

Kenwood TK-715K 220MHz Amateur Band Conversion

By: Alex, KD6VPH

The Kenwood TK-715K is a narrowband 220MHz 10W FM radio that was used on regioNet systems throughout North America and elsewhere quite a few years ago. This radio can be modified for use on the Amateur radio 1.25cm 222-225MHz band as a very basic radio- which is admittedly best suited as a repeater receiver and transmitter/exciter. The modification will require quite a few tools and parts to be properly converted for use on wideband 1.25cm.

PLEASE ENSURE YOUR TK-715 has an FCC ID on rear panel of "ALH23362130" to ensure it is the correct split radio to be used on 220MHz.

The TK-715 has quite a few limitations hence why its best suited as a repeater receiver or transmitter/exciter.

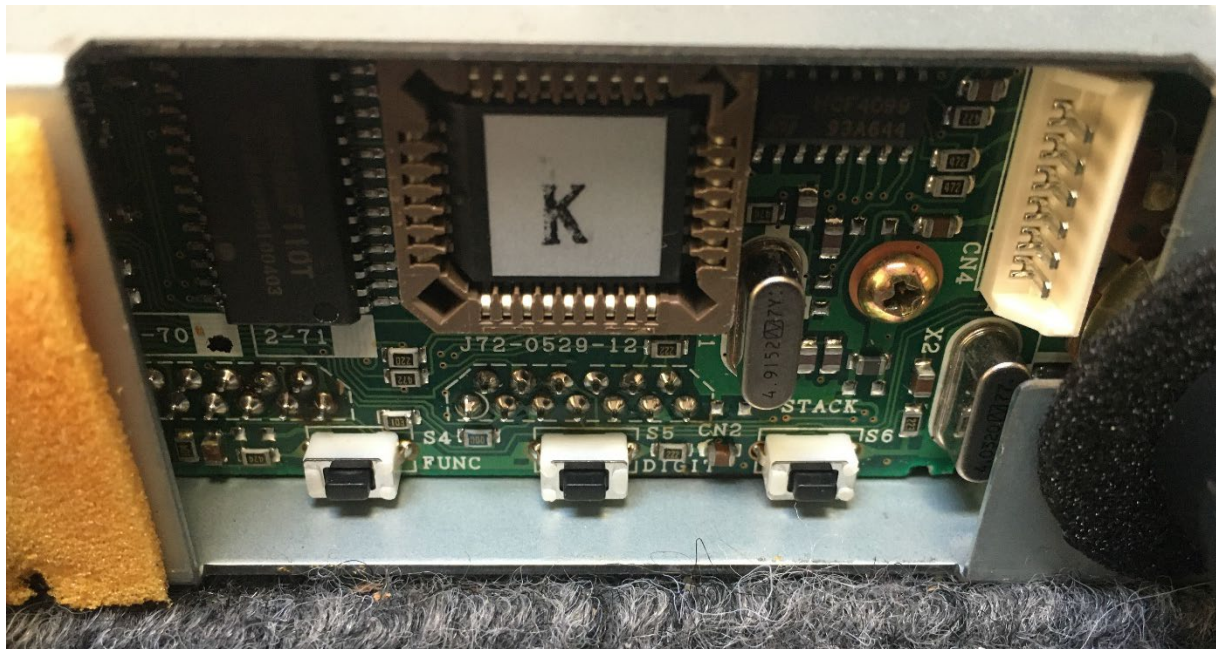
- No built-in tone generation
- No VFO (like most/all commercial radios)
- No ability to program new channels/frequencies without burning a new PROM
- No ability to name programmed channels
- There are quite a few modifications required to convert for amateur radio use

You will need the following to properly convert the radio to the amateur band:

- ✓ Hex Editor of your choice
- ✓ EPROM Burner capable of burning 27C256 PLCC's (Not DIP's)
- ✓ Service Monitor and Wattmeter
- ✓ Murata CFWM455F Wideband IF Filter
- ✓ Tone board for tone encode (decode optional) such a Com-Spec TS-32P, TS-64, or repeater controller with tone encode/decode if these radios are to be used in a repeater configuration

PROM Removal and Hex Editing/Programming

1. Remove top and bottom metal covers of radio as well as the plastic front panel. When removing the plastic front panel; you need not remove any screws or the channel and volume knobs.
2. Once the front panel is removed from the radio chassis you can remove the LCD from the radio by removing the securing screw and pulling the LCD module straight out the front of the radio.
3. Once the LCD module is removed, we can remove the 27C256 PLCC (the square IC labeled "K"). Before doing so pay attention to its orientation and where the corner alignment notch is located. Place the PLCC in your EPROM burner and read the IC. Save the image as a BIN file.



