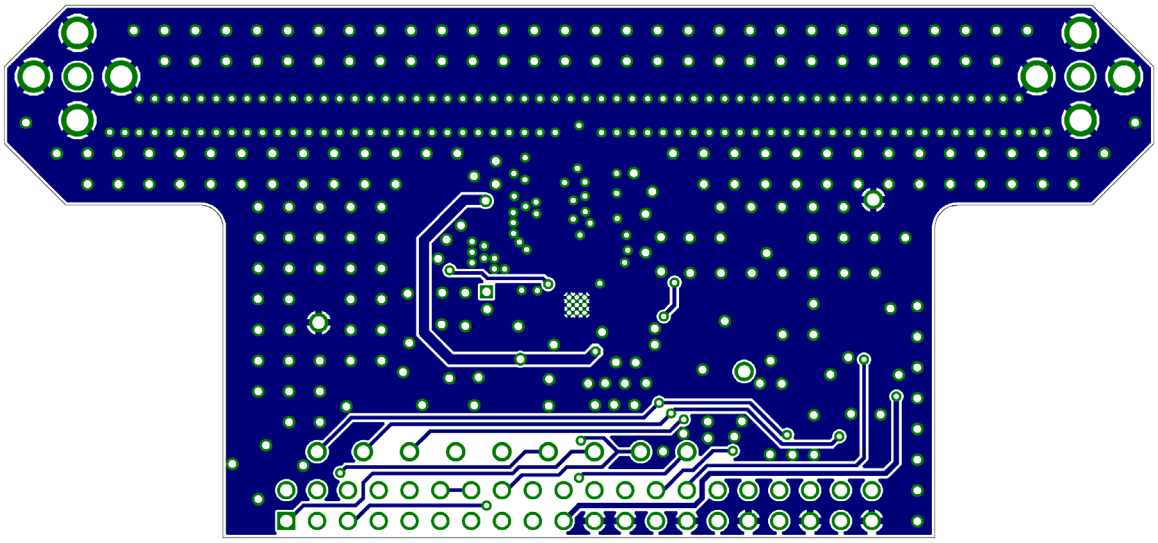
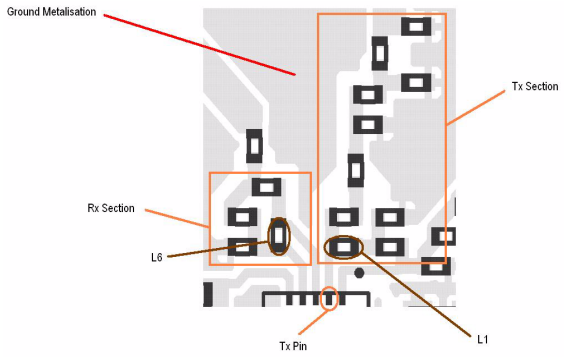
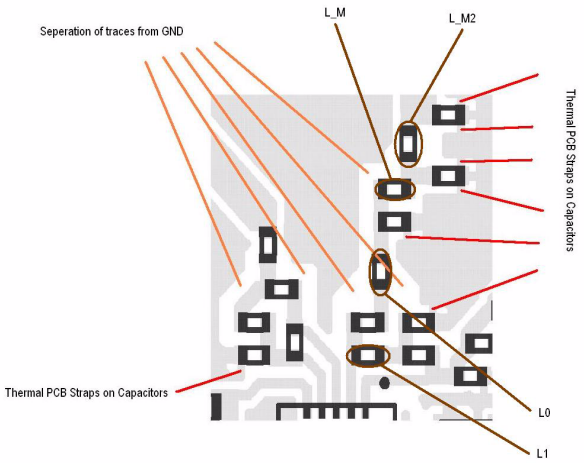
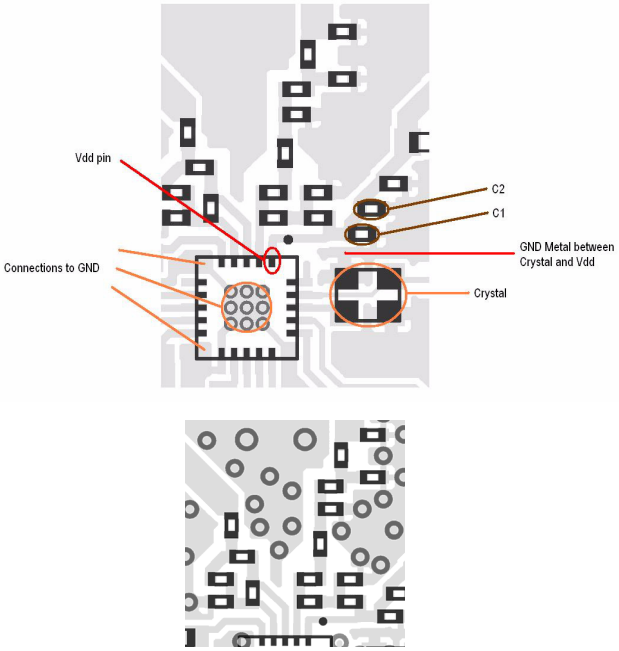
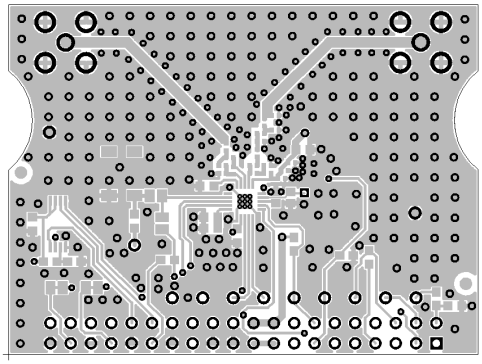
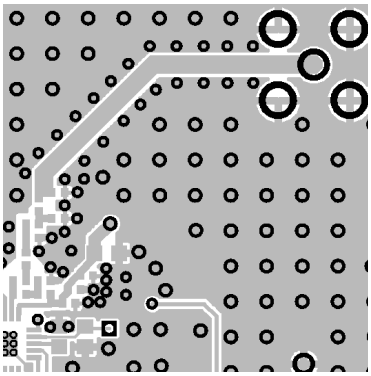
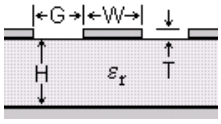


