

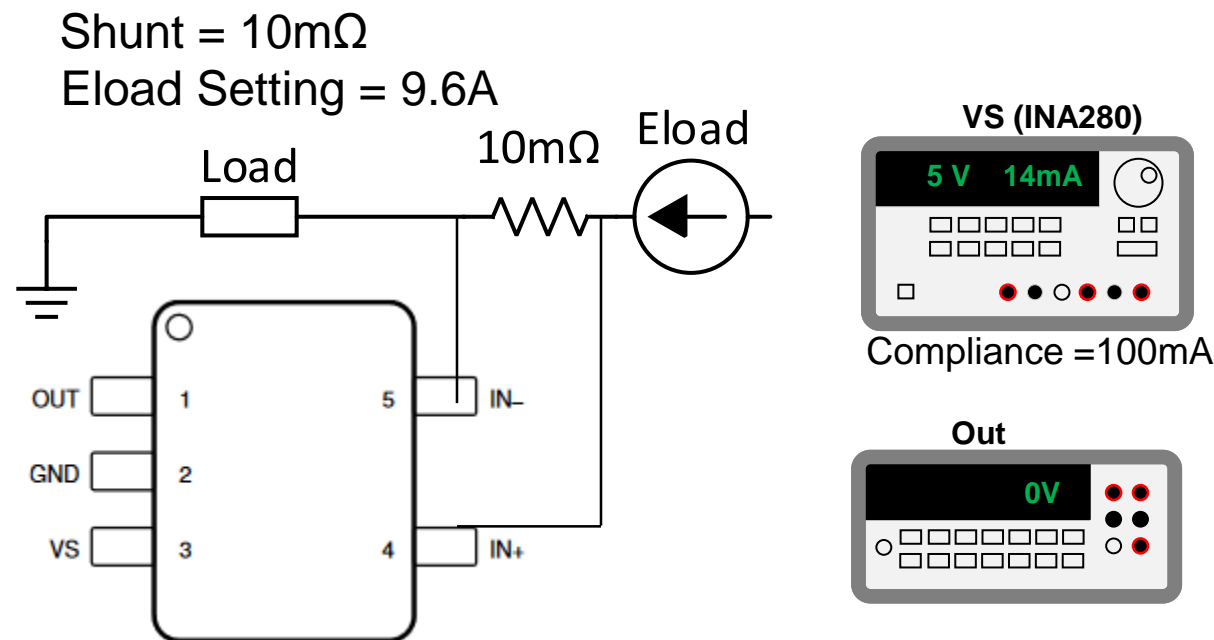
Debugging a Current Shunt Monitor circuit – Probe Placement and Soldering

TI Precision Labs – Current Sense Amplifiers

QUIZ

Debugging a Current Shunt Monitor – Probe Placement and Soldering – Quiz

1. An Electronic Load (Eload) is rigged up such that it supplies forward current across a shunt that is sensed across pins IN+ and IN-. Given the following details, what is likely happening with this INA280A3?
- IN- and IN+ shorted
 - VS is shorted to GND
 - OUT is shorted to GND
 - Unable to determine from information.