4. We can now hex edit three different sections of the saved 27C256 PLCC image. One section of the image will bypass the startup sequence and put the radio directly into channel mode, the next will change the PLL step size from 6.25KHz to 5KHz, and the last hex edit will program the receive and transmit frequencies.
5. First, we will bypass the startup sequence routine- this routine would normally have us pressing the "ST" button upon startup so that the radio will go to the first programmed test channel. Using your hex editor starting at location 1A3Ah and you will find "27FB" in hex, we need to change this to "0101" so the radio will go to test channel 1 upon power up. Save your changes after editing.

000019F0	08 20 F6 A7 00 86 01 B7 01 20 BD C2 16 0F 39 BD	. . . . . 9.
00001A00	C1 8E BD 9D 9D 27 17 B6 02 10 81 CB 26 10 B7 03 ' . . . & . .
00001A10	AE CE 88 7E BD BD 88 86 0A BD C8 B2 20 1E 7F 03	. . . ~
00001A20	AE BD 9D 39 25 0B CE 88 76 BD BD 88 7C 03 AE 20	. . 9% . . . v . . | . .
00001A30	06 CE 88 6E BD BD 88 BD 9D 9D 27 FB BD 9D 52 CC	. . n ' . . R .
00001A40	00 01 DD D7 BD 9A A7 BD 9C 24 BD 9B 83 BD 9D 39	. . . . . \$ . . . . 9
00001A50	26 05 BD 9A E9 20 F0 BD 9C 00 B6 03 94 26 19 B6	& & . .
00001A60	03 95 26 02 20 E1 BD 9A 8C DC D7 F3 03 A3 DD D7	. . &
00001A70	BD 9A A7 7F 03 95 20 CF BD 9A 8C DC D7 B3 03 A3	. . . . .

- Our next step will be to change the PLL step size from 6.25KHz to 5KHz. Changing the step size is necessary because the amateur 220MHz band is wideband FM (25KHz channel spacing), the original commercial band this radio was used for is narrowband FM (12.5KHz channel spacing). The TK-715 uses a 12.8MHz TCXO and a frequency step size of 6.25KHz. to figure out the divisor we have to do some math:

$$12.8\text{MHz (our TCXO)} / .00625\text{MHz (our 6.25KHz step size in MHz)} = 2048$$

To change this to a 5KHz step size we need to find our divisor

$$12.8\text{MHz (our TCXO)} / .00500\text{MHz (our desired step size in MHz)} = 2560$$

The above 2048 (6.25KHz step size) is in decimal, in hex that would be 0800- so doing a search we find our 6.25KHz step size starting at address 7FEAh. We need to change this step size to 5KHz which we found above to be 2560 in decimal or "0A00" in hex. Edit the hex as circled below to be "0A00". Save your changes after editing.

00007FA0	00	18	09	A0	00	05	AC	0D	FF	00	00	30	0D	F0	00	FB	.....0....
00007FB0	00	13	20	00	02	F0	0E	10	00	00	20	09	B0	00	05	A0	.. .....
00007FC0	0D	F0	00	00	28	0D	E0	00	FA	F0	13	18	00	FF	FF	FF(.....
00007FD0	FF	FF	FF	FF	FF	FF	FF	FF	EC	E0	EC	F0	ED	00	FF	00	.....
00007FE0	EE	00	01	08	00	01	0D	0D	0E	00	08	00	89	7E	89	7E~.~
00007FF0	DF	67	89	7E	D5	93	D5	81	89	7E	89	7E	DF	7D	89	7E	.g.~.....~.~.}.~
00008000																	

- Our last hex editing step will be adding frequencies which is one step you may want to think about in some depth. Since the radio will be running the rest of its life in test mode; we have 79 channels that can be programmed in the radio. We can find the first test channel of 00001 starting at location 06E0h as shown below; ; Channel 0 RX hex of "0000" and Channel 0 TX hex of "0000". Channel 1 RX hex of "74B2" and Channel 1 TX hex of "88E2". Channel 2 is followed shortly thereafter with a RX hex of "74B4" and a TX hex of "88E4". Each channel is comprised of a RX Frequency and a TX Frequency. Channel 0 by default was never programmed with a frequency, but ensure you start your programming there. Each channel goes in succession one after another in a RX and TX pair on and on all the way up to test channel of 80.

00006DC0	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	.....
00006DD0	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	.....
00006DE0	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	.....
00006DF0	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	.....
00006E00	00	00	00	00	74	B2	88	E2	74	B4	88	E4	74	B6	88	E6	...t...t...t...
00006E10	74	B8	88	E8	74	BA	88	EA	74	BC	88	EC	74	BE	88	EE	t...t...t...t...
00006E20	74	C0	88	F0	74	C2	88	F2	74	C4	88	F4	74	C6	88	F6	t...t...t...t...
00006E30	74	C8	88	F8	74	CA	88	FA	74	CC	88	FC	74	CE	88	FE	t...t...t...t...
00006E40	74	D0	89	00	74	D2	89	02	74	D4	89	04	74	D6	89	06	t...t...t...t...