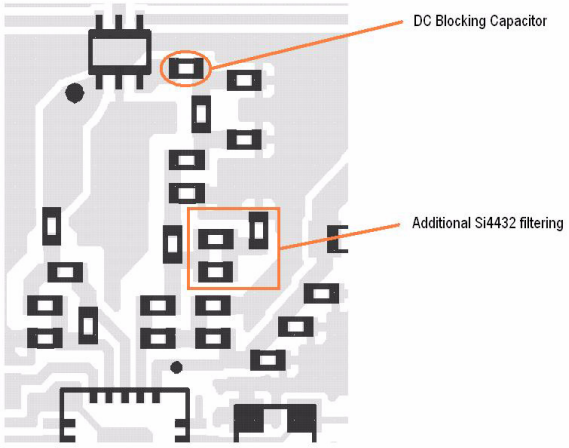
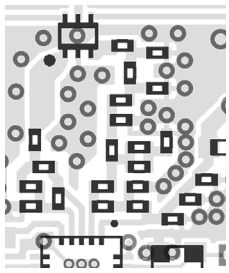
Figure 33. Si4432 Antenna Diversity Reference Design—Bottom

5. Checklist

1.	☐	Is the choke inductor (L1) as close to the TX pin as possible?	
2.	☐	Is the RX parallel inductor (L6) perpendicular to the choke inductor (L1) in the TX path?	
3.	☐	Is the TX and RX separated by a ground metal on the top layer?	
4.	☐	Is the TX match, using the smallest board space possible?	
5.	☐	Are the TX path inductors perpendicular to each other?	
6.	☐	Is there at least 0.5 mm in separation in the matching between traces/pads to the ground metal?	
7.	☐	Are there thermal straps used with the capacitors, and is the GND pin trace thicker?	
8.	☐	Are the smaller V_{DD} bypass capacitors kept as close to V_{DD}?	
9.	☐	Do exposed pad footprints use as multiple vias and is the ground connected to the top layer?	
10.	☐	Is the crystal as close to the RFIC as is possible?	
11.	☐	Does ground metal exist between the crystal and the V_{DD} feed?	

12.	☐	Was large ground metallization added to at least the RF sections?	
13.	☐	Was the area on the bottom layer under the matching network filled with ground metal and was wiring a routing avoided in this region?	
14.	☐	Were 50 Ω grounded coplanar lines used for connecting the matching network, the switch and/or the SMA connector(s)?	
			

5.1. Additional Concerns for the Si4432

15.	☐	Was an additional parallel LC resonant circuit is added into the TX path with a series resistor?	
16.	☐	Was a series capacitor added to the TX path to block the dc when a TX/RX switch (or the Diversity switch) is used?	

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