

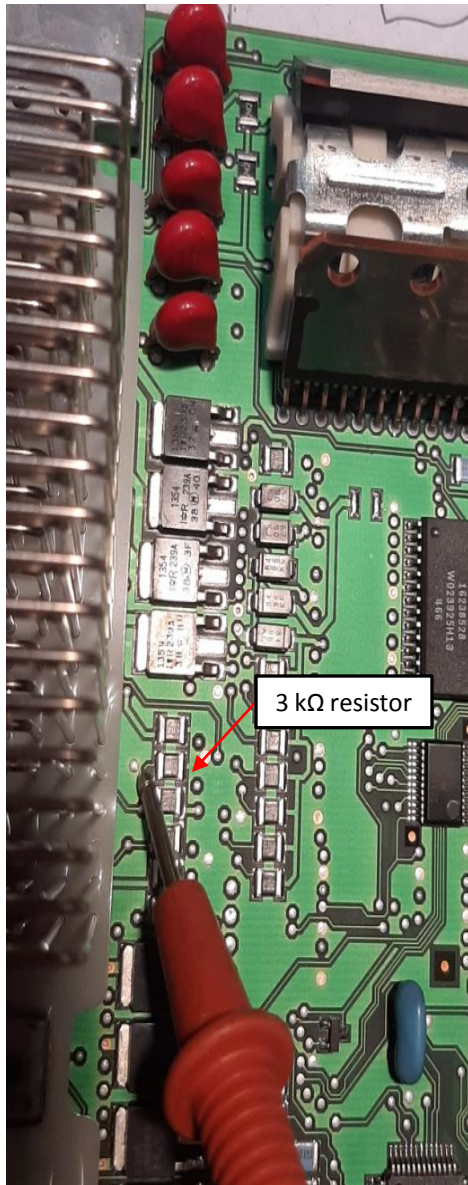
Modifying P59 Blue Green PCM For AC Analog Request*

Rocketmench

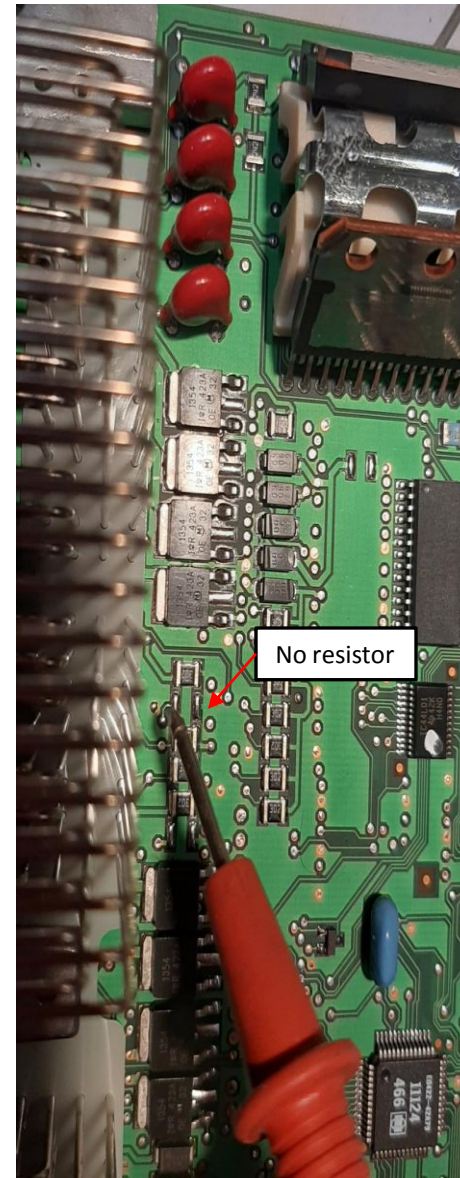
2/8/2021

* PCM's that already have analog A/C request circuitry (and IAC drivers for DBC) from factory:
Service Numbers: 12576106, 12581565, 12586243, 12589462, 12602801

Service No 12576106
IAC, Analog AC present

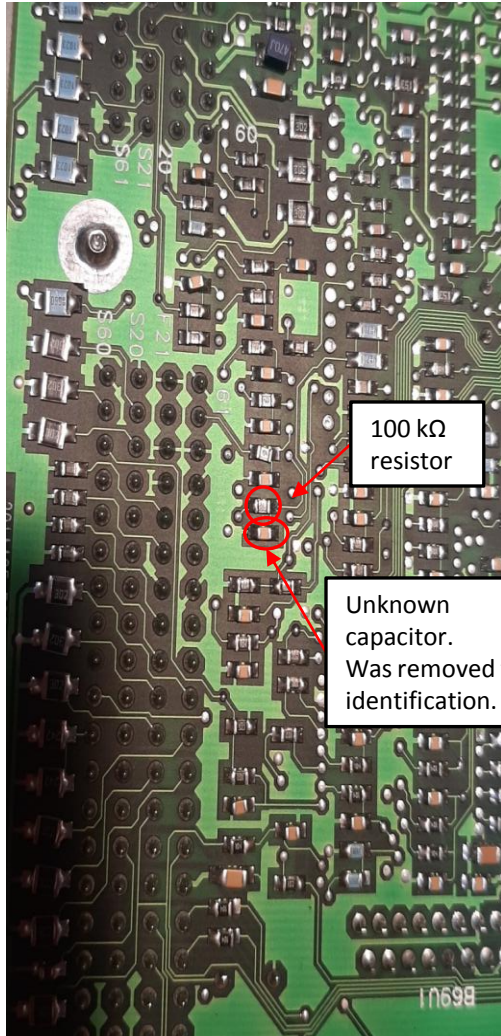


Service No 12586242
No IAC No Analog AC



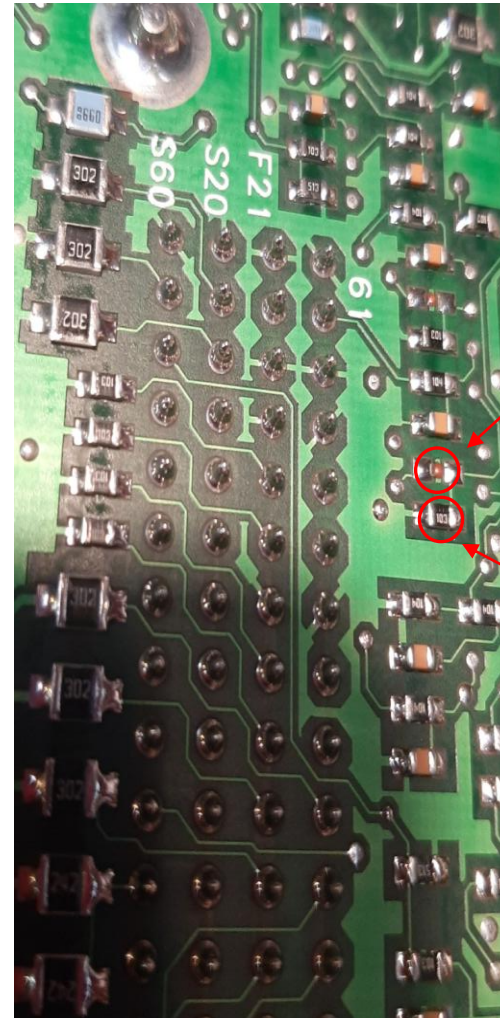
Service No 12576106
IAC, Analog AC present