1 Features (INA280)

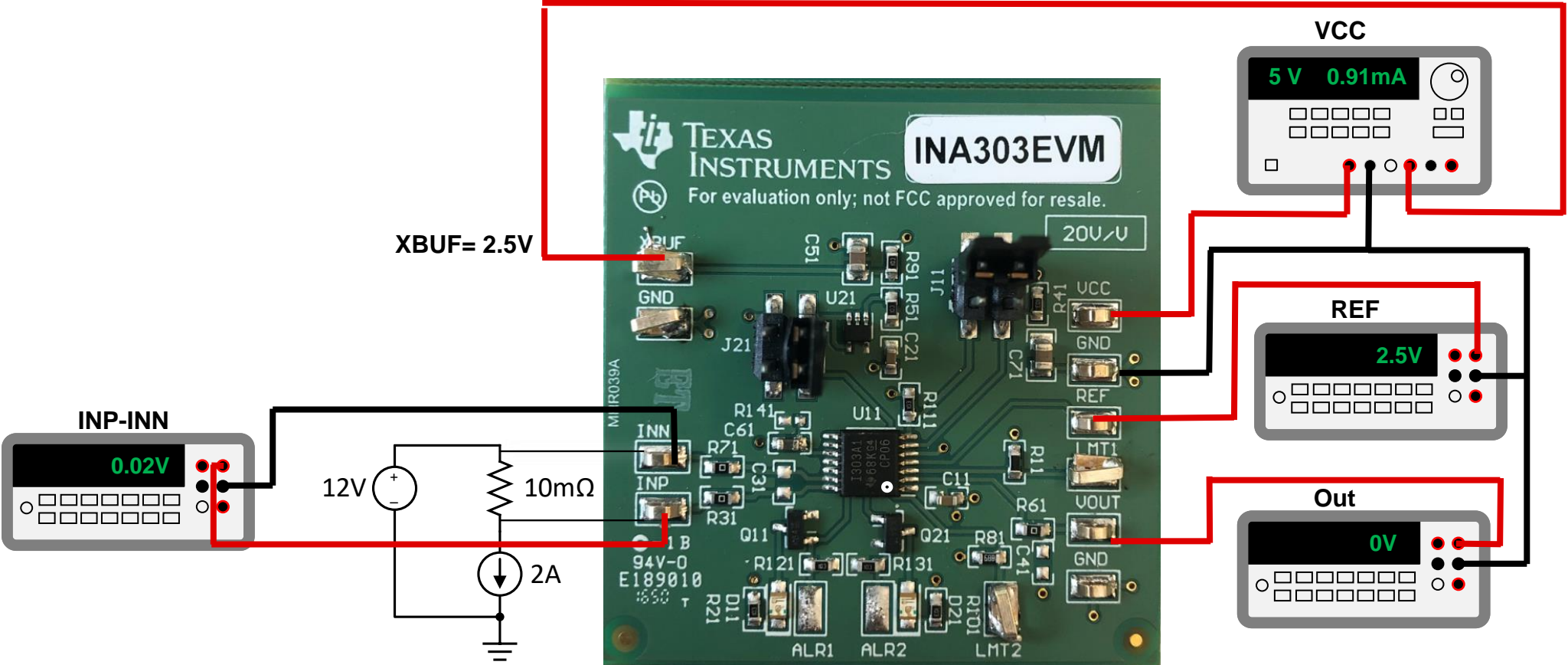
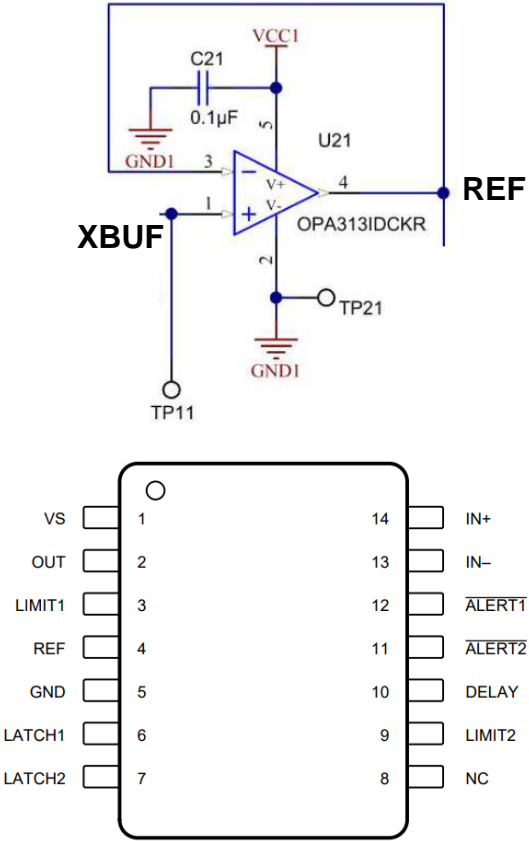
- Wide common-mode voltage:
 - Operational voltage: 2.7 V to 120 V
 - Survival voltage: -20 V to +122 V
- Excellent CMRR:
 - 120-dB DC (Minimum)
 - 85-dB AC at 50 kHz
- Accuracy
 - Gain:
 - Gain error: ±0.5% (maximum)
 - Gain drift: ±20 ppm/°C (maximum)
 - Offset:
 - Offset voltage: ±150 μV (maximum)
 - Offset drift: ±1 μV/°C (maximum)
- Available gains:
 - INA280A1: 20 V/V
 - INA280A2: 50 V/V
 - INA280A3: 100 V/V
 - INA280A4: 200 V/V
 - INA280A5: 500 V/V
- High bandwidth: 1.1 MHz
- Slew rate: 2 V/μs
- Quiescent current: 370 μA

