

DSQUELCH.TXT

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NEW DATA & TONE SQUELCH CIRCUIT FOR THE PRO-2004, PRO-2005 & PRO-2006

Here's an easy modification to make PRO-2004/5/6 scanners recognize worthless DATA and/or continuous TONE signals and to resume SCANNing or SEARCHing within a second after locking up on these types of signals. It works similar to the SOUND SQUELCH which responds to silent or unmodulated carriers. In fact, the DATA SQUELCH works with the SOUND SQUELCH, but is independent of it except for the SOUND SQUELCH button on the front panel which activates or deactivates both functions. Construction and installation are simple and within the ability of most hobbyists.

The DATA SQUELCH is ideal for use when SCANNing or SEARCHing trunked channels! No longer do trunked data channels have to be locked out! (They change every day, anyway.) The scanner skips over those obnoxious signals! It will also discriminate against cellular data and most FBI-type continuous tones. My DATA SQUELCH will likewise discriminate against continuous tones used on the Improved Mobile Telephone Service (IMTS) and other non-voice signals including digital pagers. In other words, the DATA SQUELCH accepts voice signals and rejects most others.

STRONG ADVICE: You should have the Service Manual for your scanner before doing this modification. Order it from any Radio Shack store or directly from Tandy National Parts Center in Ft. Worth, Tx; (800) 442-2425.

CONSTRUCTION OF THE DATA SQUELCH CIRCUIT BOARD

Cut a piece of "perf board" about 1" x 1" though smaller is ok if you are good at micro circuits. Refer to the Parts List and, if available, the Schematic Diagram:

DIRECTIONS FOR PRO-2004/5/6: Directly to Pin 5 of U-1, solder the (+) leg of C-2 and one leg of each of R-1 and R-2. Ground the free ends of C-2 and R-2. To the free end of R-1, solder the cathode of one of the diodes, D-2. To the anode of D-2, solder the cathode of D-1. Ground the anode of D-1. NOTE: the junction of D-1 cathode and D-2 anode will be the INPUT of this circuit.

To Pin 2 of U-1, solder one end of R-3 and the anode of D-3. Solder the free end of R-3 to Pin 3 of U-1. Solder a hookup wire several inches long to the cathode of D-3 & let hang free. Solder a several inch long hookup wire to Pin 3 of U-1 & let hang free. Ground Pin 12 of U-1. Solder one end terminal of VR-1 to Pin 3 of U-1; solder the other end terminal of VR-1

DSQUELCH.TXT

to ground. Solder the middle lug of VR-1 to Pin 4 of U-1. Pins 1,6,7,8,9,10,11,13 & 14 of U-1 are not used.

PRO-2004 ONLY: Solder the (+) leg of C-1 directly to IC-5, Pin 14.

PRO-2005/6 ONLY: Solder the (+) leg of C-1 directly to IC-5, Pin 7.

PRO-2004/5/6 ALL: Solder a hookup wire to the (-) leg of C-1. Solder the other end of this hookup wire to the INPUT of the above circuit at the junction of D-1 and D-2. Solder the ground trace of the new circuit board to a ground in the scanner. Solder the free end of the hookup wire at Pin 3 of U-1 to the OUTPUT leg of IC-8, the +5v supply regulator on the main chassis of the scanner. IC-8 is the same in all three scanners, PRO-2004/5/6.

PRO-2004 ONLY: Locate CN-504 on the Logic/CPU Board, PC-3, and follow its wire bundle back to the main receiver board. Locate the sky blue (light blue) wire that connects to the chassis at the right end of the row of wires and remove that wire from the chassis. (This wire comes from Pin 15 of CN-504.) Solder the anode of D-4 to the spot where the blue wire was removed. Solder the now loose blue wire to the cathode of D-4. Solder the free end of the hookup wire at the cathode of D-3 to the cathode of D-4.

PRO-2005/6 ONLY: Locate CN-3 on the main receiver Board and follow its wire bundle up to the Logic/CPU board. Locate the sky blue (light blue) wire that connects to Pin 4 of CN-3. Clip that blue wire halfway between CN-3 and the Logic/CPU Board. Solder the anode of D-4 to the loose end of the blue wire that goes down to CN-3. Solder the cathode of D-4 to the loose end of the blue wire that goes up to the Logic/CPU Board. Solder the free end of the hookup wire from D-3 to the cathode of D-4.