C2 Connector



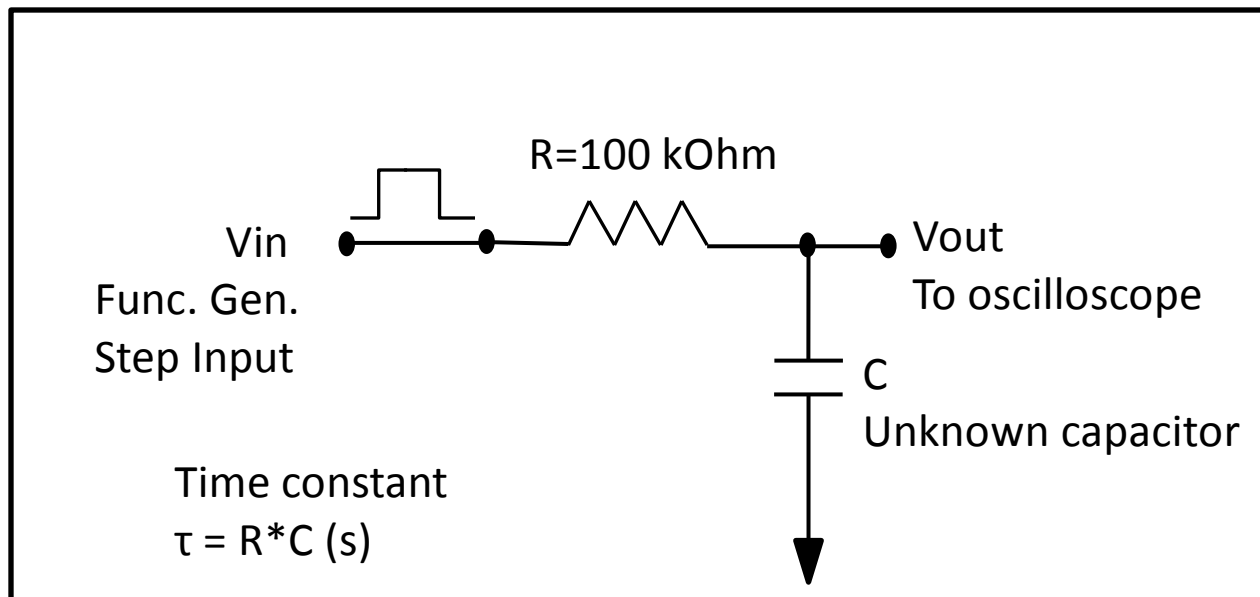
Service No 12586242
No IAC No Analog AC

C2 Connector



- Resistors have markers for identification.
- Capacitor lacks marker requiring step response test.
- Capacitor removed from board for testing.
- RC circuit used to determine C from step input time response.

Step response test circuit



Derivation of Step Response RC circuit

Governing equation

$$\frac{(V_{in} - V_{out})}{R} = C \frac{dV_{out}}{dt}$$

Non homogeneous equation

$$\frac{dV_{out}}{dt} + \frac{1}{RC} V_{out} = \frac{1}{RC} V_{in}$$

Superposition $v_t = v_f + v_n$
 v_t = total solution
 v_f = forced solution
 v_n = natural solution

