

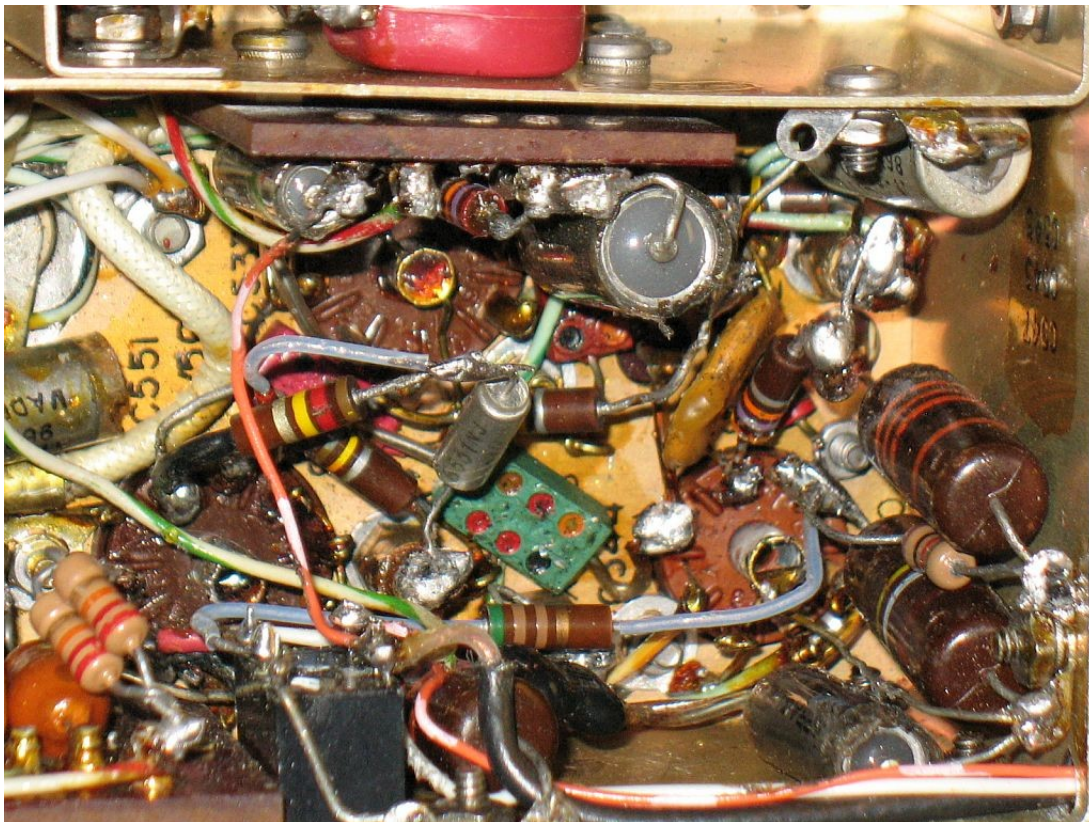
Improving Capt. Lee Product Detector and SSB AGC
include change of Product Detector to 6BY6, 2-28-24
Larry Haney, 3-2-2024

The original implementation of Capt. Lee's Product Detector for the R-390A, 1: bypassed the noise limiter, 2: used a modified front panel BFO on/off switch to switch the audio, and 3: did not update the AGC for good and easy SSB reception. This document is focusing on fixing 2 and 3. See my document: [R390A Fix Lankford 2 diode SSB AGC.pdf \(r-390a.net\)](#) for an indepth description of how to fix the AGC for very good SSB reception.