PRO-2004/5/6 ALL: ADJUSTMENT OF VR-1: Push the SOUND SQUELCH button ON and attach a voltmeter (-) to ground and (+) to Pin 5 of U-1. Tune the scanner to a strong, noisy data channel or to a loud, single tone carrier. Measure the DC voltage at Pin 5 of U-1, (2.5v to 4.5v, typically). Calculate 80% of that measurement, and adjust VR-1 for the 80% level of the above measurement. Typically, about 2 to 3.8v. The exact adjustment isn't too critical, but if set too low, then voice signals will trigger the SCAN/SEARCH RESUME. If set too high, then data & tone signals won't trigger the SCAN/SEARCH RESUME. Another way to find the optimum setting is to put a voltmeter (+) on Pin 2 of U-1 and (-) to ground and tune the scanner to a cellular or trunked data channel. Adjust VR-1, first one way and then the other and then to a point so that the voltage on Pin 2 of U-1 just becomes stable with a nice and steady +5 volts. It takes a steady 5-volts for about one second to trigger the SCAN/SEARCH RESUME function, but don't adjust VR-1 any further than necessary to stabilize the DATA/TONE voltage at Pin 2.

DSQUELCH.TXT

OPERATION & NOTES: The description for the above circuit does not discuss the DPDT switch shown in the schematic diagram, and which can be wired as shown to select SOUND SQUELCH only or both SOUND and DATA SQUELCH, combined. More sophisticated switching schemes can be devised to select one or the other or both. As it is, the above described basic circuit runs BOTH SOUND & DATA SQUELCH at the same time. That is, your scanner will resume SCANNing or SEARCHing almost immediately after it locks up on either a silent signal or a data/continuous tone signal! Voice signals will cause the scanner to stay locked as normal until the signal goes away. Minor adjustment of VR-1 may be necessary for optimum results, but the final setting will produce a voltage on Pin 4 of U-1 of about 80% of the peak voltage on Pin 5 of U-1. The DC input signal at Pin 5 of U-1 will be nearly zero on silent or quiet signals and about 2.8 to 4.5v with data & continuous tone signals. Pin 5 will show a very erratic and rapidly changing voltage from nearly zero to 4 volts or so for voice signals. The DC output voltage at Pin 2 of U-1 will be nearly zero on silent or quiet signals; and a steady +5v with data & continuous tone signals. Voice signals will cause a rapid fluctuation of the signal between 0-5 volts at Pin 2 of U-1. When the SOUND SQUELCH button is off, neither SOUND nor DATA SQUELCH are operable and scanner operation will be completely normal.

IN CASE OF DIFFICULTY: The most critical part of this mod is the rectifier circuit consisting of D-1, D-2, R-1, R-2, C-1 and C-2. Make sure the diode polarities are correct (banded end is the cathode). Make sure polarity of the capacitors is correct. Tune the scanner to a strong cellular (879-881 MHz) or trunked data channel (851-866 MHz), and measure the DC voltage at Pin 5 of U-1. There should be between 2.5 and 4.5 volts. You won't measure "too much" but not enough is possible. If so, check the wiring and components mentioned just above. Next most critical is the polarity and wiring of the two isolation diodes, D-3 and D-4. Last but not least is the wiring of U-1. The circuit is so simple and affirmative in its action that you're not likely to encounter trouble if you follow these instructions. On one PRO-2005, I noticed a chirping, morse code type of sound on quiet channels. If yours exhibits this, change capacitor C-1 from 1.0-uF to 0.1-uF, #272-1432. If the "tweet" is still there, then solder a 220-uF (or larger) capacitor directly to Pins 4 and 11 of IC-5 in the scanner. Pin 4 should get the (+) lug of the capacitor while Pin 11 will be (-). Radio Shack part number for the capacitor is #272-1029.

If you can't resolve a problem, send me a SASE and one loose extra stamp with a complete description of the problem and its symptoms and I'll respond with written suggestions and advice. Sorry, no phone calls, please.

THEORY OF OPERATION OF THE DATA/TONE SQUELCH

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To understand the simple operation of my DATA SQUELCH, it is first necessary to understand the PRO-2004/5/6's SOUND SQUELCH (SSQ) circuit on

DSQUELCH.TXT

which we will "piggy back" the new DATA SQUELCH circuit. The circuits are identical among the PRO-2004/5/6 scanners but circuit symbols differ. Bear with me here while I use a simple scheme for this discussion. P4 means PRO-2004; P5/6 means PRO-2005 and PRO-2006 and P4/5/6 means "all".

SOUND SQUELCH THEORY OF OPERATION: A weak portion of the receiver's audio is sampled at the detector and amplified through IC-5 (P4/5/6). The highly amplified audio is fed from IC5, (P4, Pin 14 or P5/6, Pin 7) to a rectifier network (P4, D-41 & D-42; P5/6, D-43 & D-44). This rectifier network converts the audio signal to a DC signal that is proportional in level to the level of the audio signal, and it is used simply as a bias to turn on or off a transistor, (P4, Q-21; P5/6, Q-19). Most audio signals are strong enough to turn the transistor on while very weak or silent signals keep it off. When the transistor is off, 5-volts is on its collector, but when the transistor is ON, the collector drops to nearly zero volts. 5 volts and 0 volts forms the logic required by the CPU for making decisions. The collector of the transistor is fed directly to the CPU, (P4, IC-503, Pin 24; P5/6, IC-501, Pin 18). When the SOUND SQUELCH button on the front panel is set to the ON position and when CPU's SSQ pin is at zero volts, the scanner scans or searches as normal, locking on any signals which break the squelch. Similarly, when the SOUND SQUELCH button is off, a ground is placed on the CPU's SSQ pin, which keeps it at zero volts, no matter what.

