Author — **Topic: AD8302 does weird things (Read 2187 times)**

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DM2LCT
Contributor
Posts: 5
Country:

AD8302 does weird things
« **on:** January 03, 2018, 12:04:44 pm »

Hello!

I think I first have to introduce myself. (And I think I also have to apologize for my bad English.) I'm a 25 years old engineering student, I like ham radio, KiCad and building circuits with vacuum tubes and other weird stuff. I like to do things analog, I can not programming computers. Although I like to play with circuits since I have been 10 years old and studying electrical engineering I'm still not an expert.

A few months ago I found a (theoretically) great VNA schematic from a russian ham radio operator: http://ra4nal.qrz.ru/vna.shtml
It uses a AD9851 DDS module to generate a RF signal. A directional coupler measures forward and reflected power and an AD8302 measures magnitude and phase of whatever you put into its inputs. And right there happens weird stuff no one I know can explain. So I think i have to ask some real experts.

I started measuring around this chip over the holidays at my parents home but my measurement equipment there is quite old east german and soviet stuff and would do better in a museum (but hey... It still works somehow after 30 to 40 years...).

So I found out that:

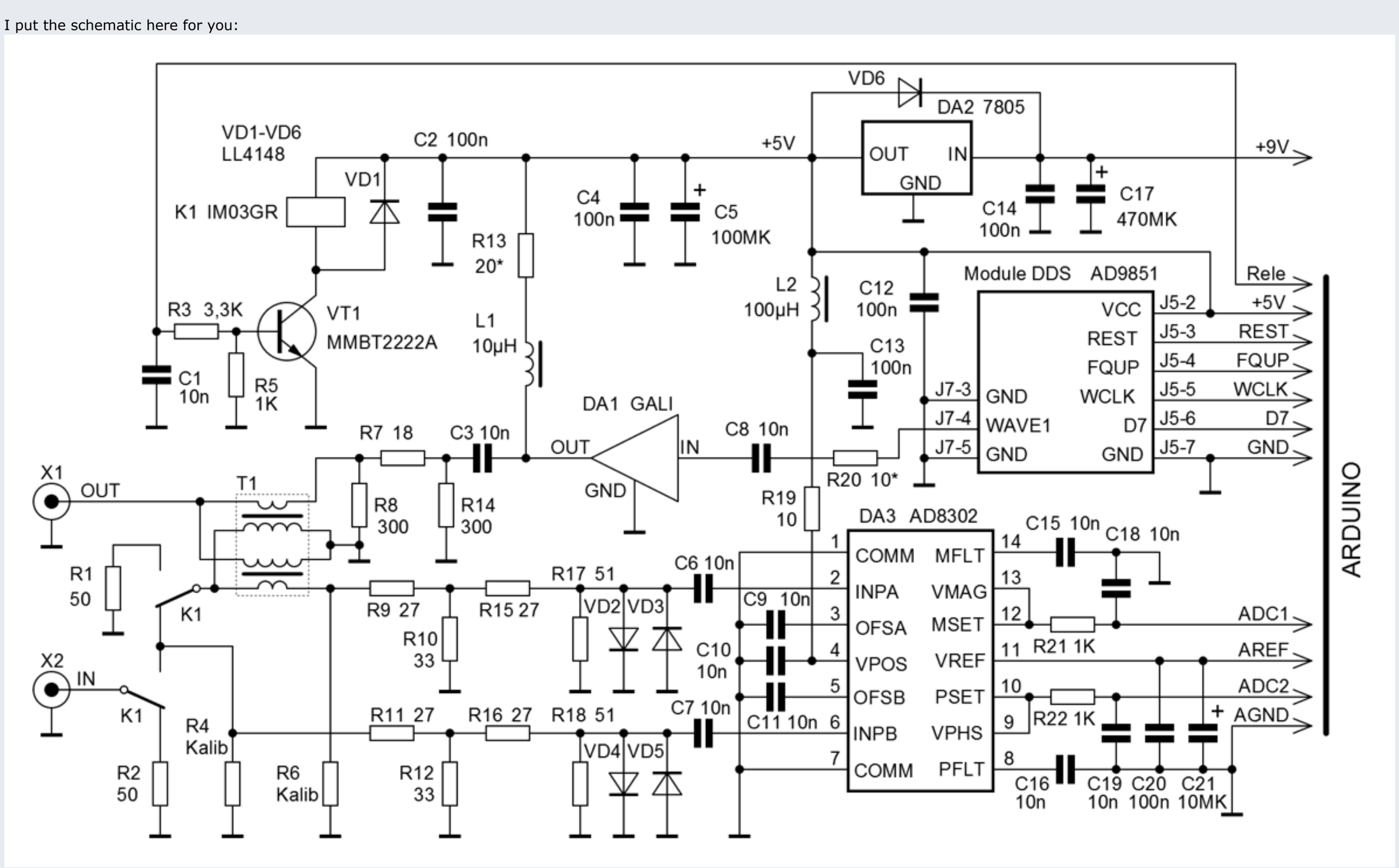
1. Input B of the AD8302 has a DC offset of about 4 volts which should not be there. Input A does not have any DC offset. Weird.
2. No matter what happens on the inputs of the AD8302, the phase output will always be 900mV. Although 900mV means a phase of 90° according to the datasheet the chip has an internal phase shift of 90°, so this should be defined as 0°. But for example with a simple filter connected between DUT and DET you cannot have a phase of 0° for all frequencies...
3. The measurement of the magnitude between A and B seems to work somehow. Actually this circuit measures reflection loss quite good, so I can analyze antennas with vnaJ on my computer. But it cannot measure such things like phases or impedances and all this kind of stuff.