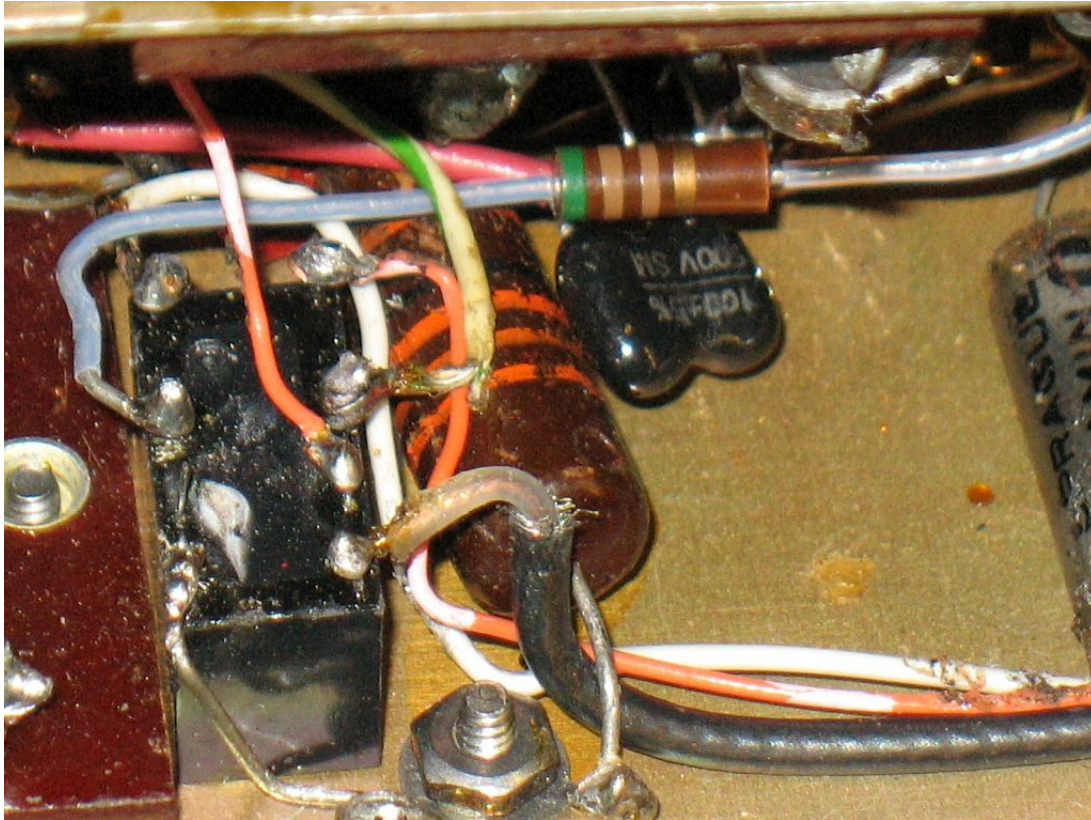
I'll describe here how to install and use the mini relay (found by Jacques Fortin) to switch the audio for Capt. Lee's Product Detector. This solution is a lot easier to install than altering the front panel BFO on/off switch and since it is all contained in the IF deck, it makes substituting IF modules very easy.

There are two relays (and I'm sure many more) that will work well for switching the audio, an SPDT or a DPDT. How to get them and their technical specs are described below. If you only want to switch the audio, the SPDT will work. If you want to switch the audio and the AGC gain, the DPDT is a good choice. To help you decide which way to go, you should first read my document: [R390A Fix Lankford 2 diode SSB AGC.pdf \(r-390a.net\)](#), starting on page 4.

Because the noise limiter is bypassed, the best location for the relay is in the compartment behind the BFO oscillator coil. This is where two of the three audio lines are located and the AGC gain control is also there. The DPDT relay (black box about .5" x .5" x 1") is at the bottom of the photo on the left side. Here's a photo of it:



To accomplish the audio switching, I disconnected the white wire with the green tracer from capacitor C549 (which is at the top of the photo mounted on the left side of the circuit board). You can see the wire reconnected to the relay common contact (on the right side of the relay) and an orange wire with white tracer connected to the normally closed relay contact connecting to C549. This is shown in the next photo:



The small black coax connected to the normally open contact on the relay goes to the right and connects to the output of the product detector. All that is left to do to make it functional is to connect the power to the relay coil. You can see in the photo above that an orange wire with white tracer is connected to the rear right contact – this goes to the low side of R531 (which will be changed to 7.5K ohms). You can also see a solid white wire is connected to the rear left contact. That is the BFO B+ and is connected to it in the BFO compartment shown in the next photo. It's in the center (where one end of the 2.2 K ohm resistor (R531) is still connected) right above the bellows.