Forced Soln. $v_f = K_f$

$$\frac{dK_f}{dt} + \frac{1}{RC} K_f = \frac{1}{RC} V_{in}$$

$$\frac{1}{RC} K_f = \frac{1}{RC} V_{in}$$

$$K_f = V_{in}$$

Natural Soln. $\frac{dv_n}{dt} + \frac{1}{RC} v_n = 0$ Homogeneous equation

$$v_n = K_n e^{st}$$

$$K_n e^{st} + \frac{1}{RC} K_n e^{st} = 0$$

$$K_n e^{st} \left(s + \frac{1}{RC} \right) = 0$$

$$s + \frac{1}{RC} = 0$$

$$s = -\frac{1}{RC}$$

$$V_n = K_n e^{-t/RC}$$

$$v_t = v_f + v_n$$

$$v_t = V_{in} + K_n e^{-t/RC}$$

$$V_o = V_{in} + K_n e^{-0/RC}$$

$$V_o = V_{in} + K_n$$

$$K_n = V_o - V_{in}$$

$$V_{out} = v_t = V_{in} + (V_o - V_{in}) e^{-t/RC}$$

$$V_o = 0 \quad \text{Initial condition}$$

$$V_{out} = V_{in} \left(1 - e^{-t/RC} \right)$$

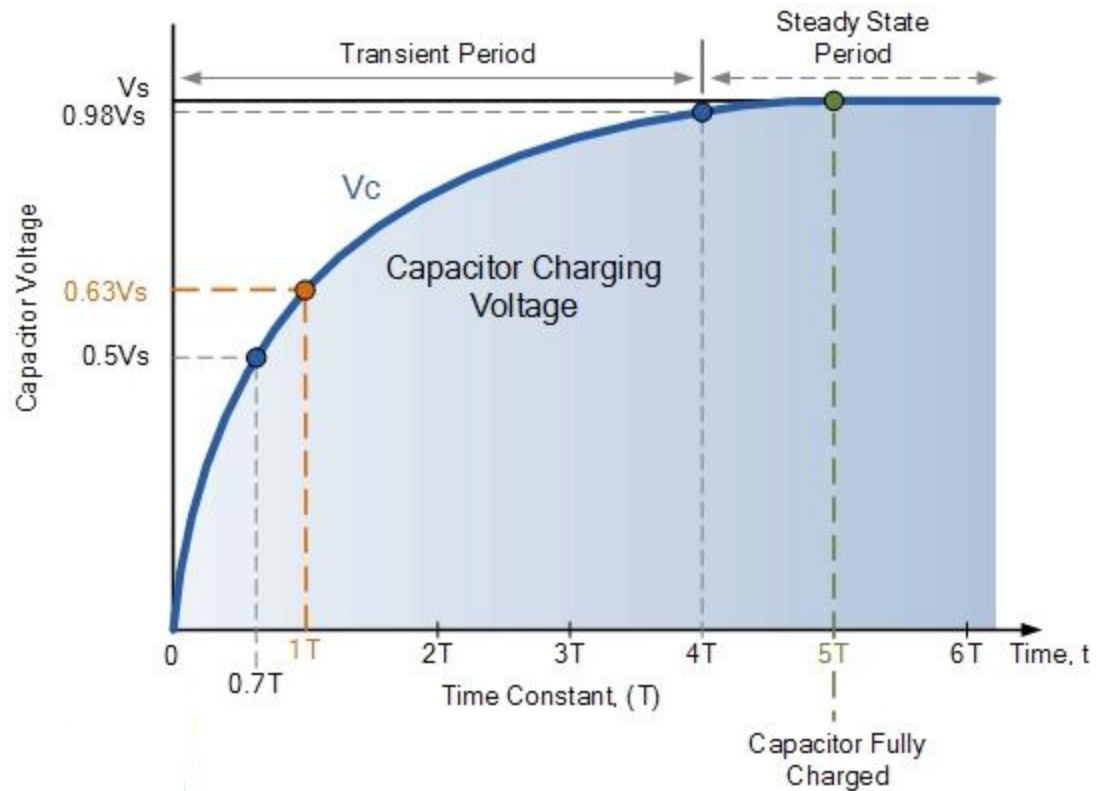
$$\tau = RC$$

$$V_{out} = V_{in} \left(1 - e^{-t/\tau} \right)$$

Step Response
 When $t = \tau$,
 $V_{out} = 63.2\% V_{in}$

$$V_{out} = V_{in} \left(1 - e^{-t/\tau} \right)$$

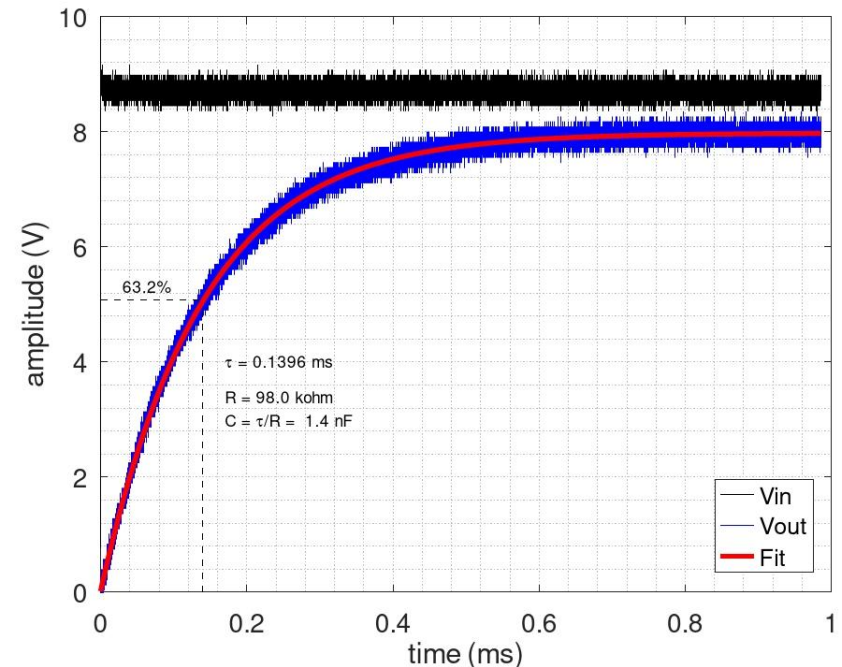
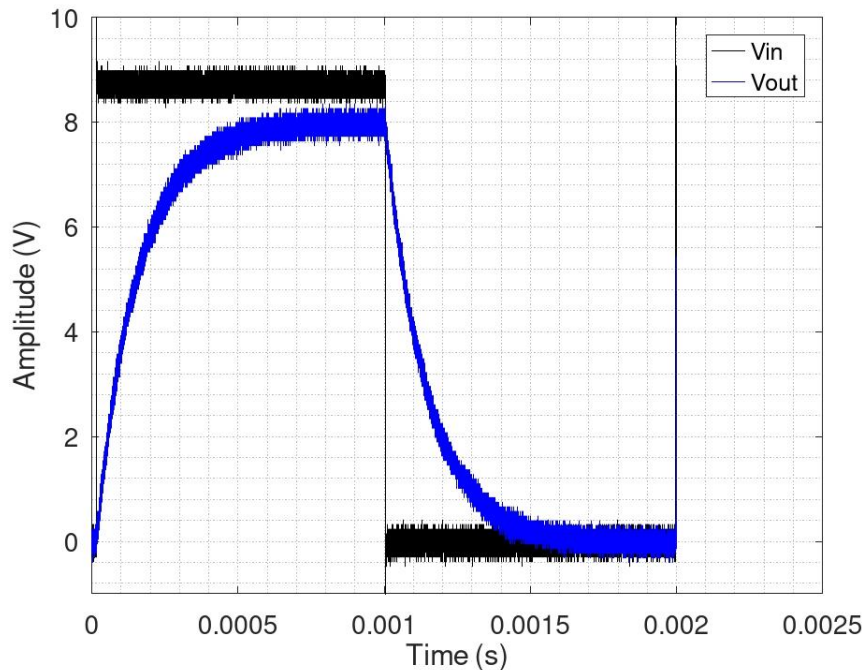
$$\tau = RC$$



Determining value of missing capacitor

- Extracted (unlabelled) capacitor from PCM at A/C request. Performed step response test using function generator and oscilloscope with capacitor in parallel with known resistor.
- Time constant $\tau = R \cdot C =$ time to rise to 63.2% of final value.
- $R=98 \text{ k}\Omega$. $\tau = 0.1396 \text{ ms}$. **Therefore C = ~ 1.4 nF.**