I replaced this Chip several times because I thought it could be broken (first I had some cheap clones from china, 23€ for an original bug is quite expensive for a student). I even later bought an original one from mouser. But it also behaves like the chinese clones. I checked several times if there were shorts or faults on the PCB (I also checked with an eyepiece of an microscope) but there seems to be everything OK.

When I'm back home in Dresden I will measure everything again with ~~newer~~ better hardware in my hackerspace.

So do you guys have an idea of what possibly could be wrong with my toy?

I put the schematic here for you:


VD6
DA2 7805
OUT IN
GND
+9V
VD1-VD6
LL4148
C2 100n
+5V
VD1
K1 IM03GR
C4 100n
C5 100MK
C14 100n
C17 470MK
R13 20*
L2 100µH
C12 100n
Module DDS AD9851
VCC
REST
FQUP
WCLK
WAVE1
D7
GND
J5-2 +5V
J5-3 REST
J5-4 FQUP
J5-5 WCLK
J5-6 D7
J5-7 GND
J7-3
J7-4
J7-5
Rele
R3 3,3K
VT1 MMBT2222A
L1 10µH
C13 100n
C1 10n
R5 1K
DA1 GALI
R7 18
C3 10n
OUT
IN
GND
C8 10n
R20 10*
X1 OUT
T1
R8 300
R14 300
R19 10
DA3 AD8302
C15 10n
C18 10n
ARDUINO
R1 50
K1
R9 27
R15 27
R17 51
VD2 VD3
C6 10n
C9 10n
C10 10n
C11 10n
COMM MFLT
INPA VMAG
OFSA MSET
VPOS VREF
OFSB PSET
INPB VPHS
COMM PFLT
R21 1K
R22 1K
ADC1
AREF
ADC2
AGND
R10 33
X2 IN
R4 Kalib
R6 Kalib
R11 27
R16 27
R18 51
C7 10n
VD4 VD5
R2 50
R12 33
C16 10n
C19 10n
C20 100n
C21 10MK

So I thank you in advance for your answers.

Ludwig

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Rerouter
Super Contributor
Posts: 4330
Country:
Question Everything... Except This Statement

Re: AD8302 does weird things
« **Reply #1 on:** January 03, 2018, 12:29:54 pm »

your input amplitude needs to be atleast less than 0dbv, if you run the inputs over range they stop behaving as expected

This is a chip i am looking to play with myself to recover phase (actually using 2 with a 90 degree ref shift for full recovery of angle)

try limiting your input to -30db compared to the reference aswell,

The inputs after the AC coupling caps are biased to VCC - 100mV, so after the capacitors, 4V would sound OK, but i would not expect before them unless there was something else going wrong

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The following users thanked this post: DM2LCT

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babysitter
Frequent Contributor
Posts: 804
Country:
pushing silicon at work

Re: AD8302 does weird things
« **Reply #2 on:** January 03, 2018, 12:52:59 pm »

ABO Hi Ludwig, I learned a bit about the FA-VA3 but this looks interesting too.

73, Hendrik

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I'm not a feature, I'm a bug! ARC DG3HDA

DM2LCT
Contributor
Posts: 5
Country:

Re: AD8302 does weird things
« **Reply #3 on:** January 03, 2018, 03:35:24 pm »

Quote from: Rerouter on January 03, 2018, 12:29:54 pm

> The inputs after the AC coupling caps are biased to VCC - 100mV, so after the capacitors, 4V would sound OK, but i would not expect before them unless there was something else going wrong

Ok, I think this might be a very useful hint. So Input B seems to behave like it should but input A has no offset so I should check its coupling capacitor and also the capacitor at OFSA. Maybe there is a short.