The R531 is changed to 7.5 K in order to apply the correct voltage to the relay coil. This value sets it at about 20 VDC. That is very good for this 24 VDC relay coil, as a much lower value operates the armature and more than 24 VDC will cause it to overheat.

That's all there is to using a relay to switch the audio. Have fun.

For switching the AGC gain, see my document: [R390A Fix Lankford 2 diode SSB AGC.pdf \(r-390a.net\)](#).

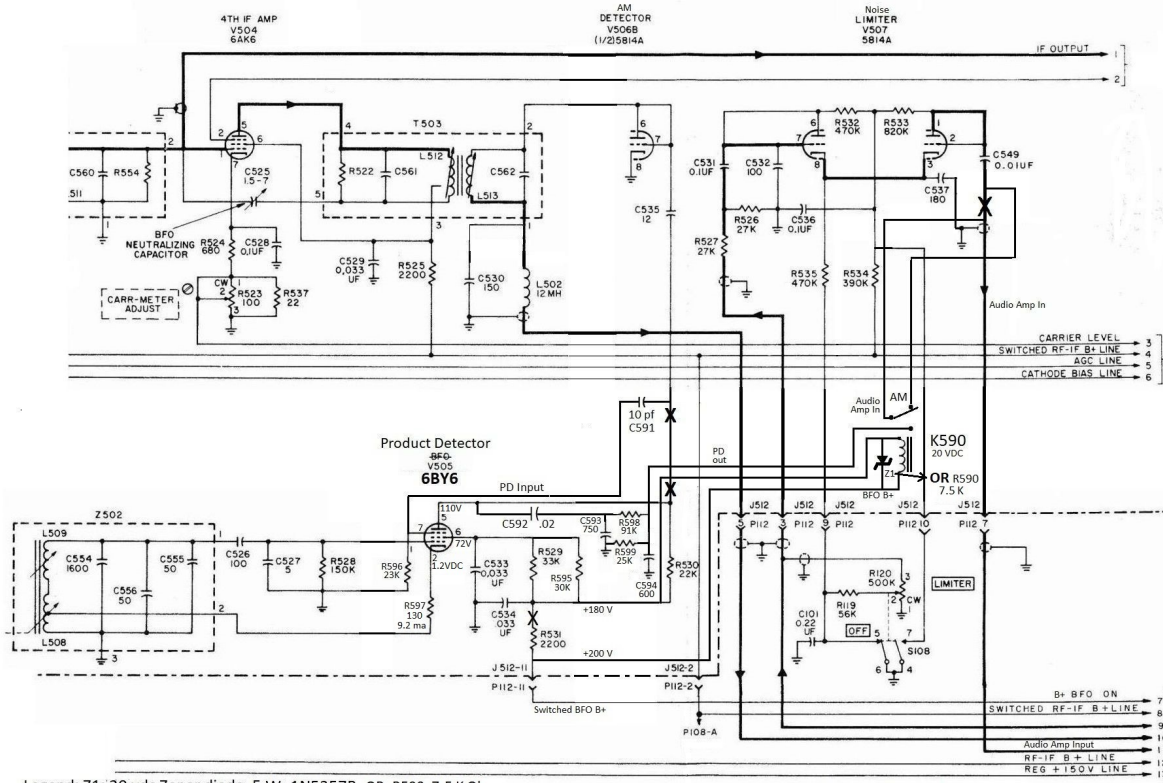
8-25-2023, Larry Haney, I received the dpdt relays today. Tested them all ok. All coils measured 2.95k ohms (my meter is probably off). All armatures operated at 14.5 vdc. All coils drew 5.7 ma at 16.8 vdc, 6.8 ma at 19.5 vdc and 6.94 ma at 20 vdc. I have no reason to doubt that they will draw the specified 8.3 ma at 24 vdc. I have designed my next mod to the Dr. Langford AGC mod for SSB which will incorporate ½ of the DPDT relay that I just received. I will let you know how that goes when I can get my daily driver back on the bench.