First-order step response

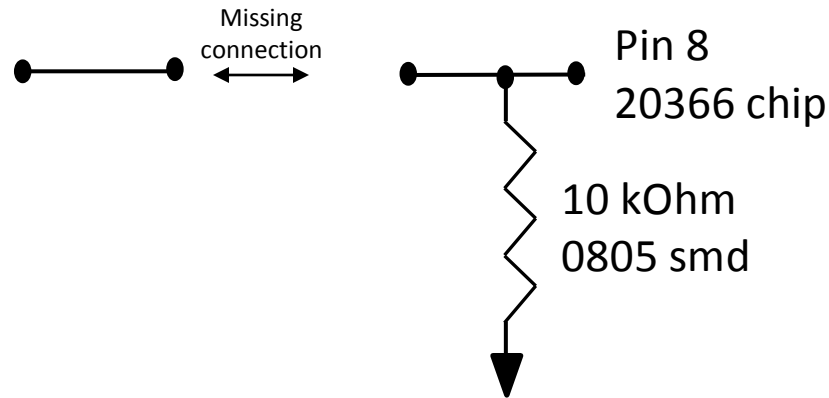


Circuit for analog AC request

PCM's that do not accept A/C analog request

C2 Pin 17
AC request
12 V in

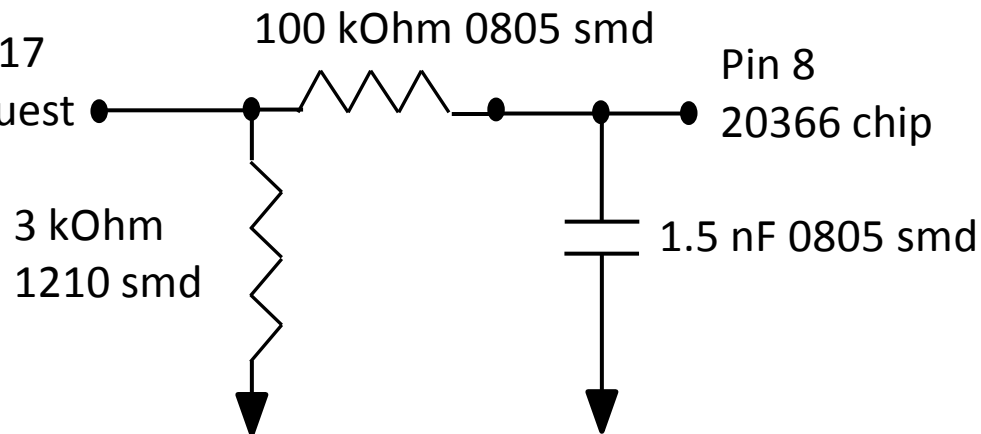
Before fix



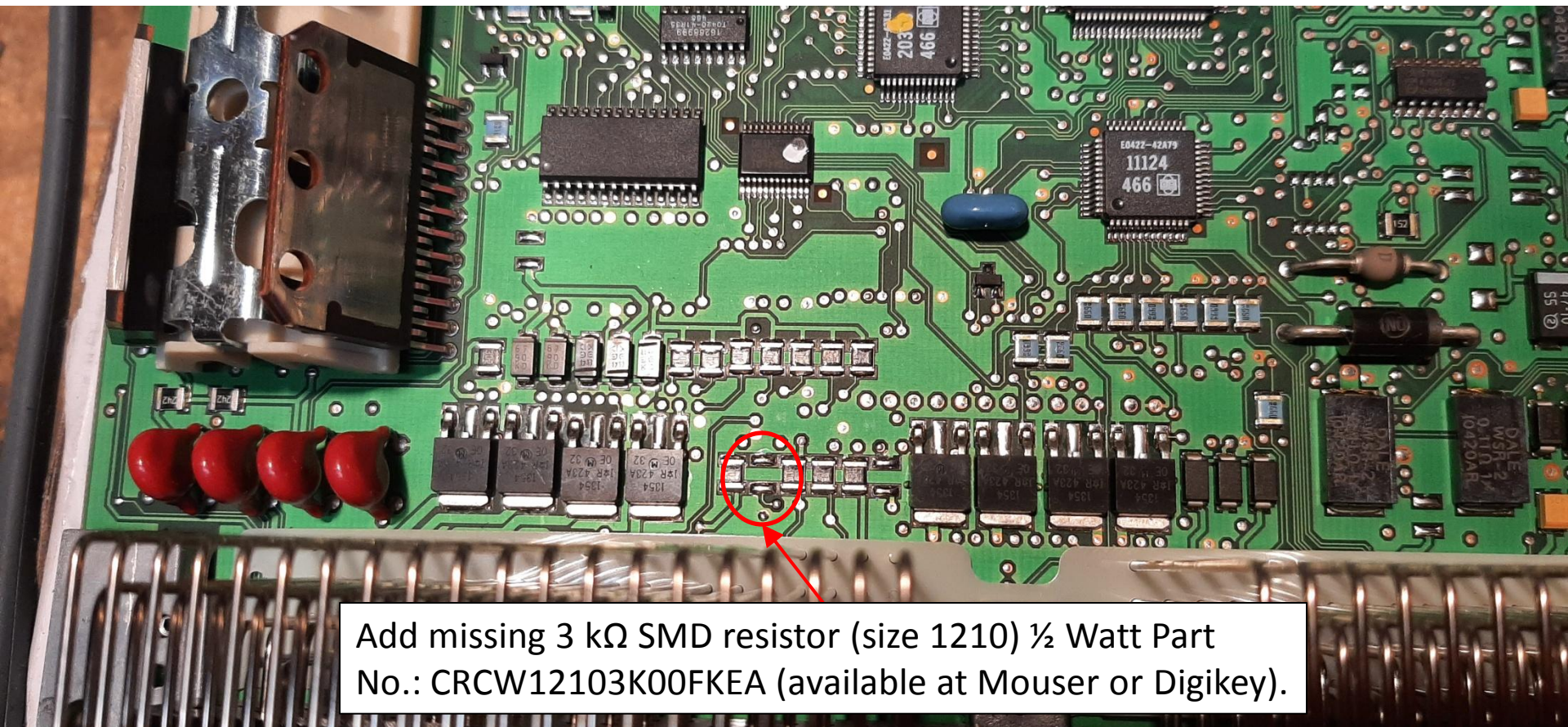
PCM's that do accept A/C analog request

C2 Pin 17
AC request
12 V in

After fix