CH 1 RX frequency of 217.0125MHz which equates to 74B2 in hex
 217.0125MHz – 30.3MHz (first IF) = 186.7125MHz and therefore:
 186.7125MHz / .00625MHz (PLL Step Size in MHz) = 29874 dec or 74B2 hex

CH 1 TX frequency of 219.0125MHz which equates to 88E2 in hex
 219.0125MHz / .00625MHz (PLL Step Size in MHz) = 35042 dec = 88E2 hex

8. **IMPORTANT NOTE: For channels that you want to leave blank (i.e. NO RX or TX Frequencies) program in all "F"s.** As shown in the picture below I have 24 channels programmed and starting at channel 25 through 80 I changed all the hex to "F", so that the radio will not RX or TX out of band. This should NOT be done if you are using the radio in a repeater or as a link (see next step for explanation).

00006E00	96 F0 AE 9C	97 64 AD D0	97 D8 AE 44	98 04 AE 70	.....d.....D...p
00006E10	97 C8 AE 34	97 80 AD EC	97 68 AD D4	97 F0 AE 5C	...4.....h.....\
00006E20	97 B0 AE 1C	97 88 AD F4	97 78 AD E4	98 00 AE 6C	.....x.....1
00006E30	CH 00 RX/TX Pair	CH 01 RX/TX Pair	CH 02 RX/TX Pair	CH 24 RX/TX Pair	.D.....1.....
00006E40	97 58 AD C4	97 90 AD FC	97 60 AD CC	97 A0 AE 0C	.X.....`.....
00006E50	97 3C AD A8	97 84 AD F0	97 B4 AE 20	98 00 AE 6C	.<..... 1
00006E60	FF FF FF FF	FF FF FF FF	FF FF FF FF	FF FF FF FF	.....
00006E70	FF FF FF FF	FF FF FF FF	FF FF FF FF	FF FF FF FF	.....
00006E80	FF FF FF FF	FF FF FF FF	FF FF FF FF	FF FF FF FF	.....
00006E90	FF FF FF FF	FF FF FF FF	FF FF FF FF	FF FF FF FF	.....
00006EA0	FF FF FF FF	FF FF FF FF	FF FF FF FF	FF FF FF FF	.....
00006EB0	FF FF FF FF	FF FF FF FF	FF FF FF FF	FF FF FF FF	.....
00006EC0	FF FF FF FF	FF FF FF FF	FF FF FF FF	FF FF FF FF	.....
00006ED0	FF FF FF FF	FF FF FF FF	FF FF FF FF	FF FF FF FF	.....
00006EE0	FF FF FF FF	FF FF FF FF	FF FF FF FF	FF FF FF FF	.....
00006EF0	FF FF FF FF	FF FF FF FF	FF FF FF FF	FF FF FF FF	.....
00006F00	FF FF FF FF	FF FF FF FF	FF FF FF FF	FF FF FF FF	.....
00006F10	FF FF FF FF	FF FF FF FF	FF FF FF FF	FF FF FF FF	.....
00006F20	FF FF FF FF	FF FF FF FF	FF FF FF FF	FF FF FF FF	.....
00006F30	FF FF FF FF	FF FF FF FF	FF FF FF FF	FF FF FF FF	.....

9. To program in amateur radio frequencies please use the charts found at the end of this document. Please note that there are two charts- one for repeater frequency pairs, and one for simplex frequencies. If you are building a repeater or link radio where the TK-715 will have the same RX and TX frequencies use the simplex frequency chart. If you are going to be using the TK-715 as a normal amateur radio with repeaters and simplex frequencies you will be using both charts. Please also note that if you are going to be making a repeater receiver, transmitter/exciter, or link radio then it would be best to program that one frequency (RX and TX hex) over and over channel 0 through 80 to prevent inadvertent channel changing to a different frequency via the front panel as the radio will power up on CH 00 by default- therefore you could also disconnect the rotary dial so it no longer functions.

