Congratulations

on the purchase of your new

Dopplers by Greany, KB6DOL PC Board.

This PC Board is based on the popular Roanoke Doppler design shown in the book entitled "Transmitter Hunting - Radio Direction Finding Simplified" by Joseph D. Moell (K0OV) and Thomas N. Curlee (WB6UZZ). Basic circuit description and antenna construction information are provided in this book. I encourage you to purchase this book before you begin construction of your doppler project.

Please do not be misled by any other Roanoke Doppler designs you may encounter. This board has been manufactured with you in mind. It is made from the highest quality materials and is a time proven product. There are no traces to cut or jumpers to add! NO ONE makes a higher quality product. A reasonable amount of electronic knowledge and skill however, are required to assemble this PC Board. Most hams and technicians are well qualified for this project). Special care should be exercised while soldering to avoid intrusion of adjoining traces and pads.

Every effort has been made to be precise in the PC Board markings, parts list, instructions, and attachments to maximize your enjoyment in assembling your radio direction finding kit.

Specifications and Description of the KB6DOL Doppler PC Board

- Double-sided circuit board with plated-through holes
- Made from the highest quality materials
- Audio amp to reduce display variations
- Low Signal Level Lockout circuit
- Additional bypass capacitors to enhance operation
- High and Low level LEDs
- Circular 16 LED display
- Power requirements: 12 VDC
- Solder-masked and silk-screened
- Dimensions: 5.5" x 7.5"

Assembly

Our Doppler is a "snap" to assemble! It's as simple as recognizing the value of the parts and soldering them into the clearly marked PC board.

The Doppler PC Board does not come with a case. This allows the consumer to custom design their own cabinet and installation. The LMB T-F783 Tite-Fit Box Chassis is a popular case for our Doppler PC board.

Fortunately, an oscilloscope is NOT required to build our Doppler. Simply solder the components into place and you're ready to go (no traces to cut or jumpers to add!)

Calibration is VERY easy! Simply drive toward a known signal and adjust the calibration pot to indicate straight ahead. That's it!

Our Doppler PC board does not come with parts. Parts are available from most electronic parts suppliers and surplus locations for about $50.

You will need to build your own antenna. Typically, the antenna can be fabricated in an afternoon. Here are some ideas from the Lab that should work well with all Roanoke Doppler style dopplers.

Base Plate Material

Almost any conductive material may be used for the base plate. My first choice is thick sheet aluminum from the metal junk yard. Aluminum is easy to work with and is relatively inexpensive. Copper-clad PC board material may also be used but doesn't seem to hold up against the elements as well. I have found solid sheet copper expensive and difficult to solder as heat is quickly dissipated. Whatever conductive material is used for the base plate, you will find there is virtually no difference in doppler performance.

Antenna Switching Circuit

When building the antenna switching circuit, try to keep all component leads as short as possible. In a perfect world, the leads would be 1/16 of an inch or less. Normally, this is not possible - so do the best you can. I have seen antenna switching circuits built for 2-meters with component leads as long as 1.5 inches that seem to work "OK".

Whether you are using the original or Wide Range antenna switching circuits, connections from the switching circuit directly to the base plate are NOT required. This is already provided by the 4 coax shields (be sure all the common connections are joined at the switching circuit). Not only does this make building the switching circuit easier, but it also eliminates the need to solder connections directly to the base plate.

Building the Base

Cut the antenna base material into a "square" to the dimensions suggested in the book "Transmitter Hunting - Radio Direction Finding Simplified" by Joe Moell, K0OV (a "must have" book if you enjoy transmitter hunting). Attach 1" x 1" wood trim or 3/4" aluminum "C" channel to all four sides below the base plate. Then cut a piece of 1/4" plywood or aluminum sheet to fit as the bottom (this will provide a convenient cavity for the switching electronics.) I prefer to use two aluminum sheets held together with 3/4" aluminum "C" channel for the base. This method looks great and will hold up tot he elements. Use stainless steel, self-taping screws to hold things together. It is also a good idea to seal the base with silicone rubber to help keep things dry.

Vertical Elements

There are many ways to mount the vertical elements. One local ham purchased 4 quarter wave antennas from a local ham dealer. I like to use SO-239 panel mount connectors. They are east to mount and wire. I then solder bronze welding rod cut to frequency into the center pin of PL-259 connectors. If you place a small piece of tape over the holes of the PL-259 (normally used for soldering the coax shield), you can fill the connector with epoxy glue. This will help support the antenna element and insulate it from the connector shell. After the epoxy has cured, you can remove the tape used to keep the epoxy from flowing out of the solder holes.