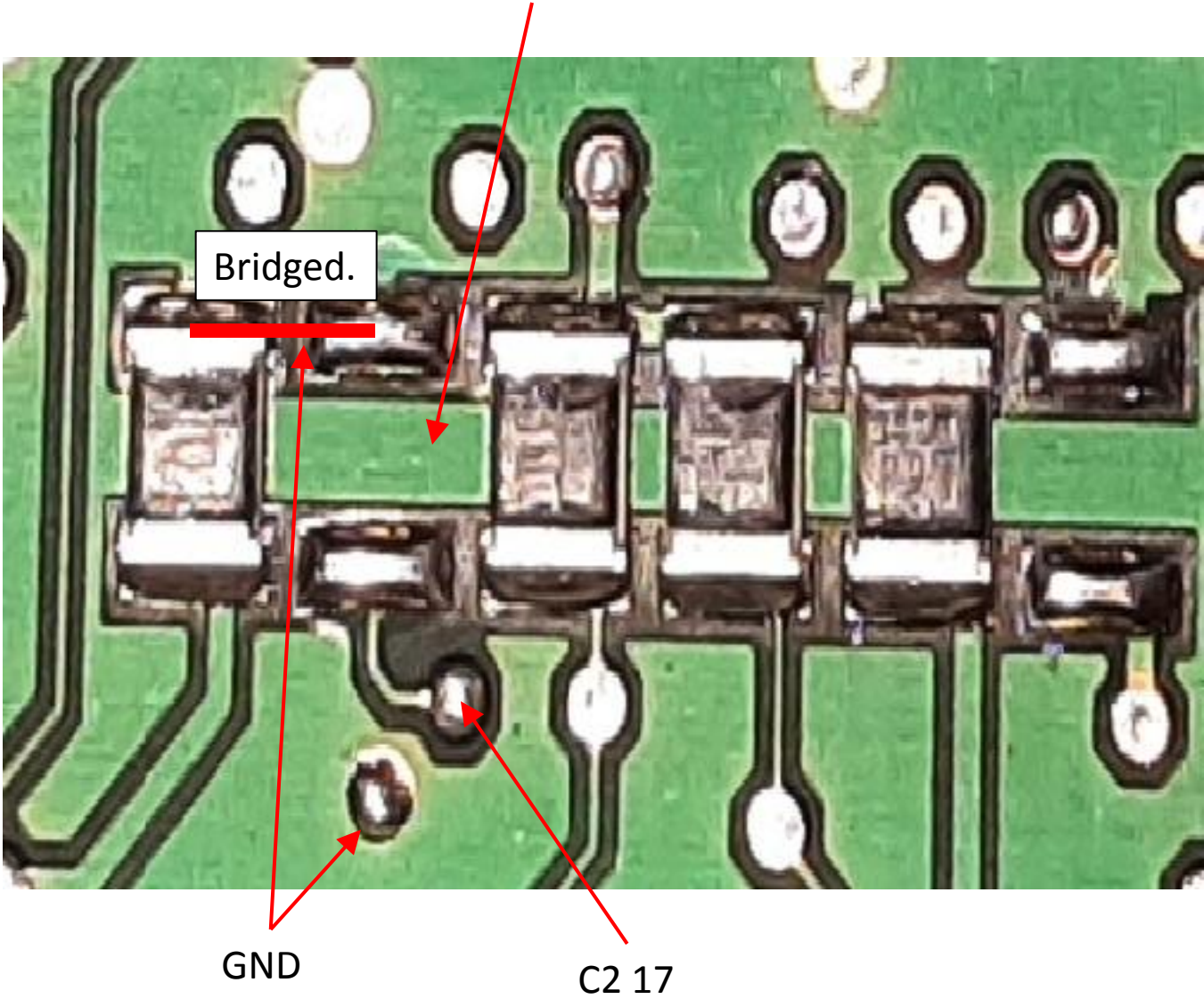



Modifications to P59 PCMs that do not support A/C analog request on C2 17.
Step 1: Add missing 3 k Ω resistor.



Add missing 3 k Ω SMD resistor (size 1210) ½ Watt Part No.: CRCW12103K00FKEA (available at Mouser or Digikey).

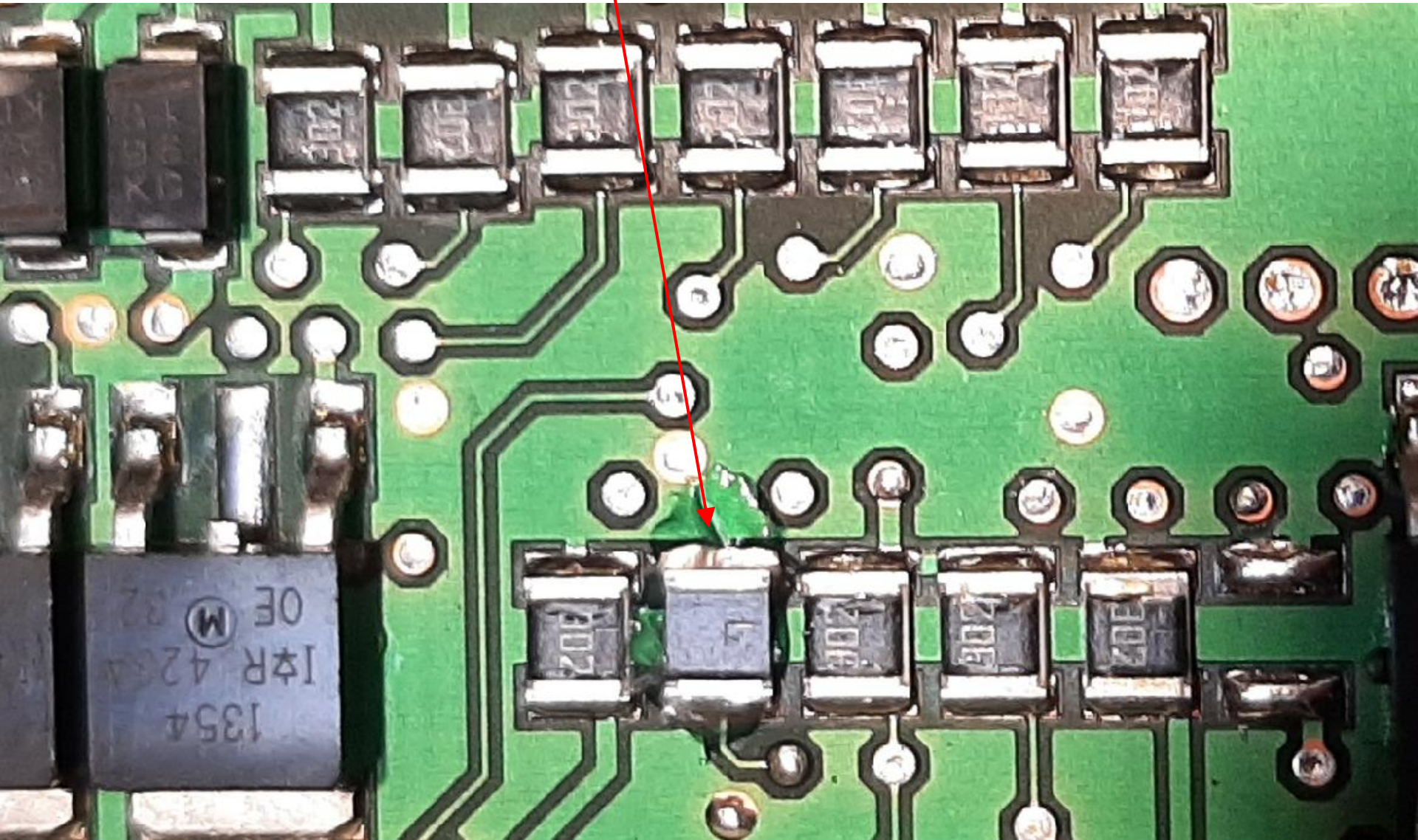
Closeup: add new ½ Watt 3kΩ 1210 SMD resistor here.