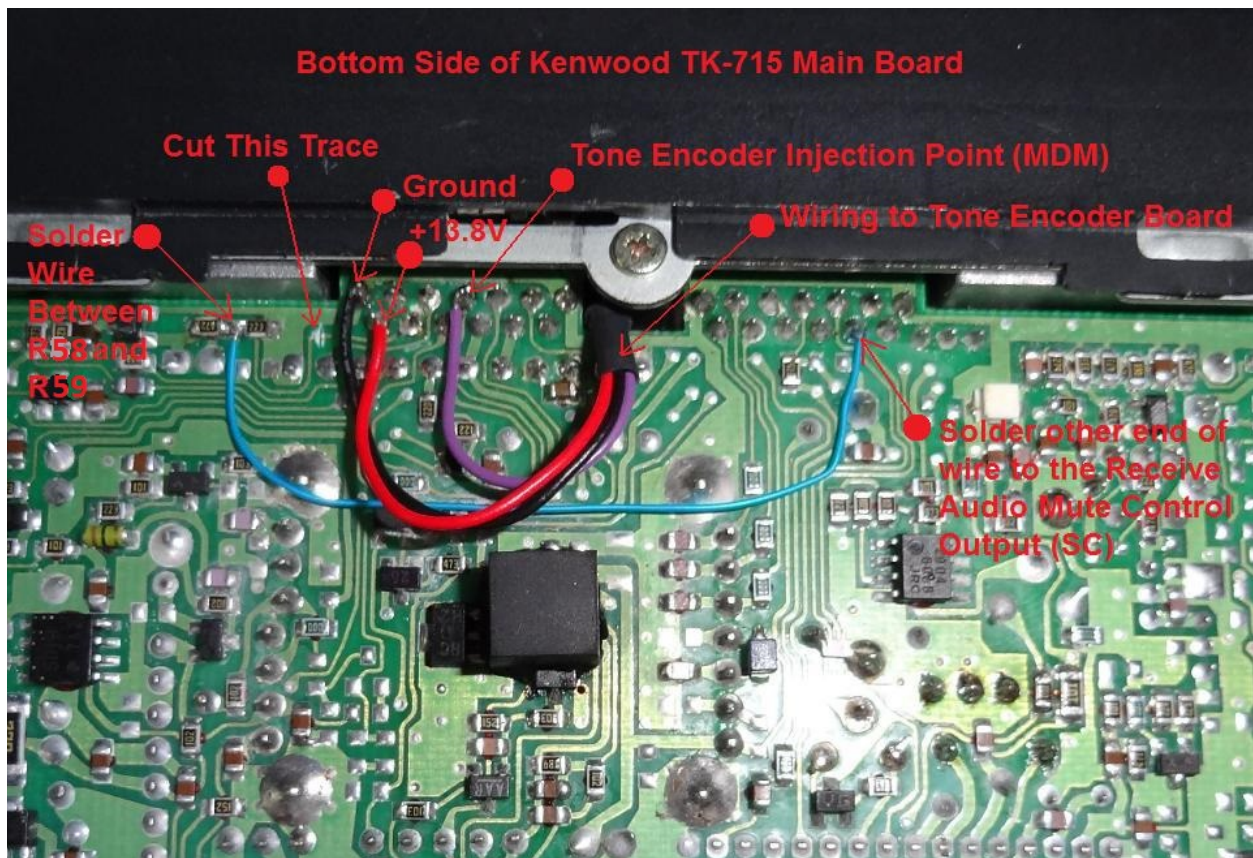
10. Reinstall your newly burned PROM and reassemble the front of the radio. On the top side of the radio in the left front portion, move jumper J2 to the "SET" (test) position. This MUST be done before proceeding!

Hardware Modifications

11. We need to remove the narrowband 455KHz IF filter and install a wideband IF filter. The TK-715 was designed to be used on narrowband FM (12.5KHz) channel spacing, the amateur 220MHz band is, as we know, wideband FM and uses 25KHz channel spacing. If you are building a repeater exciter/transmitter then this step is not necessary. Remove the Murata CFWM455G IF filter by de-soldering the input and output terminals and then each of the 3 ground terminals. After removal, install our newly procured Murata CFWM455F IF Filter.