I recommend placing the vertical elements at 1/4 wavelength spacing for the frequency of interest. Actually, the doppler will work with reduced vertical whip spacing, however, bearing accuracy will decrease as spacing is narrowed.

Joe Moell, K0OV, suggests vertical element length be cut slightly off resonance. "In fact", he writes "it is better for the whips to be slightly off resonance, since output phase versus frequency goes through a sharp transition at resonance. bearing errors due to length differences among the antennas is accentuated when they are very close to resonance." This is why the vertical elements in Joe's book show 18.5" instead of 19.2" for 2-meter operation. This is also true with the new Wide Range switching circuit.

Ground Radials

There are many ways to mount radials. You can solder bronze welding rods into crimp connectors and use screws or wing nuts to hold them in place. I like to use Fahnstock Spring Clips to attach the ground radials (use two clips for each radial). It only takes a minute to install the radials and they are held firmly in place. A plastic "static ball" should be placed at the end of each radial to protect eyes, etc. By the way, ground radials "WILL" improve the performance of the doppler antenna so don't delete them!

The Feet

When mounting the antenna on your car, large rubber pads from a luggage carrier can be used to protect the top of your car. Another idea is to build your own feet using RTV silicon rubber. To make silicone rubber feet, simply place a large "blob" (about 2" round and 1" high) where you want the feet to be. Form the feet into shape with a putty knife. I prefer to use my fingers moistened with a mixture of 30 parts water and 1 part dish washing liquid. This keeps the silicone rubber from sticking to my fingers while "shaping" the feet. When finished, the feet should measure 2" round at the base and taper to about a 1/5" flat area on the end that will come in contact with the vehicle.

Because of the thickness, silicone rubber may take a day or two to cure. These home-made silicone rubber feet have caused "ZERO" scratches to my new car.

Mag-Mount Antennas

With the advent of the new Wide-Range switching circuit by Joe Moell (K0OV), you can now use mag-mount antennas instead of the antenna array. The only problem is the switching circuit needs a place to reside. Theoretically, you could build the antenna switching circuit within the control unit, however, 4 equal lengths of coax need to run the entire distance to antenna. This will require about 80 feet of coax assuming 4 runs of 20 feet.

Another place for the antenna switching circuit could be a small weatherproof box with its own magnet centrally located between the antennas. Something else to consider with mag-mount antennas is the possibility of bearing variations if the antennas are not placed in the exact location where originally calibrated.

K0OV uses a cardboard template to ensure proper placement of his mag-mount antennas. Unfortunately, there is a minor problem. While DFing near a strong signal source, RF can penetrate the separate feed lines and cause strange readings. This may be a good reason to keep the switching electronics near the vertical whips.

The new Wide-Range switching circuit has +3.7vdc at the base of the antennas. DO NOT allow the antenna base to touch vehicle ground. As a precaution, you should install a 1/4 amp fuse to protect the +3.7vdc source. This should not pose a problem provided the antenna is built like that mentioned above with silicone feet or luggage carrier pads to provide isolation. This makes the original antenna design more desirable for those who prefer to mount the doppler antenna array directly in the roof of their vehicle because all base connections are at ground potential.

Antenna Wiring

I recommend "hard-wiring" all connections at the antenna. This eliminates the possibility of connector problems that may be caused by moisture. The other end of the coax and control cables should have connectors for the receiver and doppler control unit.

Mounting The Antenna

If you use an antenna array (not mag-mounts), you can hold the antenna in place with a luggage strap available from local hardware stores. The strap can be routed through the back windows of a sedan and "cinched" down to firmly hold the antenna in place. The windows can be "snugged" closed to eliminate unwanted wind noise. A couple of local hams like to use strong magnets to attach their antenna array to the top of their vehicle. Another ham used large suction cups - unfortunately, his antenna array has taken at least one unscheduled excursion.

Construction Tips

The only controls that are really required are the Volume Control, Power Switch, and Scan Switch. These controls are frequently used and should be conveniently located. All other controls (Phase Switch, Calibration, Damping, and Sensitivity pots) may remain on the PC board unless you have a special application for these features.

