matching nrf24 to 100ohms balanced

iot_newb *10 months ago*

I want to use the nrf24l01+ with the se2436 apmlifier, but the input of the amplifier requires an input of 100ohms balanced, while the nrf24 has a balanced output of 15ohm+j88ohm according to the datasheet.

Can I build a matching circuit to directly connect these to devices or is it recommended to first transform the signal to 50ohms unbalanced and then back again to 100ohms balanced.

Top Replies

AmbystomaLabs *10 months ago* +1

In-band, mathematically there is no difference between transforming straight to 100ohms balan...

AmbystomaLabs *10 months ago*

In-band, mathematically there is no difference between transforming straight to 100ohms balanced or going through 50ohms unbalanced first. Going through 50ohm unbalanced first is just a complicated effort that will surely give you more insertion loss, lower yields and will consume more board space. Also, unless you use a broadband balun you will lose the second order harmonic suppression that is natural to baluns.

So, no you should go straight to 100ohm balanced. The spec says "antenna load impedance" of 15+j88. Normally this is inferred to mean recommended antenna load. So the input impedance of the nRF is the conjugate or 15-j88. Though I would recommend you clarify this aspect of the spec.

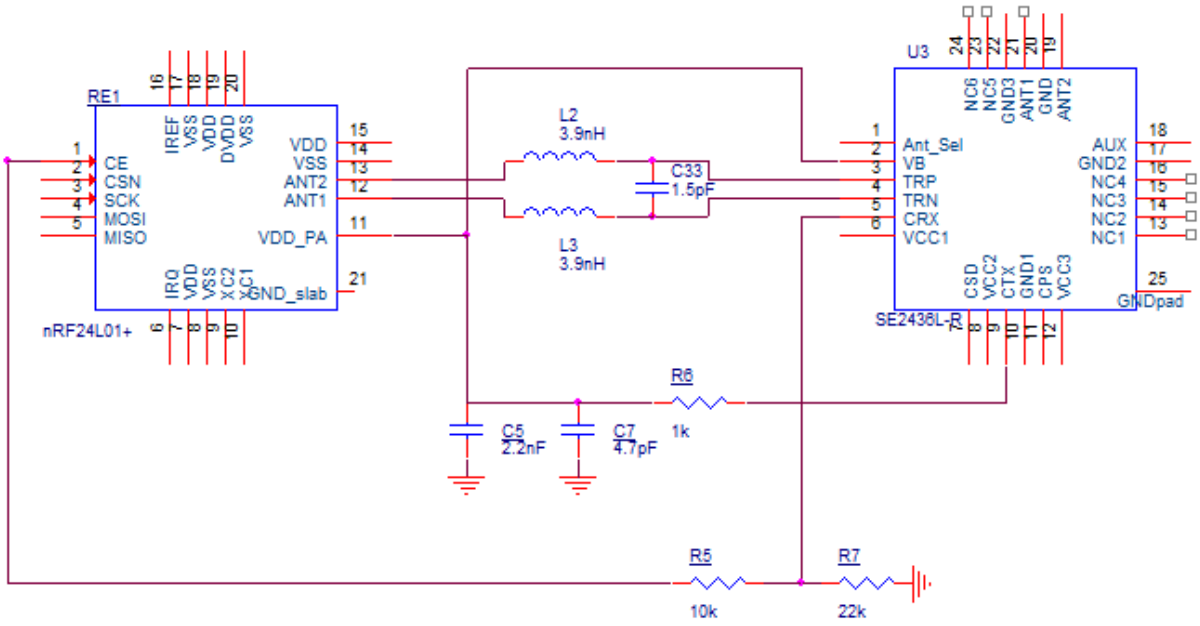
Depending on how you like to do your matches you are either taking 100+j0 and turning it into 15+j88. Or, you are taking 15-j88 and turning it into 100+j0.

Also, make it a point in your match design to decouple DC from the nRF. I didn't see it in the spec but I think the nRF chips with balanced output present DC on the pins.

iot_newb *10 months ago*

Thanks for the input.