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2. We are attempting to operate our device with a 5V supply, 2.5V Reference, and 12V common mode at 25°C. Buffer amplifier V- terminal connected to board GND. We notice that our Out = 0V, can we assume the part is broken and no further debug is needed?

- a) Yes
- b) No

POWER SUPPLY					
I_Q	Quiescent current	$T_A = 25^\circ\text{C}$	850	950	μA
		$T_A = -40^\circ\text{C to } +125^\circ\text{C}$		1150	

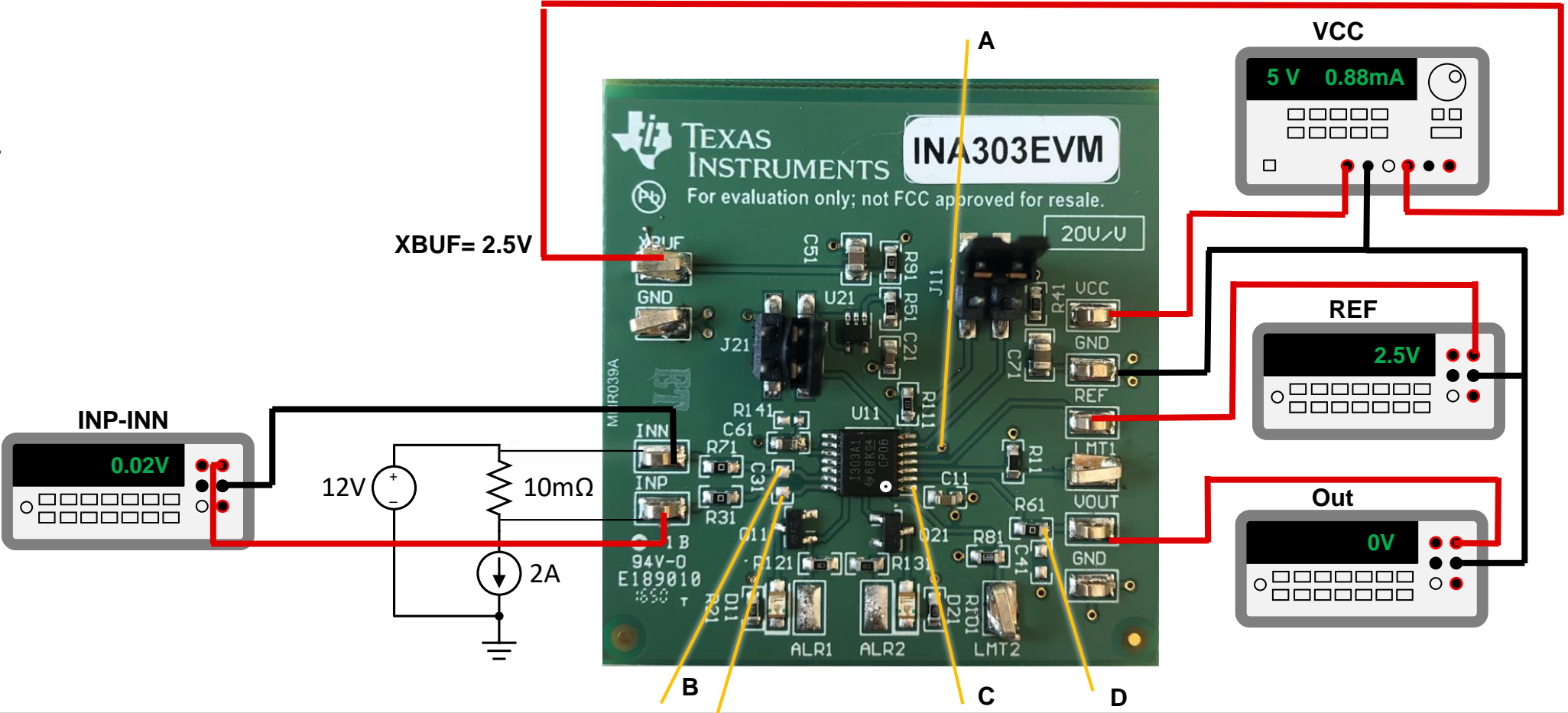
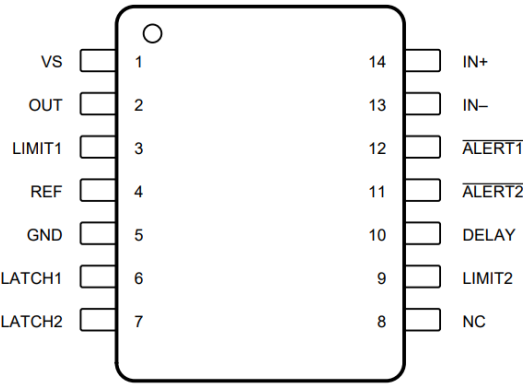
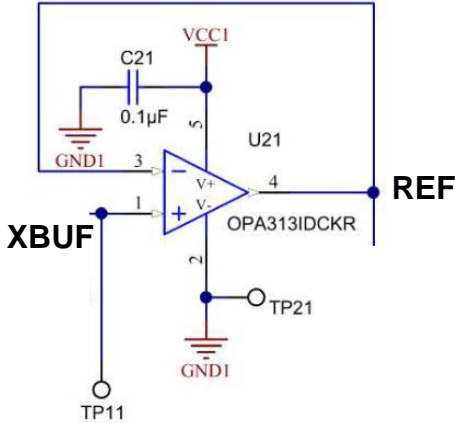


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3. We swapped in a known good part and noticed similar behavior to the last. Buffer amplifier V-terminal connected to board GND. Where would be the next logical place(s) to probe?