I've discovered the Sensitivity and Damping controls (R34 and R35) are rarely used. Because of this, I recommend using PC board mounted pots instead of the larger pots that may be mounted on the doppler cabinet. Normally, you can set these pots to the center position and the performance of your doppler will be "just right"! You can even skip installing these pots by using 250K resistors in their place.

If you plan to use more than one receiver with your doppler, you may want to locate the Calibration pot along with the Phase Switch where they can be easily adjusted. I recommend using a screwdriver adjustable pot or a locking vernier knob to avoid accidental movement. On the other hand, if you plan to use one dedicated receiver with your doppler, you may want to keep the calibration pot and Phase Switch on the PC board.

Many dopplers have been built using many different types of capacitors. So far, there does not appear any advantage using one type of capacitor over another except for cost. For what it's worth, I normally use film and monolithic ceramic capacitors. All capacitors, including electrolytic, should be rated at 25 volts (minimum). It is common to

find non-electrolytic capacitors with voltage ratings up to 600 volts! This is normal and completely acceptable for use with our Doppler PC board. You may also want to use capacitors with .394 inch lead spacing for easy mounting. Some electrolytic capacitors may not mount "flush" against the PC board. This is common and a totally acceptable practice.

You may use a DB-25 computer cable to remote the display if you wish. It works great!

The 7805 regulator is rated at more than 1 amp. When used with our Doppler PC board, the 7805 "loafs" along with a very small load (50ma typical). Because of this, no heat sink is necessary.

First Time "Power-Up"

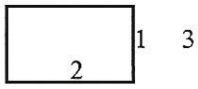
Anytime you build a project that involves point to point wiring, it's always a good idea to do some basic checks before the making your first "smoke test." Fortunately, our Doppler PC board is a time proven product and complex checks are not required. However, you may want to make some very simple checks.

First, disconnect the antenna and audio source. Temporarily install a load meter in series with one of the power leads. Apply 12vdc to the assembled board (without DIP ICs). You should see a very low current draw (less than 20ma). Check voltages on both sides of the 7805 voltage regulator. Pin 1 should be .6 volts less than your supply voltage and Pin 3 should be 5 vdc.

Remove power from the board and install all the DIP ICs. Reapply power and check current draw is less than (40-70ma typical with volume set to minimum). Once again, check the voltage regulator for values previously described. if everything goes to plan, you should see three illuminated LEDs when the doppler is powered - the center LED, one of the "compass" LEDs, and the Low Level LED.

Additional Construction Notes

1. Square pad indicates pin (1) for the device.
2. (*) indicates positive connection for electrolytic capacitors.
3. When J1 is shorted, the low detect circuit is disabled (test only).
4. DO NOT install C36 unless the audio from your receiver is very low.
5. Cathode side of diodes (banded end) should be connected to the square solder pads.
6. Cathode (flat side) of LEDs should be connected to the square solder pads.
7. The value of R-20 may be varied to adjust LED brightness. Although a 100 ohm resistor is shown in the schematic, you may want to begin with a 330 ohm resistor to ensure the current rating of U-7 is not exceeded.
8. An optional noise filter may be required to eliminate alternator noise. The Radio Shack noise eliminator kit (270-030(or noise filter (270-051) work well for this purpose.
9. The pin-out for U11 as viewed from the silk-screen side is:



PARTS LIST

Resistors (ohms) (1/4 watt, 5%)

Quantity	Rating	Part on PCB
1	10	R47
1	47	R37
2	330	R20, R31 (see note 7)
4	680	R24. R25, R26, R27
2	2.2K	R5, R48
1	3K	R46
4	3.3K	R28, R42, R43, R44
3	10K	R18, R29, R45
1	13K	R39
2	15K	R6, R22
1	18K	R10
1	22K	R9
11	33K	R3, R4, R7, R8, R12, R13, R14, R19, R21, R32, R33
3	47K	R15, R17, R38
2	51K	R2, R16
1	56K	R41
1	82K	R23
2	100K	R11, R30
1	330K	R40

Capacitors (microfarads)

Quantity	Rating	Part on PCB
3	.001	C17, C19, C20
1	.0022	C18
23	.01	C1, C2, C3, C4, C5, C14, C15, C30, C31, C37, C39, C40, C41, C42, C43, C44, C45, C46, C47, C48, C49, C50, C51
15	.1	C6, C7, C8, C9, C10, C11, C12, C13, C21, C23, C25, C27, C29, C32, C38
1	.47	C16
1	1	C28
2	4.7 (25vdc Electrolytic)	C22, C24 (replaces 5.0 uf capacitors shown in schematic)
2	10 (25vdc Electrolytic)	C35, C36 (see note 4)
1	100 (25vdc Electrolytic)	C26
2	220 (25vdc Electrolytic)	C33, C34