When the SOUND SQUELCH button is on, and when the scanner encounters a silent or unmodulated carrier, then the transistor discussed above gets turned off and a 5-volt level on its collector is fed to the CPU's SSQ pin. A 5-volt signal on the CPU's SSQ pin makes the scanner resume scanning within a second after locking onto a carrier. Therefore, as long as there are voices or other audio signals present, the CPU's SSQ pin will be "0-v low" and operation is normal. When that pin goes "+5v high", the CPU is programmed to resume scanning or searching.

DATA SQUELCH THEORY OF OPERATION: Since the CPU's SSQ pin responds only to low and high logic and really doesn't know the difference between voice and data, we can use this function with a separate circuit to make it discriminate against continuous tones and data in the same way it discriminates against silent carriers. All we need is a circuit that sends a "high" to the CPU's SSQ pin in the presence of strong, sustained audio signals such as data or continuous tones. My circuit does this handily since voice signals are erratic, varying, and not at all like data or continuous tones. C-1 of our circuit samples the amplified audio and passes it to a new rectifier circuit, D-1 and D-2, which with R-1, R-2 and C-2, becomes a DC signal proportional to the level of the audio signal. This DC signal is fed to Pin 5 of U-1, a Voltage Comparator IC. A reference voltage is adjusted by VR-1 and fed to Pin 4 of U-1. As long as the DC signal at Pin 5 is less than the reference signal at Pin 4, the output of U-1 at Pin 2 will be zero volts "low". When the DC signal at Pin 5 exceeds the reference voltage at Pin 4, then the output of U-1 goes to

DSQUELCH.TXT

+5v "high" at Pin 2.

The output of U-1, Pin 2 is coupled to the CPU via isolation diode, D-3. A "high" will tell the CPU to make the scanner resume SCANning or SEARCHing while a "low" does nothing unusual. When VR-1 is correctly adjusted, the output of U-1, Pin 2 will never go "high" long enough to trigger the CPU unless data or continuous tones are present. Voice signals may make U-1's output go high momentarily, but the interval will not be long enough to trigger the CPU, because a duration of about .5 to 1 second is required before the CPU will trigger. Therefore, most voice signals of interest will not send a "high" to the CPU, but continuous tones and data will! Therefore, our DATA SQUELCH works exactly like, though inversely to, the SOUND SQUELCH.

Isolation diodes, D-3 and D-4, allow the SOUND SQUELCH and the DATA SQUELCH to work simultaneously and not interfere with each other. Both silent and data/tone signals will cause the scanner to resume SCANning or SEARCHing, but voice signals will not be affected by the SOUND or DATA SQUELCH!

WRAPUP: Sometimes, natural pauses of a second or more in speech signals will be interpreted by the SOUND SQUELCH as a silent signal. SCAN or SEARCH may resume before speech begins after the pause. It is, therefore, ideal to route the SOUND SQUELCH and DATA SQUELCH functions through an external selector switch to permit selection of one, the other or both functions for special monitoring situations. Two toggle switches or a cumbersome rotary switch are required to do this. Next to ideal is a simple DPDT toggle switch, which when wired as shown in the schematic diagram, will select both DATA and SOUND SQUELCH simultaneously, or DATA SQUELCH only.

PARTS LIST FOR DATA/TONE SQUELCH CIRCUIT

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Circuit

Symbol	Quan	Description with Radio Shack part numbers
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C-1	1	1-uF/35vdc #272-1434 (See Text)
C-2	1	2.2-uF/35vdc #272-1435
D-1,2,3,4	4	1N4148 Switching diodes; #276-1122
J-1	1	IC Socket, 14-pin DIP, for U-1 below; #276-1999
R-1	1	390-ohm; #271-018
R-2	1	12,000-ohm; non-Radio Shack, but a 10-k and a 2.2k can be wired in series to make the needed 12-k resistor; use one each of RS #271-1335 and 271-1325 if need be.
R-3	1	3,300-ohm; #271-1328
S-1	1	DPDT toggle switch, for optional control; #275-626
U-1	1	LM-339 Comparator; #276-1712
VR-1	1	10,000-ohm trim pot; #271-282
Misc		Perf board; #276-1395

DSQUELCH.TXT

Misc Hookup wire; #278-776-Salvage the inner wires for hookups

SCHEMATIC DIAGRAM FOR DATA/TONE SQUELCH CIRCUIT

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Since you copied this file from a BBS, there is no way a schematic diagram can be reliably conveyed. You may not need one, as detailed as this is, but if you do, send a #10 Self Addressed Stamped Envelope and four (4) loose, extra first class postage stamps for the schematic and a printed copy of this manuscript. This offer expires January 31, 1991, after which a nominal charge will apply.

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