10-25-2023, Larry Haney, I've installed the DPDT relay in my IF deck and hooked the coil up replacing R531 in the BFO B+ feed. A 7.5 K ohm resistor is required in parallel with the coil to obtain a good voltage across the coil (20 VDC at 6.94 ma). This is based on the Product Detector drawing 9.2 ma of current. The relay works great.

2-28-2024, Larry Haney, I just finished testing my Product Detector using a 6BY6. It works great. Here's the schematic:

Improved Capt. Lee Product Detector

1. Added mini signal relay for audio switching for AM or SSB/CW.
2. Changed PD tube from 6BE6 to 6BY6 for lower noise operation.



Legend: Z1: 20 vdc Zener diode, 5 W, 1N5357B -OR- R590, 7.5 K Ohms
 K590: American Zettler AZ822-2C-24DE, 24 vdc coil, 8.3 ma,
 DPDT, 20 VDC at 6.94 ma in this circuit.

Mod PD2, 01/06/24 Larry Haney
 Note: The NL is bypassed here and in original.

You will notice that there is a 20 VDC Zener diode across the relay coil. This stabilizes the voltage variations that may occur due to AC power for the RX being other than 115 VAC, tube differences or tube aging. But, a 7.5K ohm resistor works very well in its place.

The rest of this document talks about the W7DI document, obtaining these relays, the relay specs and relay operation.

10-2-2023, Larry Haney, I added relay info to this file at the end.

8-1-2023, Larry Haney, As Jacques Fortin points out in the included posts, the proposed enhancement by W7DI uses a relay to switch the audio from AM to SSB/CW that is powered by the BFO (on/off) B+ circuit. His relay wiring only adds about 3 MA to the BFO B+ line, but Jacques points out (in the following post) that a better option is to use a relay with a coil that will replace R531, eliminating the additional 3 ma. I have not tried it, but it looks like it should work.

I'm so confident in it, that I'm ordering a similar DPDT relay (specs at the end) that will not only switch the audio, but will **also** switch the AGC. I'm not totally satisfied with the Dr. Langford AGC mod, so this will allow it to work differently and more correctly for AM and SSB. I'm posting this now because if you're considering doing this mod you may want to get the dpdt relay instead (it's only \$ 0.20 more).

2-25-2024, One more product detector improvement is to reduce the detector noise by replacing the 6BE6 with a 6BY6, but it is **NOT** a no-wiring change. This makes a noticeable difference in background noise between words and sentences. See above schematic.

Here's the info from Jacques on adding an SPDT mini relay to the R-390A IF deck for SSB audio switching (BFO on/off).

Posts on our list forum:

[R-390] Unobtainium SSB parts

Jacques Fortin [jacques.f at videotron.ca](mailto:jacques.f@videotron.ca)

Fri Jul 8 10:06:55 EDT 2022

Perry,

If it was the relay used by W7DI (in a variant of the Capt. Paul Lee W3JHR product detector), the following one can be used instead:

<https://www.digikey.ca/en/products/detail/te-connectivity-potter-brumfield-relays/TSC-124D3H-000/1128733?s=N4IqTCBcDaICoGUDCBaAjGALAEQMwAKAaABlJAF0BFIA>

Or any other relay with the same specifications (especially the coil resistance and coil to contacts dielectric strength).

The trick is to replace R531 with the relay coil (See the W7DI article, Ham Radio, July 1974)

When the BFO will be powered, the relay will activate and change the audio source from the AM demodulator to the product detector output.

73, Jacques, VE2JFE in Montreal

[R-390] Unobtainium SSB parts

Larry H [larry41gm at gmail.com](mailto:larry41gm@gmail.com)

Fri Jul 8 20:16:53 EDT 2022

Thank you, Jacques. I've been looking for this. Here's a link to the online pdf for the issue:

[07 July 1974.pdf \(archive.org\)](#)

Regards, Larry

[R-390] Unobtainium SSB parts

Jacques Fortin [jacques.f at videotron.ca](mailto:jacques.f@videotron.ca)

Fri Jul 8 22:17:40 EDT 2022

Hi Larry,

I also found another relay way less expensive than the P&B part:

<https://www.digikey.ca/en/products/detail/cit-relay-and-switch/J1031C24VDC-15S/14001944>

And there is a lot in stock.