Diodes

Quantity	Rating	Part on PCB
1	1N4003	D1 (see note 5)
3	1N4148	D3, D22, D23 (see note 5)
17	Red LEDs	D4, D5, D6, D7, D8, D9, D10, D11, D12, D13, D14, D15, D16, D17, D18, D19, D20 (see note 6)
2	Yellow LEDs	D2, D21 (see note 6)

PARTS LIST (continued)

Pots

Quantity	Rating	Part on PCB
1	10K (Audio)	R1
3	500K (Linear)	R34, R35, R36

Transistors

Quantity	Rating	Part on PCB
2	2N2222	Q1, Q2

ICs

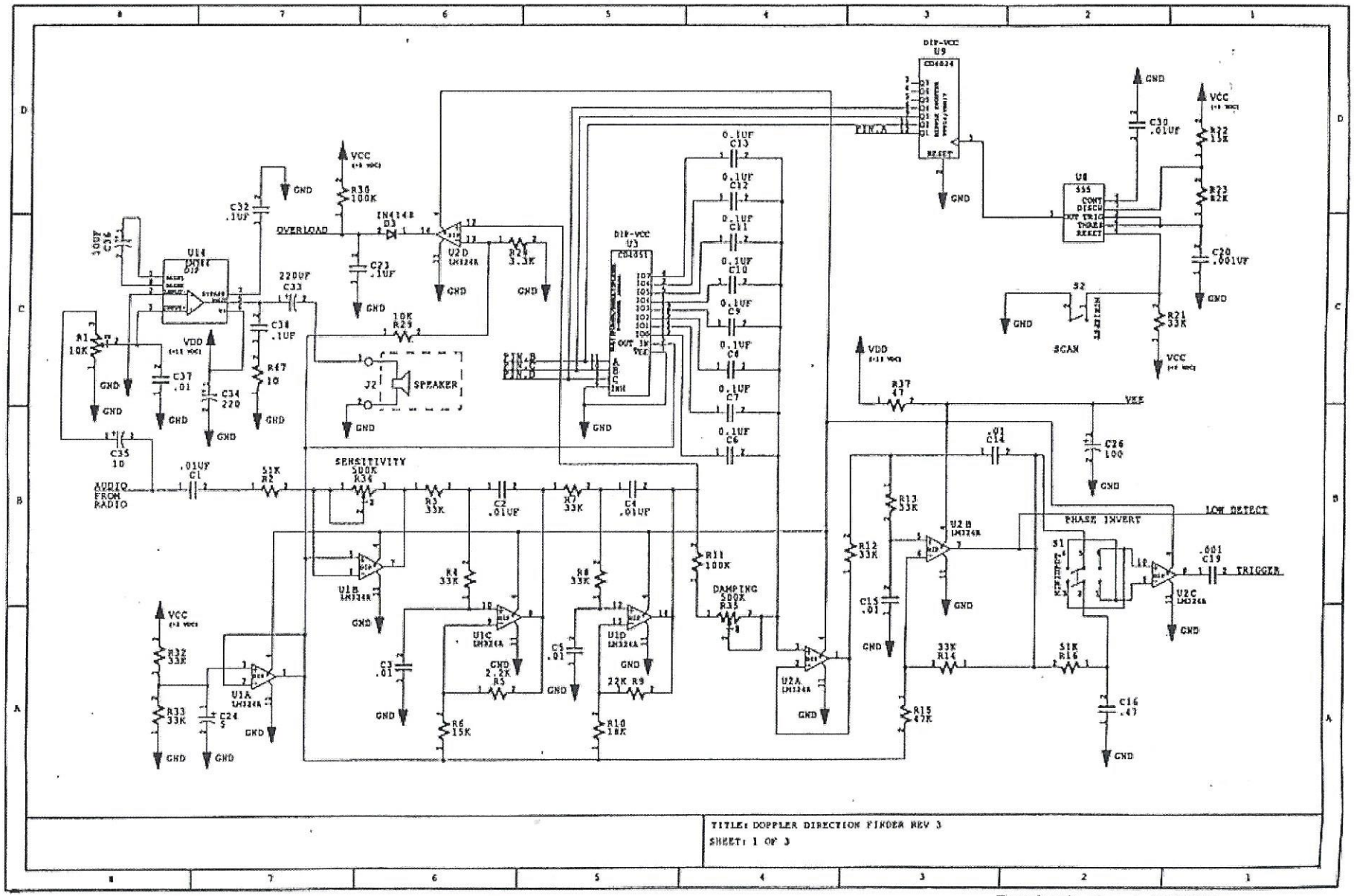
Quantity	Rating	Part on PCB
3	LM324	U1, U2, U12
1	CD4051	U3
2	LM555	U4, U8
1	CD4049B	U5
1	74LS75	U6
1	74ACT154 or 74HC154 or 54HC154 (Narrow Package)	U7
1	CD4024	U9
1	CD4028	U10
1	LM7805	U11 (see note 9)
1	74LS00	U13
1	LM386	U14