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- Front Bottom Side of TK-715 Board**
- The diagram shows the front bottom side of the TK-715 board. A blue line indicates a jumper wire connection from the 'SC' pin (pin 13 of the CN2 connector) to the junction between resistors R58 and R59. A red arrow points to the gray trace between R58 and R59, with the instruction: "Cut the Gray Trace here which ends in between R58 and R59".
- Other components and labels visible on the board include:
- Connectors: CN1, CN2, CN3, CN4
 - Resistors: R58, R59, R60, R61, R62, R63, R64, R65, R66, R67, R68, R69, R70, R71, R72, R73, R74, R75, R76, R77, R78, R79, R80, R81, R82, R83, R84, R85, R86, R87, R88, R89, R90, R91, R92, R93, R94, R95, R96, R97, R98, R99, R100, R101, R102, R103, R104, R105, R106, R107, R108, R109, R110, R111, R112, R113, R114, R115, R116, R117, R118, R119, R120, R121, R122, R123, R124, R125, R126, R127, R128, R129, R130, R131, R132, R133, R134, R135, R136, R137, R138, R139, R140, R141, R142, R143, R144, R145, R146, R147, R148, R149, R150, R151, R152, R153, R154, R155, R156, R157, R158, R159, R160, R161, R162, R163, R164, R165, R166, R167, R168, R169, R170, R171, R172, R173, R174, R175, R176, R177, R178, R179, R180, R181, R182, R183, R184, R185, R186, R187, R188, R189, R190, R191, R192, R193, R194, R195, R196, R197, R198, R199, R200, R201, R202, R203, R204, R205, R206, R207, R208, R209, R210, R211, R212, R213, R214, R215, R216, R217, R218, R219, R220, R221, R222, R223, R224, R225, R226, R227, R228, R229, R230, R231, R232, R233, R234, R235, R236, R237, R238, R239, R240, R241, R242, R243, R244, R245, R246, R247, R248, R249, R250, R251, R252, R253, R254, R255, R256, R257, R258, R259, R260, R261, R262, R263, R264, R265, R266, R267, R268, R269, R270, R271, R272, R273, R274, R275, R276, R277, R278, R279, R280, R281, R282, R283, R284, R285, R286, R287, R288, R289, R290, R291, R292, R293, R294, R295, R296, R297, R298, R299, R300, R301, R302, R303, R304, R305, R306, R307, R308, R309, R310, R311, R312, R313, R314, R315, R316, R317, R318, R319, R320, R321, R322, R323, R324, R325, R326, R327, R328, R329, R330, R331, R332, R333, R334, R335, R336, R337, R338, R339, R340, R341, R342, R343, R344, R345, R346, R347, R348, R349, R350, R351, R352, R353, R354, R355, R356, R357, R358, R359, R360, R361, R362, R363, R364, R365, R366, R367, R368, R369, R370, R371, R372, R373, R374, R375, R376, R377, R378, R379, R380, R381, R382, R383, R384, R385, R386, R387, R388, R389, R390, R391, R392, R393, R394, R395, R396, R397, R398, R399, R400, R401, R402, R403, R404, R405, R406, R407, R408, R409, R410, R411, R412, R413, R414, R415, R416, R417, R418, R419, R420, R421, R422, R423, R424, R425, R426, R427, R428, R429, R430, R431, R432, R433, R434, R435, R436, R437, R438, R439, R440, R441, R442, R443, R444, R445, R446, R447, R448, R449, R450, R451, R452, R453, R454, R455, R456, R457, R458, R459, R460, R461, R462, R463, R464, R465, R466, R467, R468, R469, R470, R471, R472, R473, R474, R475, R476, R477, R478, R479, R480, R481, R482, R483, R484, R485, R486, R487, R488, R489, R490, R491, R492, R493, R494, R495, R496, R497, R498, R499, R500, R501, R502, R503, R504, R505, R506, R507, R508, R509, R510, R511, R512, R513, R514, R515, R516, R517, R518, R519, R520, R521, R522, R523, R524, R525, R526, R527, R528, R529, R530, R531, R532, R533, R534, R535, R536, R537, R538, R539, R540, R541, R542, R543, R544, R545, R546, R547, R548, R549, R550, R551, R552, R553, R554, R555, R556, R557, R558, R559, R560, R561, R562, R563, R564, R565, R566, R567, R568, R569, R570, R571, R572, R573, R574, R575, R576, R577, R578, R579, R580, R581, R582, R583, R584, R585, R586, R587, R588, R589, R590, R591, R592, R593, R594, R595, R596, R597, R598, R599, R600, R601, R602, R603, R604, R605, R606, R607, R608, R609, R610, R611, R612, R613, R614, R615, R616, R617, R618, R619, R620, R621, R622, R623, R624, R625, R626, R627, R628, R629, R630, R631, R632, R633, R634, R635, R636, R637, R638, R639, R640, R641, R642, R643, R644, R645, R646, R647, R648, R649, R650, R651, R652, R653, R654, R655, R656, R657, R658, R659, R660, R661, R662, R663, R664, R665, R666, R667, R668, R669, R670, R671, R672, R673, R674, R675, R676, R677, R678, R679, R680, R681, R682, R683, R684, R685, R686, R687, R688, R689, R690, R691, R692, R693, R694, R695, R696, R697, R698, R699, R700, R701, R702, R703, R704, R705, R706, R707, R708, R709, R710, R711, R712, R713, R714, R715, R716, R717, R718, R719, R720, R721, R722, R723, R724, R725, R726, R727, R728, R729, R730, R731, R732, R733, R734, R735, R736, R737, R738, R739, R740, R741, R742, R743, R744, R745, R746, R747, R748, R749, R750, R751, R752, R753, R754, R755, R756, R757, R758, R759, R760, R761, R762, R763, R764, R765, R766, R767, R768, R769, R770, R771, R772, R773, R774, R775, R776, R777, R778, R779, R780, R781, R782, R783, R784, R785, R786, R787, R788, R789, R790, R791, R792, R793, R794, R795, R796, R797, R798, R799, R800, R801, R802, R803, R804, R805, R806, R807, R808, R809, R810, R811, R812, R813, R814, R815, R816, R817, R818, R819, R820, R821, R822, R823, R824, R825, R826, R827, R828, R829, R830, R831, R832, R833, R834, R835, R836, R837, R838, R839, R840, R841, R842, R843, R844, R845,