The coil will still replace R531, but with a 5.1K in parallel to match the 2.2K value.

73, Jacques, VE2JFE in Montreal

Note: 8-11-2023, LH, Thank you, Jacques. **The US DigiKey URL for the relay is:**

[J1031C24VDC.15S CIT Relay | DigiKey](https://www.digikey.com/product-detail/en/cit-relay-and-switch/J1031C24VDC.15S/CIT-Relay-and-Switch/14001944)

The current price at DigiKey is \$1.34 ea.

The coil characteristics are:

Coil Voltage	24VDC
Coil Current	6.3 mA
Coil Resistance	3.84 kOhms
Must Operate Voltage	18 VDC

The relay specs from DigiKey are:

J1031C24VDC.15S

Digi-Key Part Number	2449-J1031C24VDC.15S-ND
Manufacturer	CIT Relay and Switch
Manufacturer Product Number	J1031C24VDC.15S
Description	RELAY GEN PURPOSE SPDT 2A 24V

J1031C24VDC.15S

Manufacturer Standard Lead Time 13 Weeks

Detailed Description General Purpose Relay SPDT (1 Form C) Through Hole

Customer Reference

Datasheet [Datasheet](#)

Product Attributes

TYPE	DESCRIPTION	SELECT
Category	Relays Signal Relays, Up to 2 Amps	
Mfr	CIT Relay and Switch	
Series	J103	
Package	Tube	
Product Status	Active	
Mounting Type	Through Hole	
Coil Voltage	24VDC	
Contact Form	SPDT (1 Form C)	
Contact Rating (Current)	2 A	
Switching Voltage	125VAC, 60VDC - Max	
Coil Current	6.3 mA	
Coil Type	Non Latching	
Features	-	
Termination Style	PC Pin	
Seal Rating	Sealed - Fully	
Coil Insulation	-	
Must Operate Voltage	18 VDC	
Must Release Voltage	2.4 VDC	
Operate Time	4.5 ms	
Release Time	1.5 ms	
Operating Temperature	-40°C ~ 85°C	
Contact Material	Silver (Ag), Gold (Au)	
Relay Type	General Purpose	
Coil Resistance	3.84 kOhms	

8-11-2023, Larry Haney, info on adding a dpdt instead of an spdt relay to R-390A IF deck for SSB audio switching (BFO on/off) **AND** the AGC gain. Since this coil res is 2.88 k, it would need a resistor in parallel with it to equal the original 2.2 k value of R531. More on the modified AGC when I get that done.

Link to dpdt relay on DigiKey:

[AZ822-2C-24DE American Zettler | Relays | DigiKey](#)

The current price at DigiKey is \$1.55 ea.

Fits std 16 pin IC socket.

Product Attributes

TYPE	DESCRIPTION	SELECT
Category	Relays Signal Relays, Up to 2 Amps	
Mfr	American Zettler	
Series	-	
Package	Tray	
Product Status	Active	
Mounting Type	Through Hole	
Coil Voltage	24VDC	
Contact Form	DPDT (2 Form C)	
Contact Rating (Current)	2 A	
Switching Voltage	250VAC, 220VDC - Max	
Coil Current	8.3 mA	
Coil Type	Non Latching	
Features	-	
Termination Style	PC Pin	
Seal Rating	Sealed - Fully	
Coil Insulation	-	
Must Operate Voltage	16.8 VDC	
Must Release Voltage	1.2 VDC	
Operate Time	5 ms	
Release Time	2 ms	
Operating Temperature	-55°C ~ 90°C	
Contact Material	Silver Palladium (AgPd), Gold (Au)	
Relay Type	General Purpose	
Coil Resistance	2.88 kOhms	
Base Product Number	AZ822	