Switches (miniature)

Quantity	Rating	Part on PCB
1	DPDT	S1
2	SPST	S2, S3

IC Sockets

Quantity	Rating	Part on PCB
3	8 pin DIP socket	U4, U8, U14
5	14 pin DIP socket	U1, U2, U9, U12, U13
4	16 pin DIP socket	U3, U5, U6, U10
1	24 pin DIP socket (narrow package)	U7



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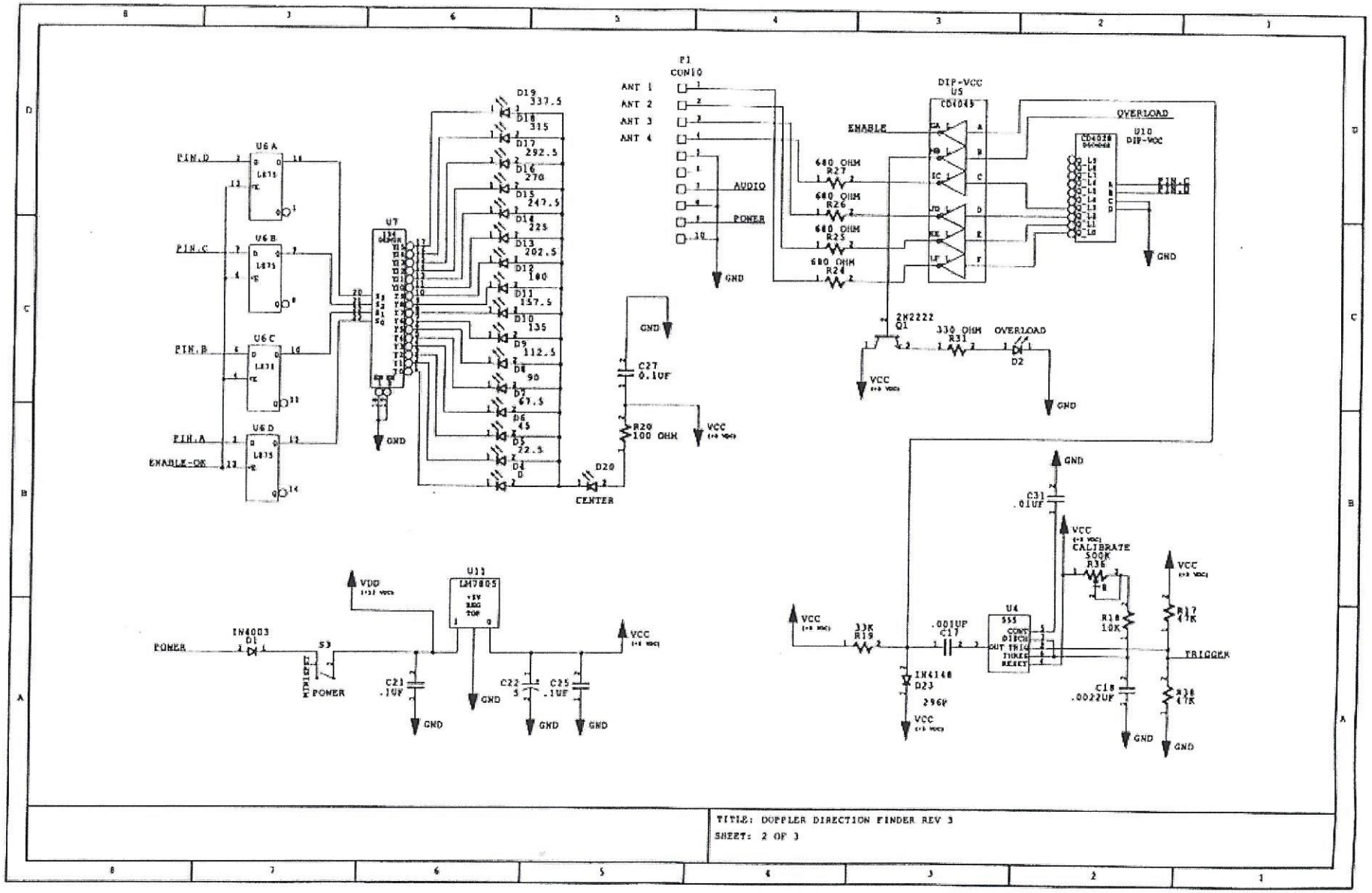