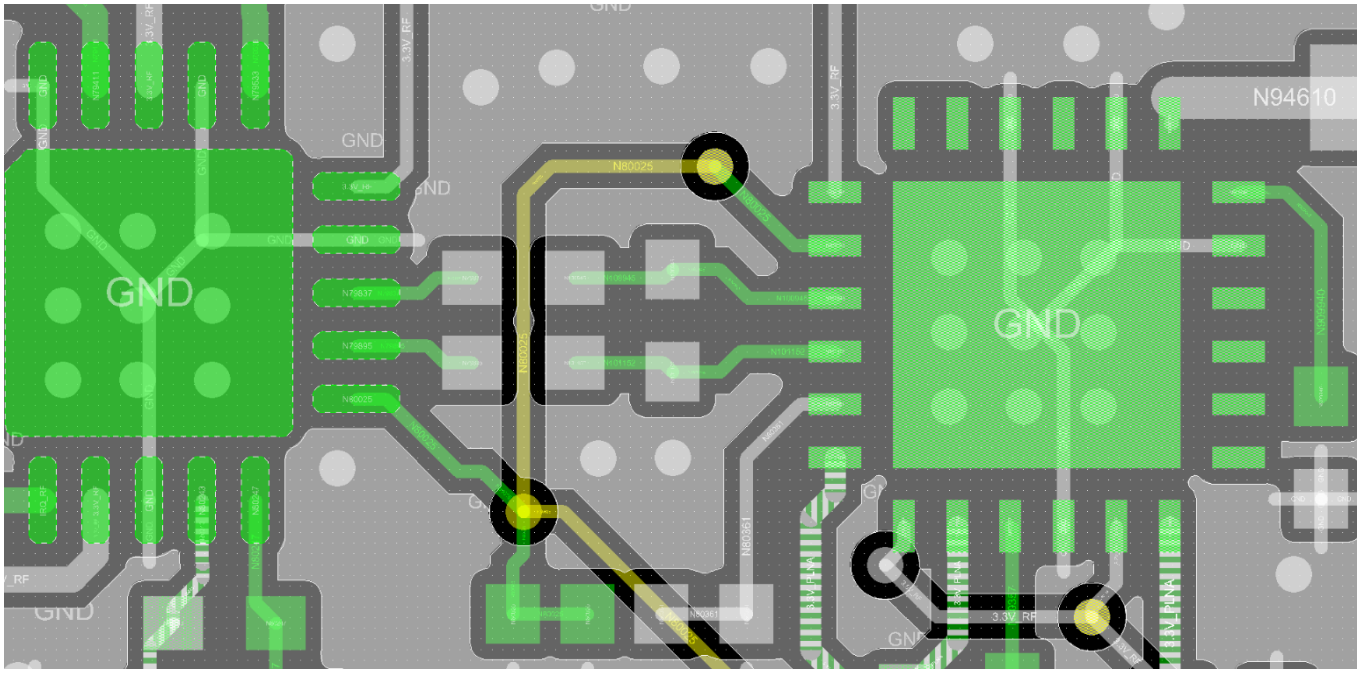
You are correct the impedance of the nrf24 is 15-j88 and therefor the load impedance should be 15+j88. And if my calculations are correct I would need a 3.9nH in series and a 1.5pF in paralell to get the proper matching at 2.4Ghz.



According to the datasheet of the nrf24. ANT1 and ANT2 needs a DC path to the VDD_PA, should I connect that through the balun DC connection of the SE2436 as shown in the figure above?

I've edited the figure according to your recommandations.

I'm controlling the switching between TX_Mode and RX_Mode with CE and VDD_PA. The amplifier is in RX_Mode as long as the nrf is active, CE = high. When the nrf switches to TX_mode the VDD_PA goes high, and switches the amplifier to TX_mode. At this point both CTX and CRX is high, which is a state not specified in the datasheet, but tests has shown that the amplifier really is in TX_mode.



Here is a picture of the layout, the nrf on the left and the amplifier to the right. I've been using 0402 inductors and capacitors.

> **AmbystomaLabs** *10 months ago in reply to iot_newb*

Close, but not quite right. The component values would be half you show for the topology you have chosen.

Also, since you are within an octave or so of SRF for these components the actual value will be a little less. I normally use the MuRata Chip S-Parameter & Impedance Library app to look up real impedance values. Though most respectable chip manufacturers also publish their real component data.

So that being said, the real series inductance should be about 7.5nH/2 or the most available standard size will be 3.9nH. You are generally better off buying components that comply with the standard number scheme then trying to buy something that is the precise mH.

Then the best approach for the cap is a 1.5pF straight between the two legs. Just skip ground. The way you have it the effective impedance is twice what you thought it was.

The stripline doesn't have to be a diff pair. Just treat it as two 50ohm lines that are coplanar with ground. and stick them next to each other close enough that you still have room to place the series components.

You are going to need to keep this match really close to the nRF for it to be correct. You should be using 0402 or 0201 parts.

AmbystomaLabs *10 months ago in reply to iot_newb*

Yes that is the correct way to power it. You run VDD_PA to VB. Remember to hook up the logic solution from nRF to SE2436. You should make sure the SDK for the nRF24 supports PA/LNA control. This is the best way to drive an external amp as there isn't a lot of good feedback with the RF events to do it on your own. I only code for nRF52 so I can't advise on the software link between softdevice and the hardware for nRF24. Otherwise you can use VDD_PA to drive the SE24 but the downside is it will be in an lna on state all the time whenever the pa isn't on. Not the best thing for low power consumption.

You should repost your updated schematic to make sure you got it right. Then I would recommend you also submit your layout for review.

AmbystomaLabs *10 months ago in reply to iot_newb*

The way you describe the logic seems fine.

I assume this is a two layer board. It's not great that you had to split the ground plane, but I see why you did. Make sure the top and bottom are stitched together well around the split.

You should increase the width of the traces as much as possible in the RF. Your traces are way, way too small. You will never get to the size required for it, but if you make them as thick as is possible you will minimize the error.

Ideally you would match it correctly when you had the artwork since it won't be perfect. But I get the feeling you don't have a VNA.

The good thing is, the way the match is done the fix for the parasitics will be a decrease in the size of the inductors and an increase in the size of the cap. Pretty trivial. But I bet it ends up close even without re-visiting it.

AmbystomaLabs *10 months ago in reply to iot_newb*

There is a way to walk the VDD_PA signal across the match without splitting the gnd up, but then that will just give you a new set of unknowns. So, probably better to just stick with splitting the gnd.