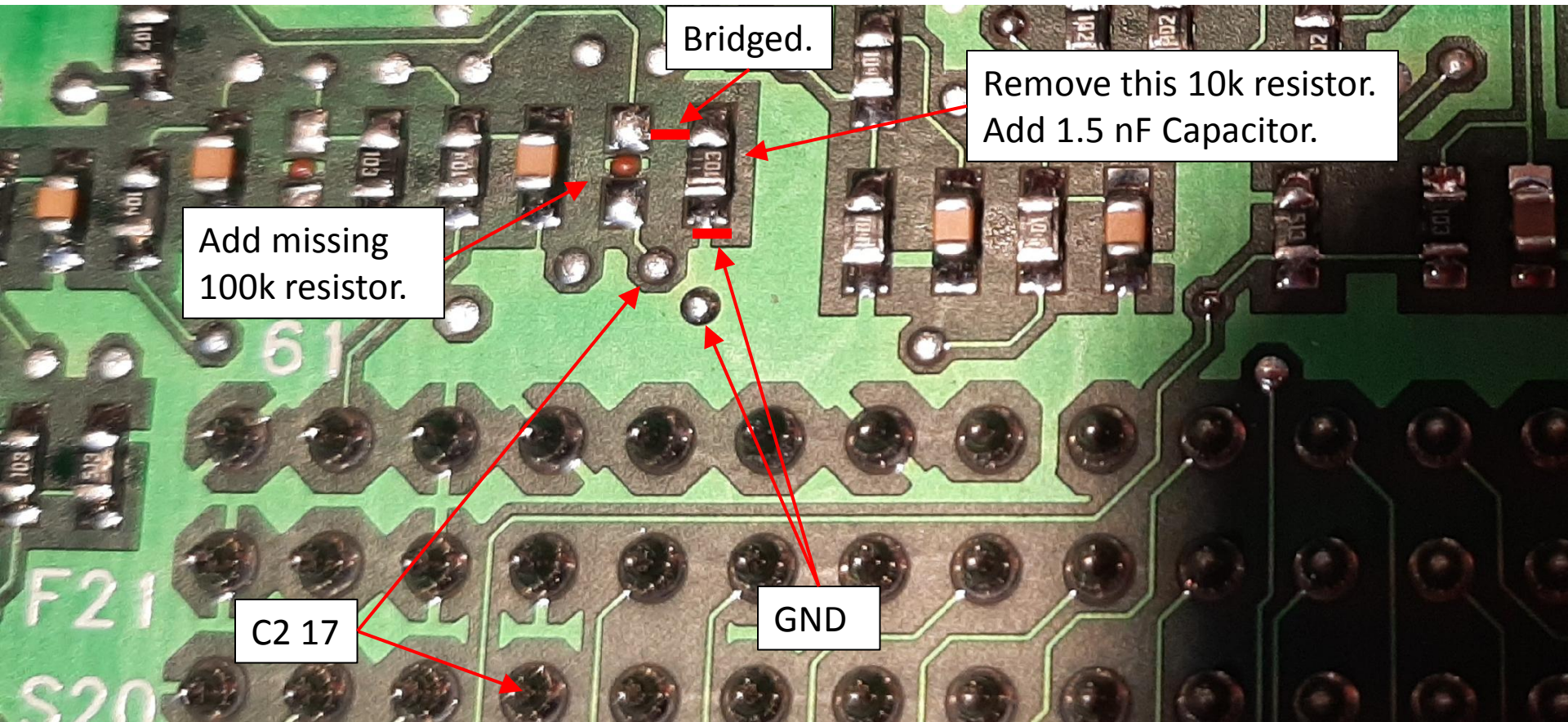
The image shows two long, thin, silver-colored metal strips, likely lead wire, positioned horizontally. Below them, a small, square, black resistor component is visible. A text box is overlaid on the image, providing details about the resistor.

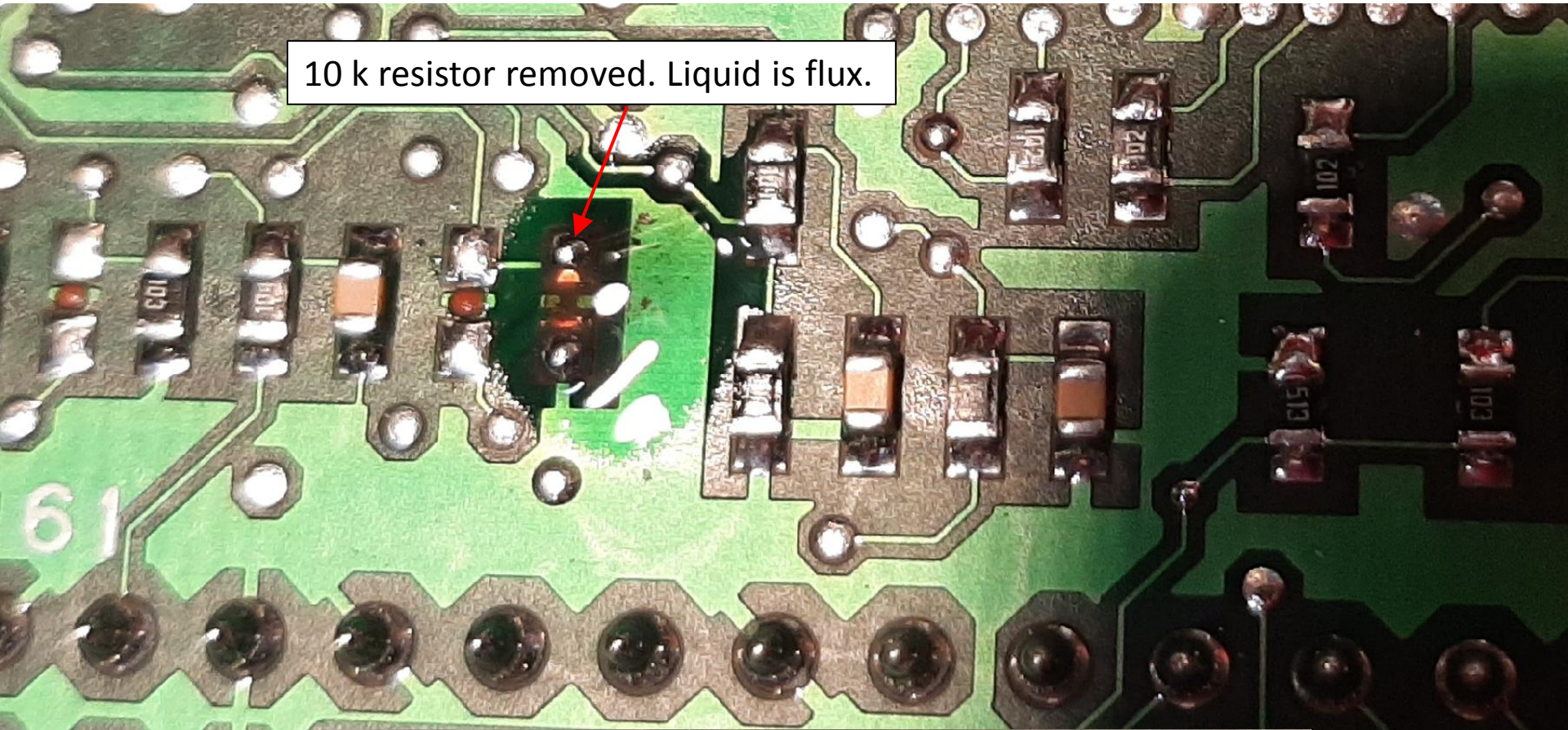
New 1210 3 k Ω ½ Watt SMD resistor.
Part No: CRCW12103K00FKEA.