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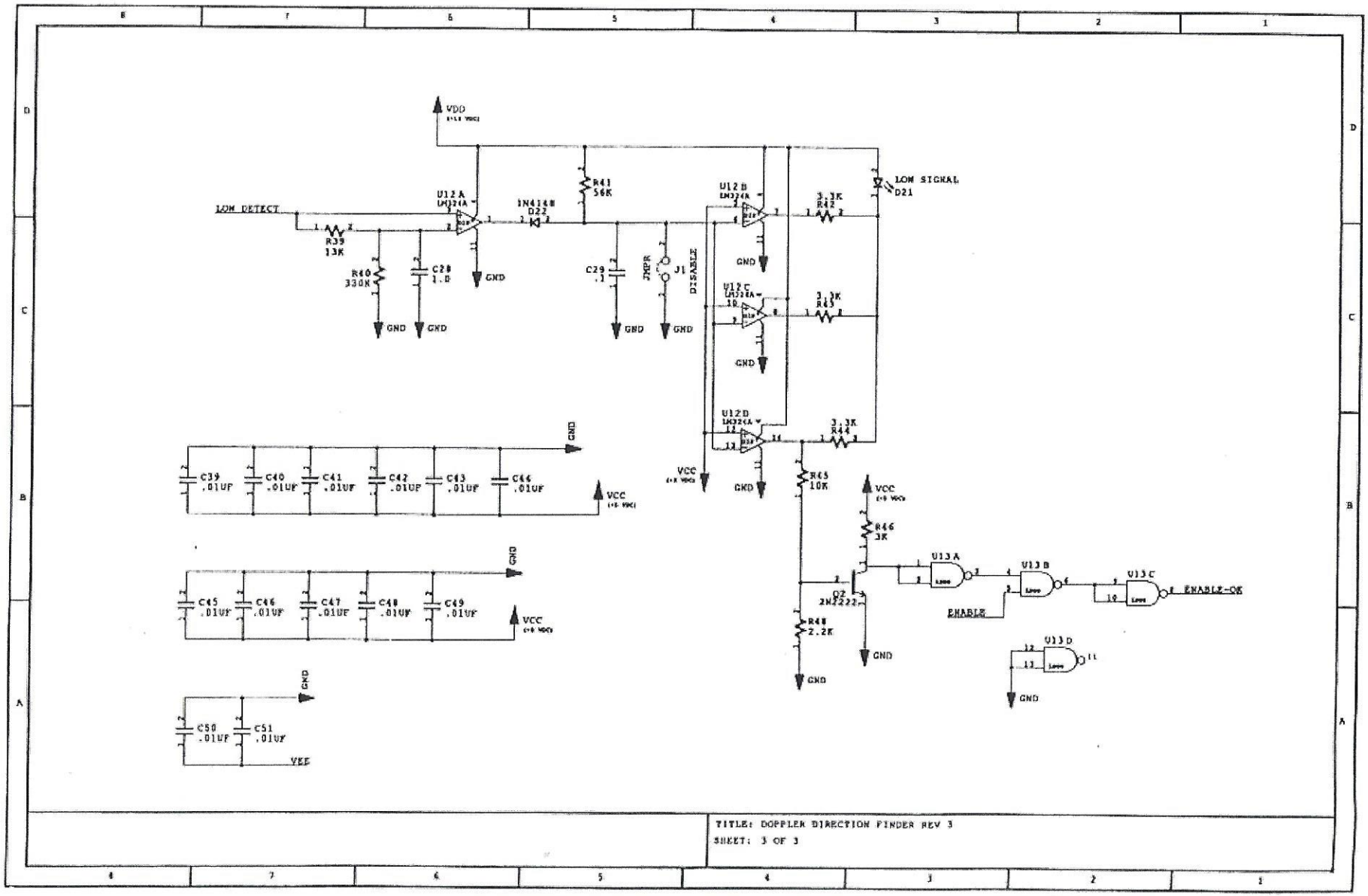