- a) A
- b) B
- c) C
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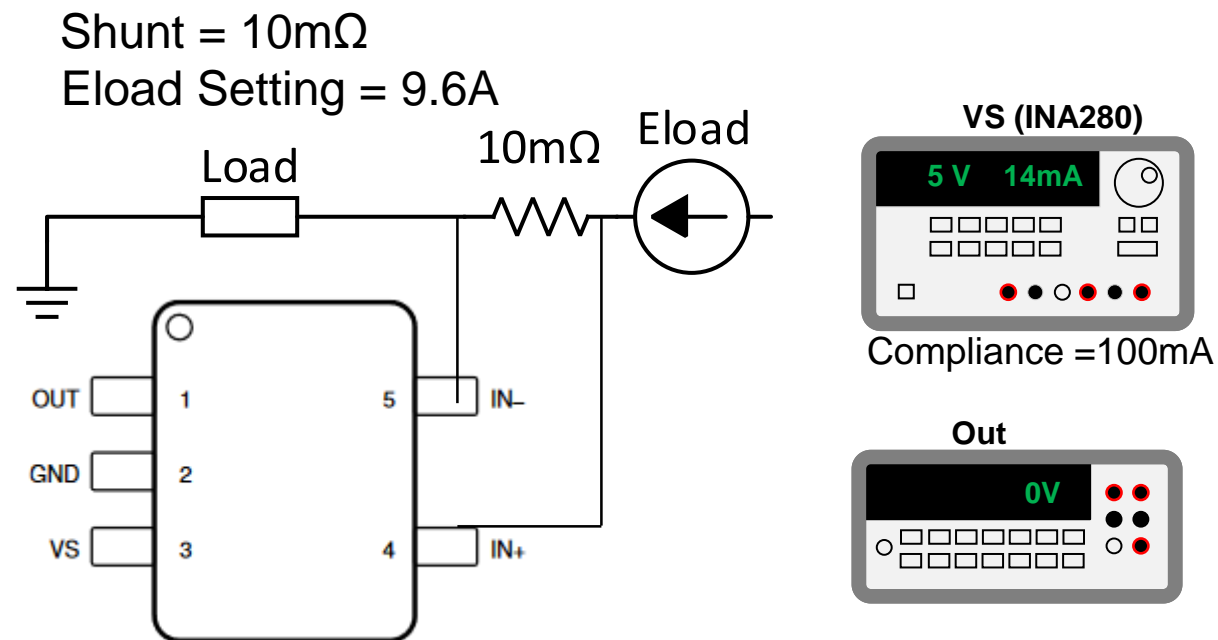


Answers

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 - a) IN- and IN+ shorted
 - b) VS is shorted to GND
 - c) OUT is shorted to GND**
 - d) Unable to determine from information.

The best answer here is OUT is shorted to GND. While we do not have enough details from the Eload side to determine if there is a connection issue to the input pins, we do have details from the supply that suggest there is a connection issue with the supply. Based on the features section pulled from the datasheet, we should see a quiescent current lower than 25mA. If VS were shorted directly to GND, we would expect the supply to hit the compliance value set. If the compliance was set even higher, we might expect to hear a pop when the solder bridge shorting VS and GND fused open. As the supply definitely has an issue, the only logical choice left is that OUT is shorted to GND. This actually corresponds to the short circuit graph and claw curves



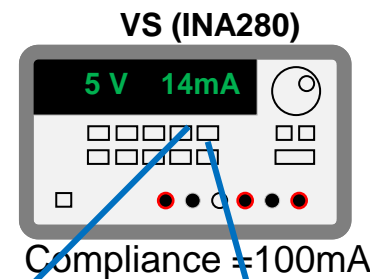
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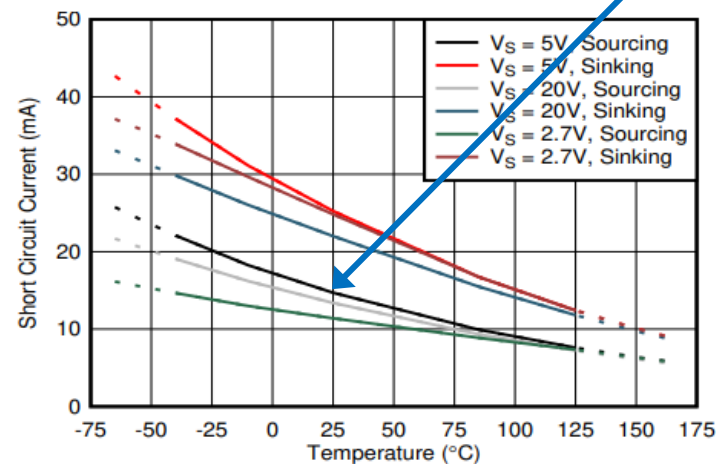