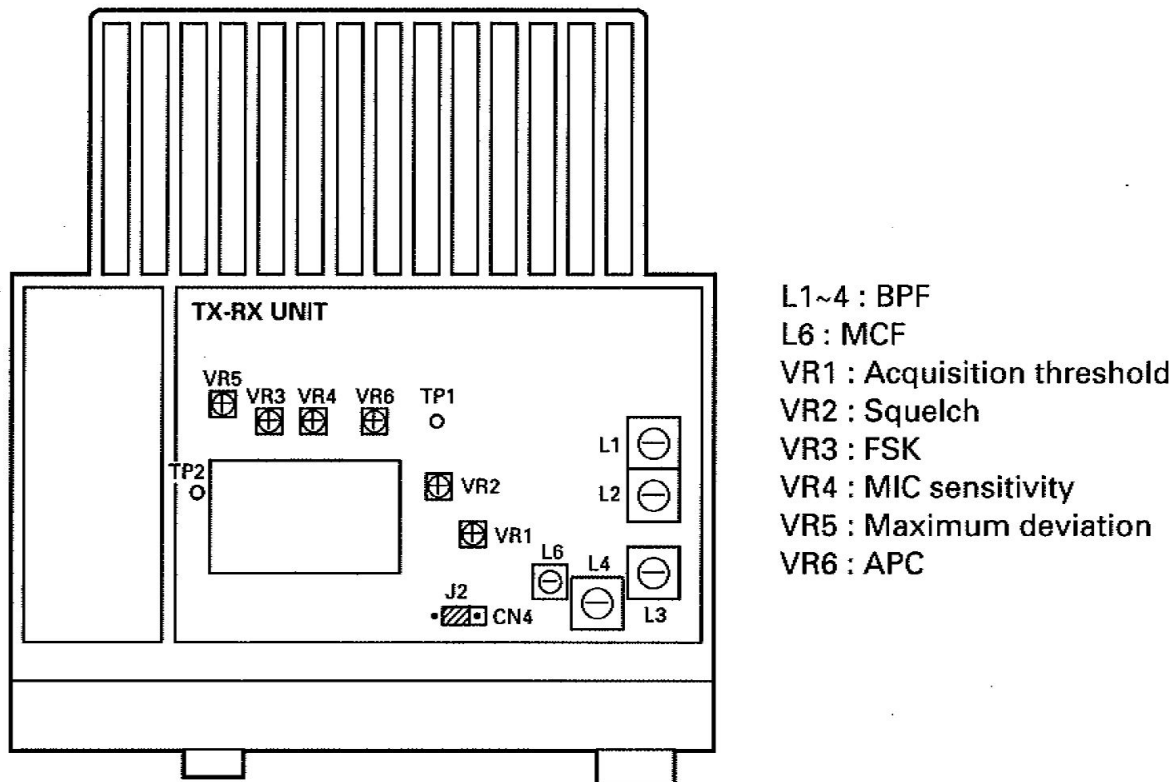


13. Shown below is a Com-Spec TS-32P tone encoder board. Power is supplied to the TS-32P board via the radio- on the underside of the main board. +13.8 is labeled "B", Ground is labeled "E" and tone injection is labeled "MDM". Wiring from the TS-32P to the radio is shown in the picture above in step 10. After Installing the tone board set the tone to 151.4Hz, adjust the level potentiometer all the way down.



Radio Alignment

Using a service monitor we need to adjust the radio for wideband ham use on 222-225MHz. Use the frequency of 223.5000MHz (1.25m National Calling Frequency- no doubt you programmed this in your PROM right?) OR use the receive or transmit frequency of your repeater or link if that is its intended use.