New 3 kΩ resistor soldered into place



Step 2: Flip the board over. Remove 10k resistor.





10 k resistor removed. Liquid is flux.

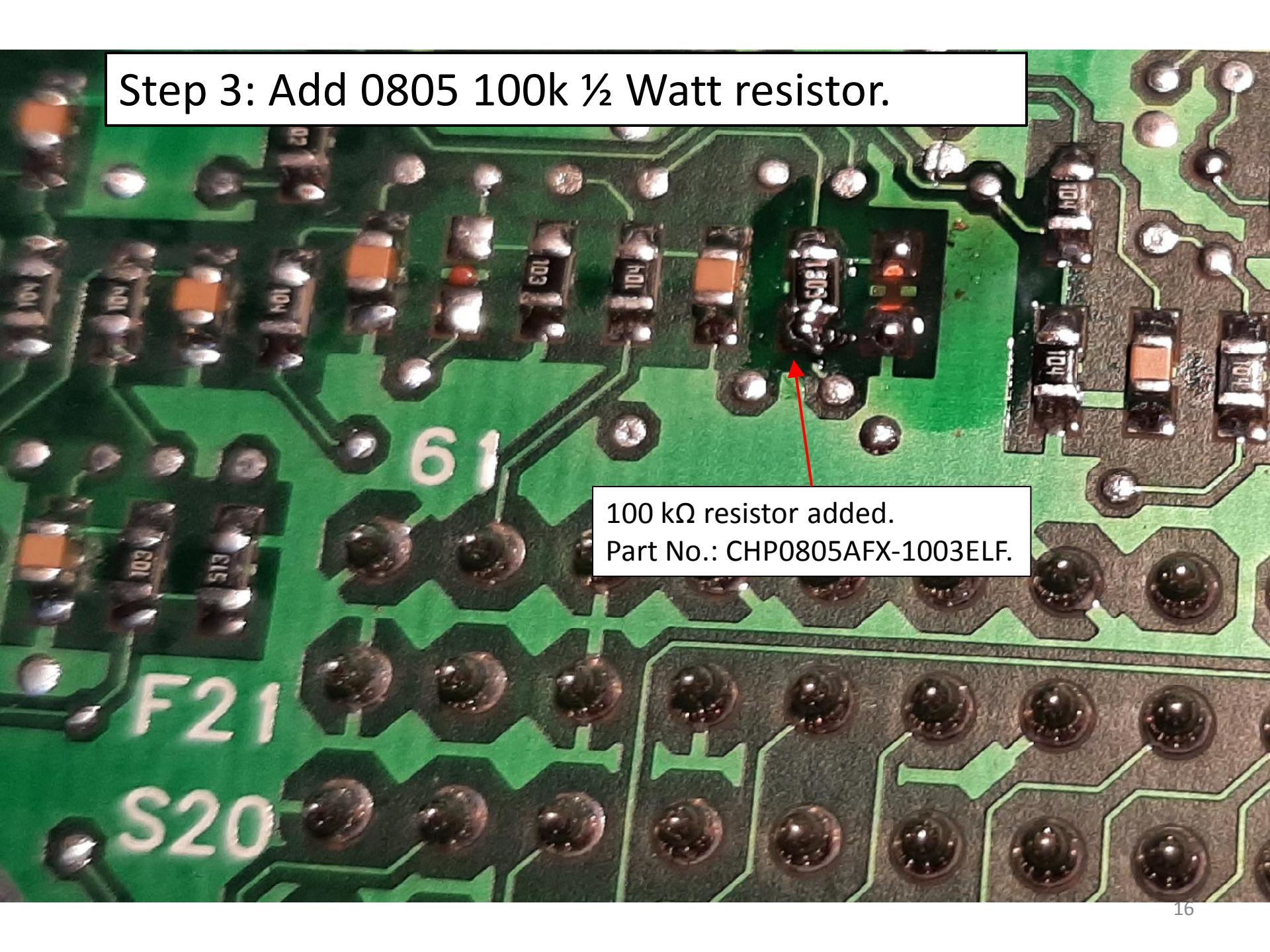
Flux. Clean with alcohol.




New 100 k Ω 0805 ½ Watt SMD resistor.
Part No.: CHP0805AFX-1003ELF



Step 3: Add 0805 100k ½ Watt resistor.