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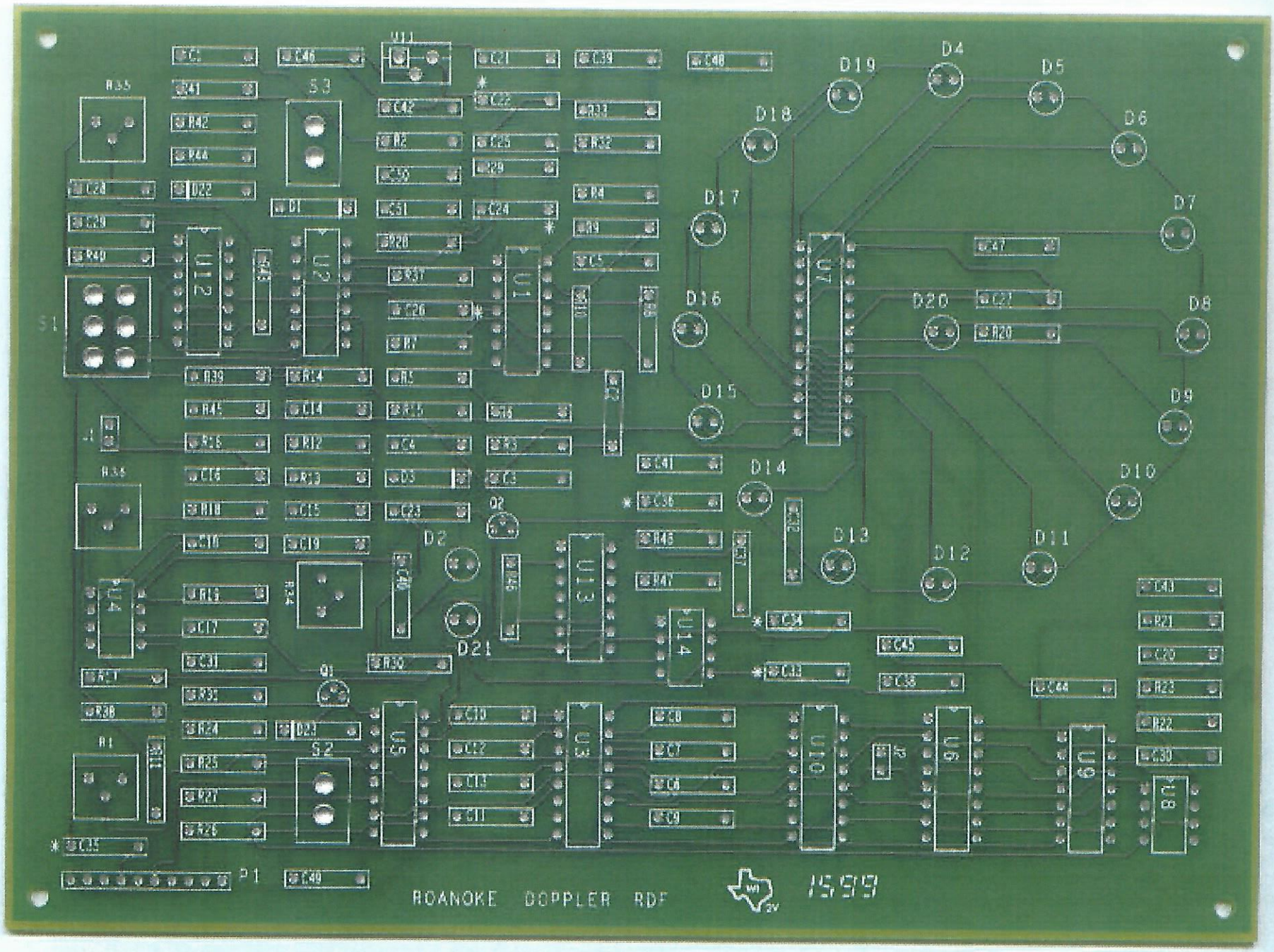
ROANOKE DOPPLER RDF
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