Transmitter Adjustments

- Ensure the radio is on frequency and if not adjust the vari-cap on the TCXO (12.800MHz) until the radio is on frequency
- Adjust the power out of the radio for 15W into a 50 Ohm dummy load by adjusting VR6
- Adjust the maximum deviation by injecting a 1000Hz tone at 50mV into the mic line and adjusting the max deviation for ~4.1KHz using VR5 (with no subaudible tone present from your tone encoder board)
- VR4 is the mic gain adjustment and should not need to be adjusted
- With no tone being injected into the mic connector adjust the potentiometer on your tone encoder board for 750Hz (this is your subaudible tone level)

Receiver Adjustments

- Inject a signal on 223.5000MHz (or your repeater receive frequency), with a tone of 1000Hz, at 3KHz deviation, with a level at approx. 110dBm- the receiver should open up and be noisy- if not increase the level of your signal generator until it opens up the receiver- but the signal should be noisy. In order starting from L1 then proceeding on to L2, L3, and finally L4 adjust for maximum 12dB SINAD value, keep repeating the adjustment slowly and carefully staring at L1 and ending at L4 until no performance increase is seen.
- L6; the MCF, should NOT need any adjustment
- Adjust the squelch using VR2; set your signal generator on 223.5000MHz to your 12dB SINAD point with 1000Hz tone at 3KHz deviation, adjust VR2 so that it opens, shut off your signal generator and the squelch should close, if not repeat until you are happy with the squelch operation

Kenwood TK-715 Repeater Frequency Pairs to Hex Chart

RX Freq	Dec	Hex	TX Freq	Dec	Hex	RX Freq	Dec	Hex	TX Freq	Dec	Hex
223.6000	38660	9703	222.0000	44400	AD70	224.3000	38800	9790	222.7000	44540	ADFC
223.6200	38664	9708	222.0200	44404	AD74	224.3200	38804	9794	222.7200	44544	AE00
223.6400	38668	970C	222.0400	44408	AD78	224.3400	38808	9798	222.7400	44548	AE04
223.6600	38672	9710	222.0600	44412	AD7C	224.3600	38812	979C	222.7600	44552	AE08
223.6800	38676	9714	222.0800	44416	AD80	224.3800	38816	97A0	222.7800	44556	AE0C
223.7000	38680	9718	222.1000	44420	AD84	224.4000	38820	97A4	222.8000	44560	AE10
223.7200	38684	971C	222.1200	44424	AD88	224.4200	38824	97A8	222.8200	44564	AE14
223.7400	38688	9720	222.1400	44428	AD8C	224.4400	38828	97AC	222.8400	44568	AE18
223.7600	38692	9724	222.1600	44432	AD90	224.4600	38832	97B0	222.8600	44572	AE1C
223.7800	38696	9728	222.1800	44436	AD94	224.4800	38836	97B4	222.8800	44576	AE20
223.8000	38700	972C	222.2000	44440	AD98	224.5000	38840	97B8	222.9000	44580	AE24
223.8200	38704	9730	222.2200	44444	AD9C	224.5200	38844	97BC	222.9200	44584	AE28
223.8400	38708	9734	222.2400	44448	ADA0	224.5400	38848	97C0	222.9400	44588	AE2C
223.8600	38712	9738	222.2600	44452	ADA4	224.5600	38852	97C4	222.9600	44592	AE30
223.8800	38716	973C	222.2800	44456	ADA8	224.5800	38856	97C8	222.9800	44596	AE34
223.9000	38720	9740	222.3000	44460	ADAC	224.6000	38860	97CC	223.0000	44600	AE38
223.9200	38724	9744	222.3200	44464	ADB0	224.6200	38864	97D0	223.0200	44604	AE3C
223.9400	38728	9748	222.3400	44468	ADB4	224.6400	38868	97D4	223.0400	44608	AE40
223.9600	38732	974C	222.3600	44472	ADB8	224.6600	38872	97D8	223.0600	44612	AE44
223.9800	38736	9750	222.3800	44476	ADBC	224.6800	38876	97DC	223.0800	44616	AE48
224.0000	38740	9754	222.4000	44480	ADC0	224.7000	38880	97E0	223.1000	44620	AE4C
224.0200	38744	9758	222.4200	44484	ADC4	224.7200	38884	97E4	223.1200	44624	AE50
224.0400	38748	975C	222.4400	44488	ADC8	224.7400	38888	97E8	223.1400	44628	AE54
224.0600	38752	9760	222.4600	44492	ADCC	224.7600	38892	97EC	223.1600	44632	AE58
224.0800	38756	9764	222.4800	44496	ADD0	224.7800	38896	97F0	223.1800	44636	AE5C
224.1000	38760	9768	222.5000	44500	ADD4	224.8000	38900	97F4	223.2000	44640	AE60
224.1200	38764	976C	222.5200	44504	ADD8	224.8200	38904	97F8	223.2200	44644	AE64
224.1400	38768	9770	222.5400	44508	ADDC	224.8400	38908	97FC	223.2400	44648	AE68
224.1600	38772	9774	222.5600	44512	ADE0	224.8600	38912	9800	223.2600	44652	AE6C
224.1800	38776	9778	222.5800	44516	ADE4	224.8800	38916	9804	223.2800	44656	AE70
224.2000	38780	977C	222.6000	44520	ADE8	224.9000	38920	9808	223.3000	44660	AE74
224.2200	38784	9780	222.6200	44524	ADEC	224.9200	38924	980C	223.3200	44664	AE78
224.2400	38788	9784	222.6400	44528	ADF0	224.9400	38928	9810	223.3400	44668	AE7C
224.2600	38792	9788	222.6600	44532	ADF4	224.9600	38932	9814	223.3600	44672	AE80
224.2800	38796	978C	222.6800	44536	ADF8	224.9800	38936	9818	223.3800	44676	AE84