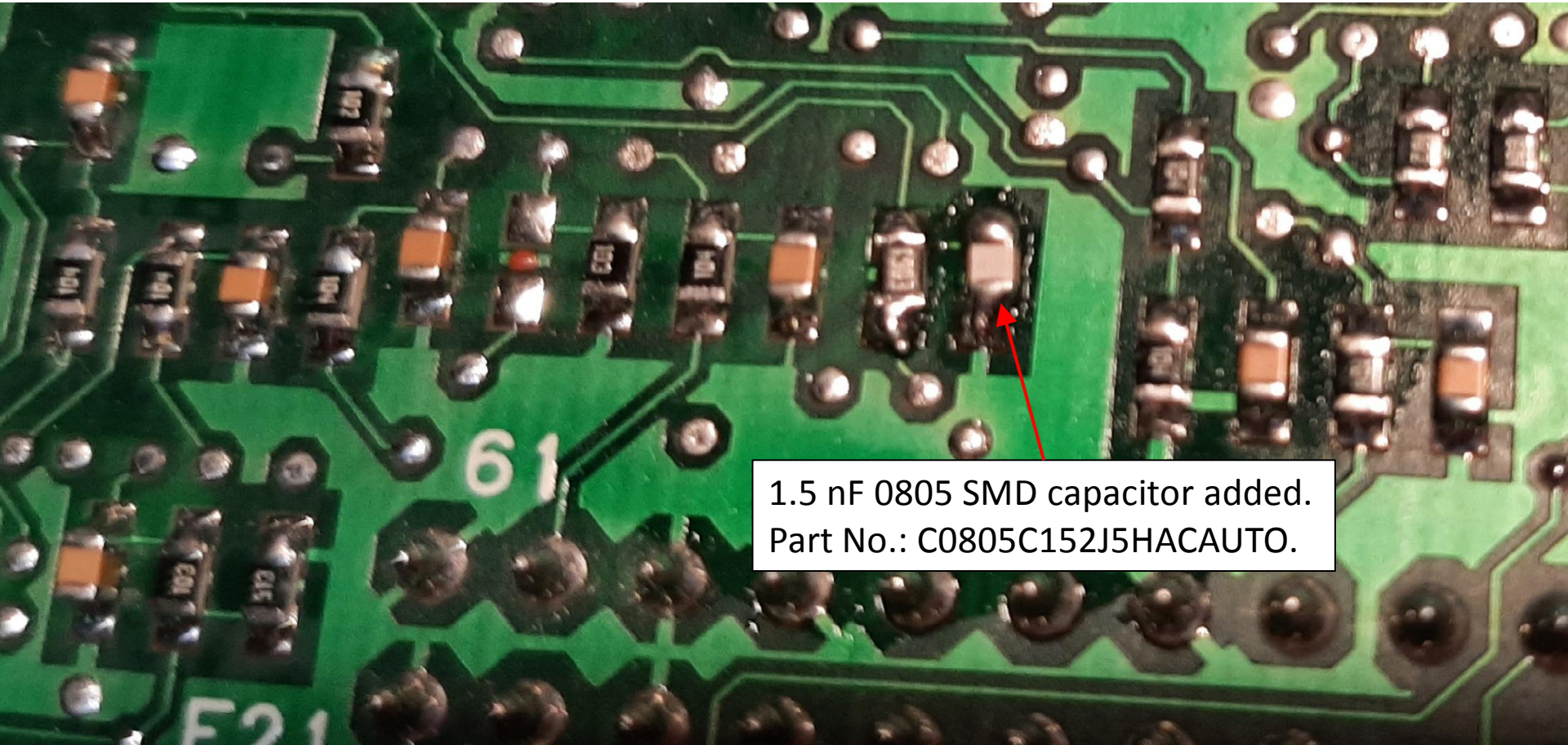


100 kΩ resistor added.
Part No.: CHP0805AFX-1003ELF.



New 50V 1.5 nF 0805 capacitor.
Part No.: C0805C152J5HACAUTO.

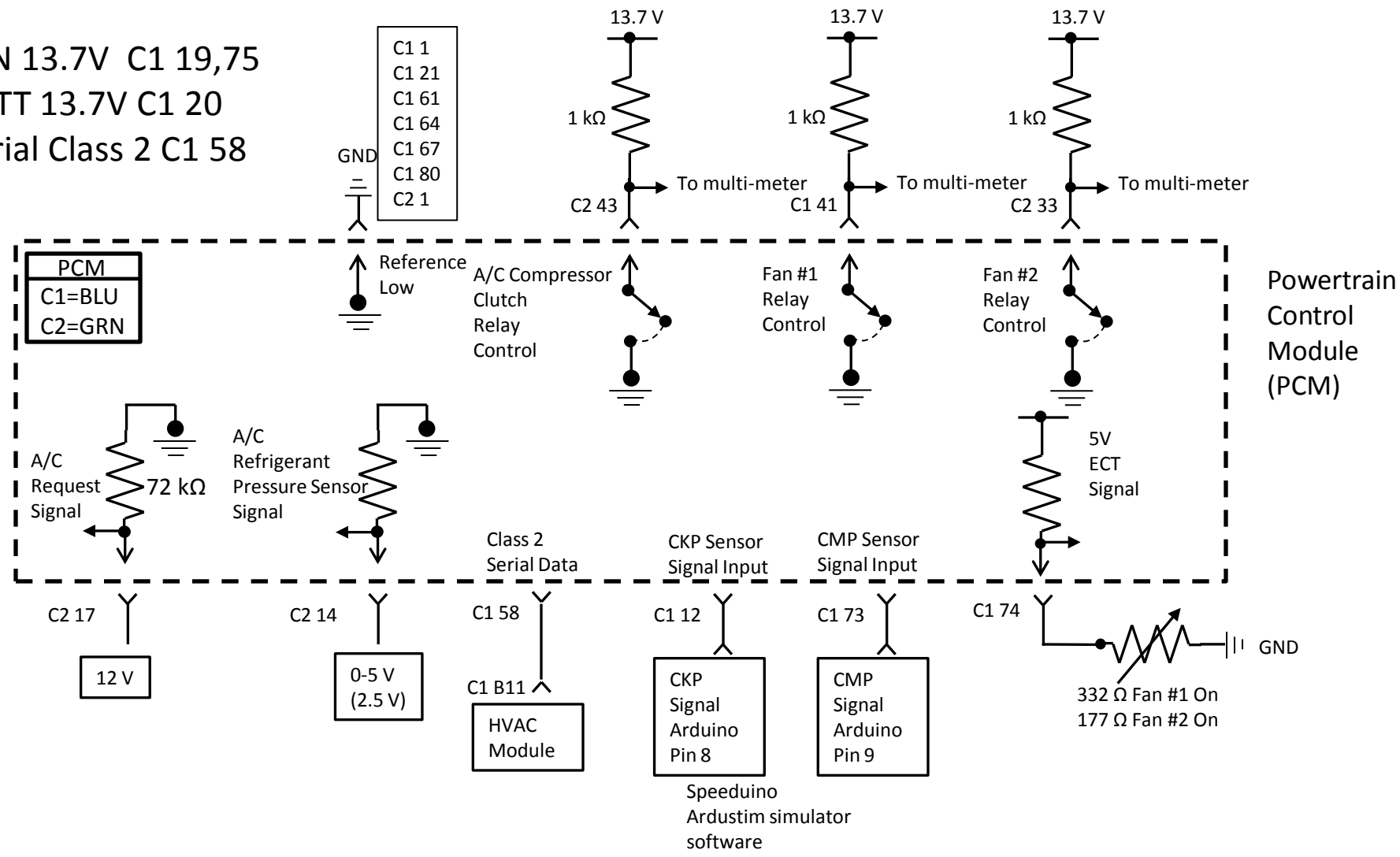
Step 4: Add 1.5 nF Capacitor.



1.5 nF 0805 SMD capacitor added.
Part No.: C0805C152J5HACAUTO.

Setup for Benchtop Testing of PCM

IGN 13.7V C1 19,75
 BATT 13.7V C1 20
 Serial Class 2 C1 58



Notes:
 PCM requires between 2854 kPa(high) and 241 kPa (low) for A/C relay control to work.

Low Fan on/off - 226.41°F / 219.17°F
 High Fan on/off - 233.59°F / 227.33°F

My Setup

2003-2007 GM HVAC Module

5kohm potentiometer to simulate ECT sensor.

IGN Switch

Blue-Green P59 PCM

Oscilloscope

Power supply provides Batt, IGN, AC press. sensor signal.

OBDX Pro VT OBD2 scanner and LSDroid/Tunerpro for programming.

Arduino Nano running modified stand-alone ardustim code to provide CKP, CMP signals.