The RF level on X1 is roundabout 0dbV. With the attenuators the inputs of the AD8302 get about 10mV RMS on their termination resistors. So the RF level seem to be OK as well. I'm going to check the two caps at INPA and OFSA.

Quote from: babysitter on January 03, 2018, 12:52:59 pm

> *ABO* Hi Ludwig, I learned a bit about the FA-VA3 but this looks interesting too.
>
> 73, Hendrik

Unfortunately everything at the Funkamateur-shop is very expencive. The miniVNA and other "commercial" Network analyzers are very expencive as well. As a student I cannot afford such a gadget.

The VNA from RA4NAL can be built for less than 25€ if you etch the circuit board at home and buy all the expencive components on ebay. So this is much more affordable for me.

Edit: I measured the capacitors: There is everything OK with them.
« Last Edit: January 03, 2018, 05:10:11 pm by DM2LCT »

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Rerouter
Super Contributor
Posts: 4330
Country:
Question Everything... Except This Statement

Re: AD8302 does weird things
« **Reply #4 on:** January 03, 2018, 08:47:10 pm »

and no short to ground on input A?

Page 5 of the datasheet shows the input schematic of each pin, with no signal being fed in, INPA, INPB, OFSA, OFSB should have a positive bias, it doesnt have to be 4V, but it should not be 0V,

equally with no signal fed in, INPA should be equal to OFSA, and same for input B.

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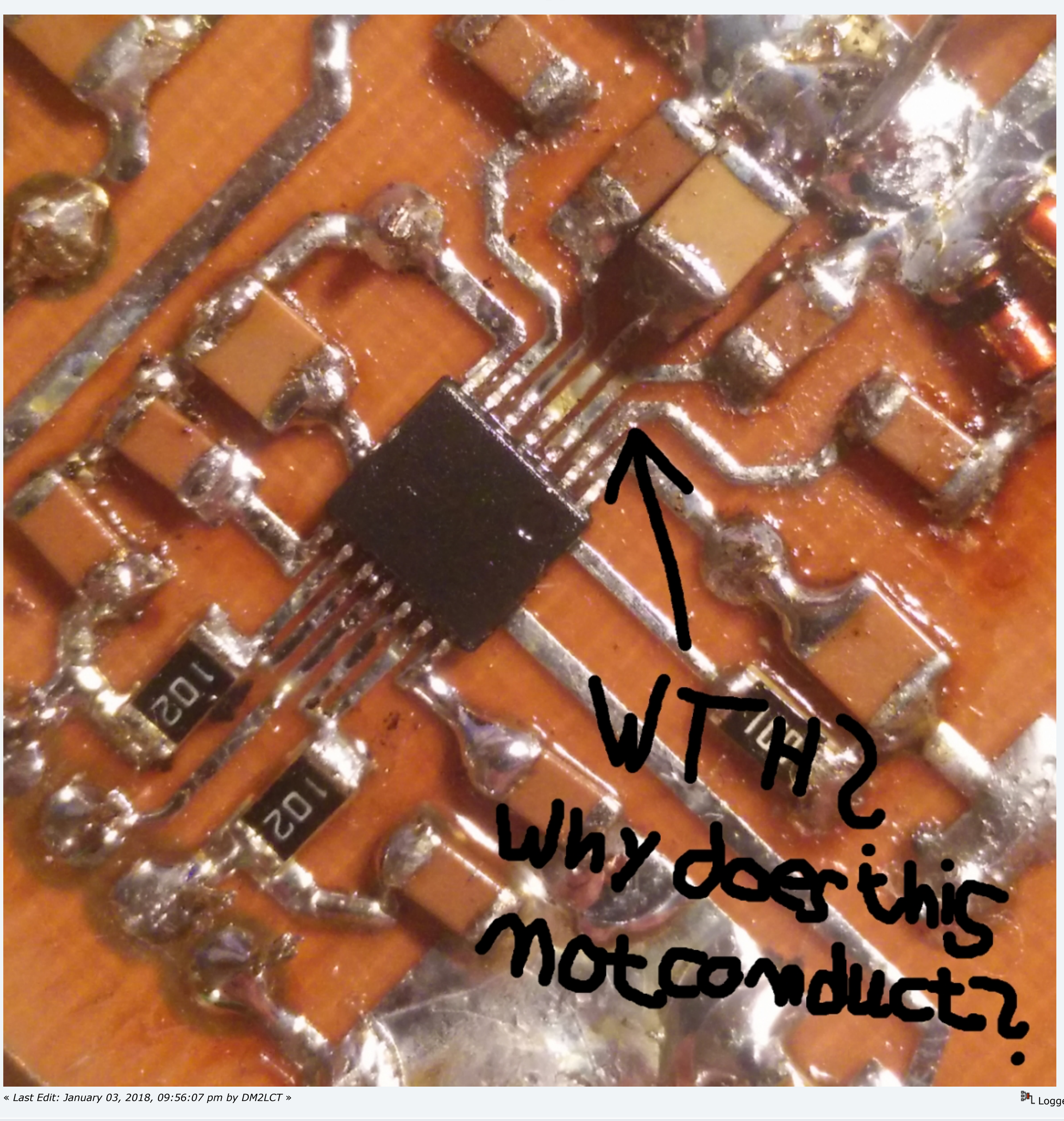
DM2LCT
Contributor
Posts: 5
Country:

Re: AD8302 does weird things
« **Reply #5 on:** January 03, 2018, 09:39:57 pm »

I now have measured again the DC offset at INPB OFSB INPA and OFSA. Now I am totally confused... I now measure at INPB and OFSB about 4.1Volts. At OFSA i measure also about 4.1V. But not at INPA. There are just a few milivolts. It seems to be shortened to ground but I also don't measure an short, not even any resistance from INPA to Ground at least not with my cheap handheld multimeter.

Edit: waaaaaaaiiiiitttt... WHY the hell does the copper track from INPA to its capacitor not conduct?



« Last Edit: January 03, 2018, 09:56:07 pm by DM2LCT »

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DM2LCT
Contributor
Posts: 5
Country:

Re: AD8302 does weird things
« **Reply #6 on:** January 03, 2018, 11:02:24 pm »

Ok. Now I have also about 4V at the decoupling capacitor of INPA. The VNA seems to measure something. But the Voltage at the VPHS output does just move a few milivolts. Tomorrow I will measure more precisely.

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1design
Regular Contributor
Posts: 121

Re: AD8302 does weird things
« **Reply #7 on:** January 04, 2018, 08:30:33 am »

Please fix the spacing between C11 and C10, that is bound to be short very soon if not already.
Also, where are the terminating resistors, from the picture they seem to be too far away from the IC for good higher frequency operation.
« Last Edit: January 04, 2018, 08:45:36 am by 1design »

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Rerouter
Super Contributor
Posts: 4330
Country:
Question Everything... Except This Statement

Re: AD8302 does weird things
« **Reply #8 on:** January 04, 2018, 11:04:15 am »

C10 and C11 are not that much of an issue, where they are touching is on a common ground plane, the other end is spread ok, Its likely from the surface tension due to the large amount of solder on the pad,

I agree the layout doesn't resound high speed RF, however the AD9851 can only realistically output up to 90Mhz, in reality closer to 60Mhz with full amplitude after the reconstruction filter, at these frequencies Independence matching lengths are not very critical.

If it was working up to a few GHz, then sure, but for that DDS, no need.

DM2LTC, keep us posted, I'm very interested in what dilemmas I may face, I'm planning to use it from 1Khz to 300Mhz for phase recovery, and a AD8307 + AD603 for much finer amplitude recovery,