Kenwood TK-715 Simplex Frequencies to Hex Chart

RX Freq	Dec	Hex	TX Freq	Dec	Hex	RX Freq	Dec	Hex	TX Freq	Dec	Hex
223.0000	38540	968C	223.0000	44600	AE38	223.7000	38680	9718	223.7000	44740	AEC4
223.0200	38544	9690	223.0200	44604	AE3C	223.7200	38684	971C	223.7200	44744	AEC8
223.0400	38548	9694	223.0400	44608	AE40	223.7400	38688	9720	223.7400	44748	AECC
223.0600	38552	9698	223.0600	44612	AE44	223.7600	38692	9724	223.7600	44752	AED0
223.0800	38556	969C	223.0800	44616	AE48	223.7800	38696	9728	223.7800	44756	AED4
223.1000	38560	96A0	223.1000	44620	AE4C	223.8000	38700	972C	223.8000	44760	AED8
223.1200	38564	96A4	223.1200	44624	AE50	223.8200	38704	9730	223.8200	44764	AEDC
223.1400	38568	96A8	223.1400	44628	AE54	223.8400	38708	9734	223.8400	44768	AEE0
223.1600	38572	96AC	223.1600	44632	AE58	223.8600	38712	9738	223.8600	44772	AEE4
223.1800	38576	96B0	223.1800	44636	AE5C	223.8800	38716	973C	223.8800	44776	AEE8
223.2000	38580	96B4	223.2000	44640	AE60	223.9000	38720	9740	223.9000	44780	AEEC
223.2200	38584	96B8	223.2200	44644	AE64	223.9200	38724	9744	223.9200	44784	AEF0
223.2400	38588	96BC	223.2400	44648	AE68	223.9400	38728	9748	223.9400	44788	AEF4
223.2600	38592	96C0	223.2600	44652	AE6C	223.9600	38732	974C	223.9600	44792	AEF8
223.2800	38596	96C4	223.2800	44656	AE70	223.9800	38736	9750	223.9800	44796	AEFC
223.3000	38600	96C8	223.3000	44660	AE74	224.0000	38740	9754	224.0000	44800	AF00
223.3200	38604	96CC	223.3200	44664	AE78	224.0200	38744	9758	224.0200	44804	AF04
223.3400	38608	96D0	223.3400	44668	AE7C	224.0400	38748	975C	224.0400	44808	AF08
223.3600	38612	96D4	223.3600	44672	AE80	224.0600	38752	9760	224.0600	44812	AF0C
223.3800	38616	96D8	223.3800	44676	AE84	224.0800	38756	9764	224.0800	44816	AF10
223.4000	38620	96DC	223.4000	44680	AE88	224.1000	38760	9768	224.1000	44820	AF14
223.4200	38624	96E0	223.4200	44684	AE8C	224.1200	38764	976C	224.1200	44824	AF18
223.4400	38628	96E4	223.4400	44688	AE90	224.1400	38768	9770	224.1400	44828	AF1C
223.4600	38632	96E8	223.4600	44692	AE94	224.1600	38772	9774	224.1600	44832	AF20
223.4800	38636	96EC	223.4800	44696	AE98	224.1800	38776	9778	224.1800	44836	AF24
223.5000	38640	96F0	223.5000	44700	AE9C	224.2000	38780	977C	224.2000	44840	AF28
223.5200	38644	96F4	223.5200	44704	AEA0	224.2200	38784	9780	224.2200	44844	AF2C
223.5400	38648	96F8	223.5400	44708	AEA4	224.2400	38788	9784	224.2400	44848	AF30
223.5600	38652	96FC	223.5600	44712	AEA8	224.2600	38792	9788	224.2600	44852	AF34
223.5800	38656	9700	223.5800	44716	AEAC	224.2800	38796	978C	224.2800	44856	AF38
223.6000	38660	9704	223.6000	44720	AEB0	224.3000	38800	9790	224.3000	44860	AF3C
223.6200	38664	9708	223.6200	44724	AEB4	224.3200	38804	9794	224.3200	44864	AF40
223.6400	38668	970C	223.6400	44728	AEB8	224.3400	38808	9798	224.3400	44868	AF44
223.6600	38672	9710	223.6600	44732	AEBC	224.3600	38812	979C	224.3600	44872	AF48
223.6800	38676	9714	223.6800	44736	AEC0	224.3800	38816	97A0	224.3800	44876	AF4C