Figure 6-20. Short-Circuit Current vs Temperature

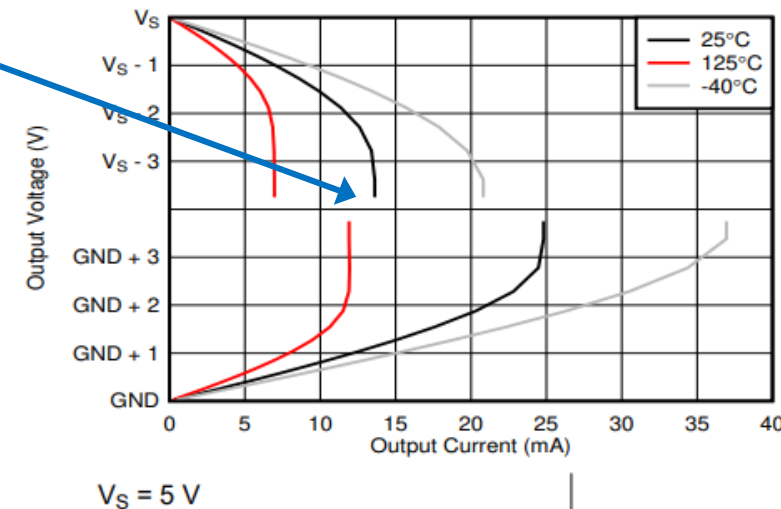


Figure 6-11. Output Voltage vs Output Current

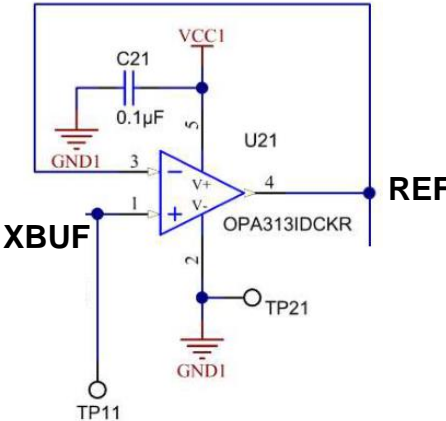
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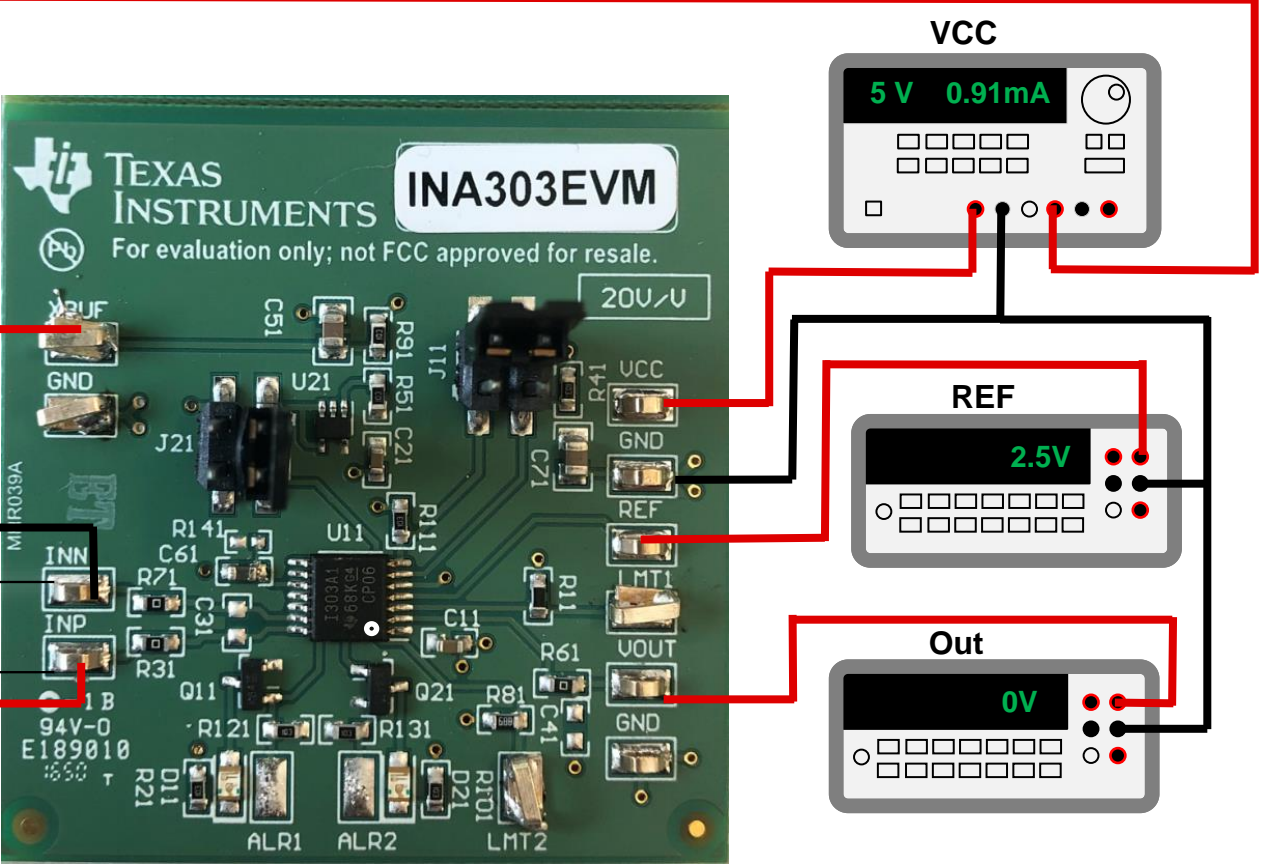
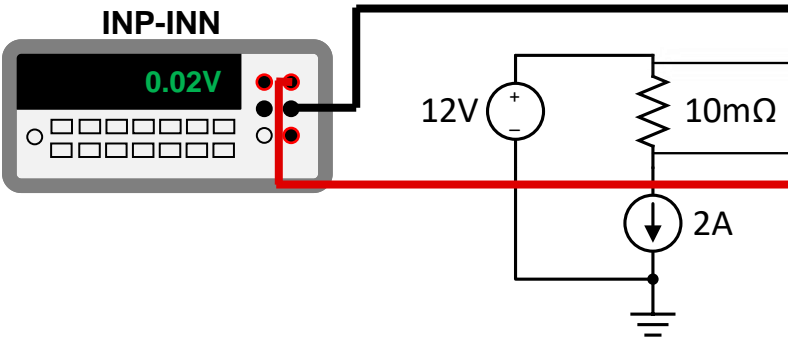
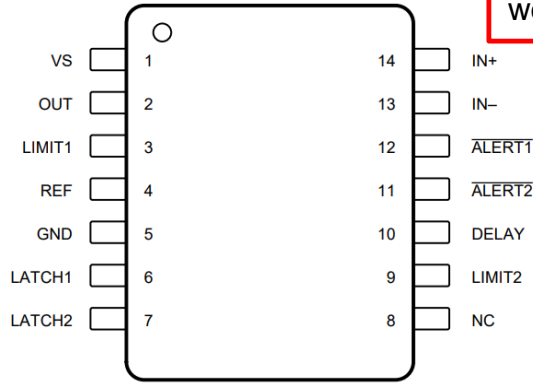
a) Yes

b) No

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We cannot assume that it is broken just yet. The supply indicates that there is current being pulled and while it is above the device typical value, it is still within specification. The REF meter indicates that there is a good signal path from XBUF to the device reference as the device ref pin is between REF test point and the XBUF output. One thing to note is that for INP, INN, and OUT, we are probing at test points and not at the device pins. While they are more convenient to work with, they may not accurately reflect the potential at the device value as there are resistors between the test points and the device. Its possible that these may not be soldered down as well as we think.



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Yet again the quiescent current suggests the device is working properly, which eliminates the need to probe VS (C) and GND (A). While it is possible that the series resistor on the output could be open, option D would be probing on the wrong side of the device to verify that. This leaves only choice B which has us probing the input pins where an optional input filter cap could be placed. While this is not directly at the device pin, there is no device between that could have a bad solder connection other than the INA303.