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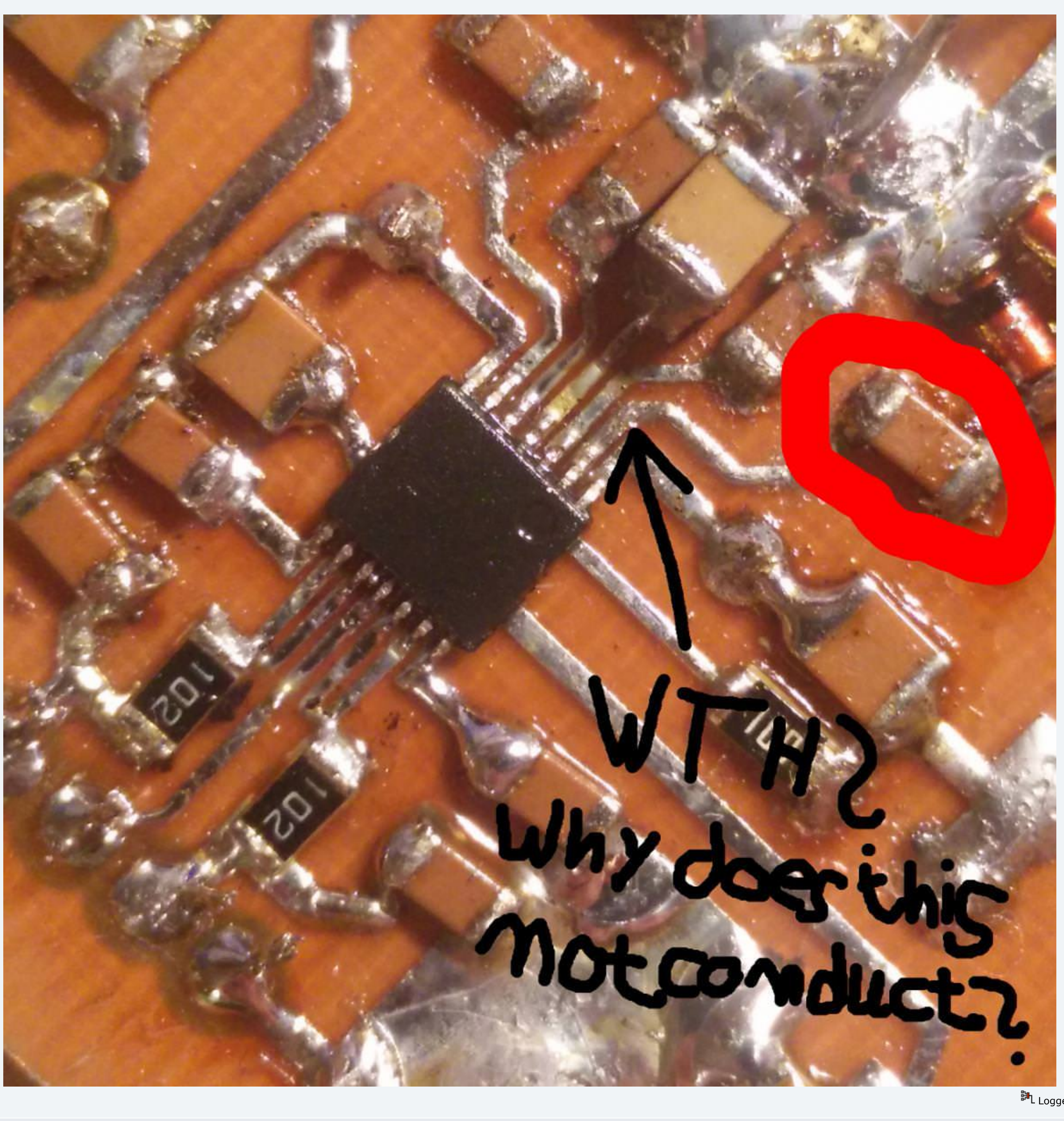
technogeeky
Frequent Contributor
Posts: 541
Country:
Older New "New Player" Player Playa'

Re: AD8302 does weird things
« **Reply #9 on:** January 04, 2018, 11:09:06 am »

It appears to me that there is a crack in this capacitor:



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Rerouter
Super Contributor
Posts: 4330
Country:
Question Everything... Except This Statement

Re: AD8302 does weird things
« **Reply #10 on:** January 04, 2018, 11:17:19 am »

looking closer at your image, it appears joints 1,2,7,9&10 could be dry joints, as the solder does not look to have flown on to the pin,

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DM2LCT
Contributor
Posts: 5
Country:

Re: AD8302 does weird things
« **Reply #11 on:** January 12, 2018, 05:19:32 pm »

Hello!

So the last few days I got a lot of work and didn't had time to look after my VNA. Today I started to measure at it but my arduino died of any reason. So I replaced the arduino. I did not change anything on my VNA board but suddenly it seems to work. The worst thing is, I don't know why it would work now. I didn't change anything.

I looked at my AD8302 and all the components around with an eyepiece of a microscope. There are no dry joints, my foto seems not to be too good...

Thank you so much for your help!

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roykjepolse
Newbie
Posts: 1
Country:

Re: AD8302 does weird things
« **Reply #12 on:** February 12, 2018, 10:29:57 pm »

Hello.

I bought a PCB from Russia and i have started to populate the PCB with parts form "Ebay".

I need to order some resistors, wich i did not have for the 3 dB attenuator (R7-8 and 14). Could i use resistor in close value, or do it have to be "spot on"?

Another question, do you know the value on R4 and R6, named Kalib, what did you use?

The last question, do you know of a english instructions?

73 de LA9RKA
Sverre

Logged