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The MWT-1: A Medium-Wave Tuner / Pre-selector with Regeneration Capability

Mark Connelly --=- WA1ION DX Labs --=- 18 DEC 1985

Introduction

Several problems are encountered today by medium-wave DXers in the quest to hear new stations.

The first is the mediocre ability of reasonably-priced receivers to deal with strong stations. Spurious mixing responses caused by overloading of a receiver's front end by several local stations are a problem most of us have experienced. Overloading is most severe at urban locations when an outdoor wire antenna of considerable length is connected directly to the receiver input. The most common remedies are (1) use a (tuned) loop antenna or (2) attenuate the signal from the longwire. Solution (1), using the loop approach, is of considerable merit if the building in which the loop resides is not made of an RF-absorptive material and if the RF noise level within that building is low. Shielded, balanced loops offer reduction of some types of electrical noise. Of course there are many cases that rule out successful loop operation - e. g. a steel-frame building with numerous SCR light-dimmers and TV sets. Common-remedy (2), using a potentiometer or resistive-divider to attenuate the signals from a longwire antenna, will often give the desired results of a low manmade-noise level and freedom from overloading-caused spurious responses, but the penalty may well be that a DX station's weak signal level may be lower than that which the receiver can detect.

A second problem is that the same receivers that are readily overloaded by strong stations in the city may not be sensitive enough to receive weak signals when operated in the country. A DXer may not always be able to solve the low-sensitivity problem by casually strolling outside with a 2000-foot-roll of Beverage wire: the land required may simply not be available. Some car receivers yield impressive sensitivity with short whip aerials, so a DXer would expect that a $ 300 to $ 500 communications receiver should pull tremendous signals from a 50'/15 m. longwire. Such is often not the case, however.

The third problem to be considered is the insufficient selectivity of some receivers. This is especially notable with the many moderately-priced digital-readout portables now in common use - e. g. the Sony ICF-2001, Uniden CR-2021, Realistic DX-400. Mediocre selectivity is also a "feature" of the Kenwood R-600 and R-1000: the so-called "narrow" selectivity position provided by these receivers just can't "cut the mustard" on foreign splits like the more expensive rigs (R-71, etc.) or like the old-timers (R-390A, HQ-180A).

The MWT-1: a DX problem-solver

The MWT-1 Medium Wave Tuner can be placed between an antenna lead and the receiver's input. This tuner can perform four distinct functions which allow the DXer to get optimum results for the given receiver / antenna / location combination. These functions are summarised as follows:

(1) Direct antenna to receiver connection: The antenna may be connected through the tuner directly to the receiver's input. An attenuator pot (R1) allows reduction in the signal levels provided by the antenna (thereby combatting front-end overload problems).

(2) Passive tuning (no amplification): Overloading / spurs from unwanted -frequency stations may be reduced or eliminated with little or no loss of desired-frequency DX station signal strength. The L-C tank circuit in the tuner is adjusted to peak the desired frequency; stations on other frequencies are attenuated. Those using sizable longwires and mediocre receivers at strong-signal urban locations benefit the most from the passive tuning approach.

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(3) Simple Active tuning (amplified, no regeneration): The desirable features of passive tuning are coupled with the added benefit of amplification. Thunderous signal levels may be obtained from wires as short as 20'/ 6 m.; even a car whip provides worthwhile DX. High-impedance shortwires which perform poorly into 50-ohm receiver inputs "come to life" when active tuning is used. Even a Beverage's output can be improved, at least at sites without strong local stations.

(4) Regenerative tuning: Reception improvements made by simple active tuning are taken even further by regenerative tuning. Much more gain is achievable. Furthermore, previously-listed Problem # 3 (insufficient receiver selectivity) can now be attacked. A regenerative tuner, when peaked and on the verge of oscillating, tightens the received passband to the point that audio can be successfully extracted from a station on 999 kHz that is 10 dB weaker than a station on 1000 kHz. This selectivity-enhancement works like a Q-Multiplier circuit and is somewhat independent of the receiver's own selectivity. This gives car radios and other broad-selectivity receivers split-catching capabilities normally associated with mid-priced communications receivers. A Q-Multiplier differs from the MWT-1 in that the Q-Multiplier works on the IF (usually 455 kHz) and has to be wired to the receiver's innards while the MWT-1 works on the RF input and does not require any wiring to the receiver other than to its signal-input jack. Regenerative tuning is more complicated (adjustment-wise) than passive or simple active tuning are, but the results are frequently worth the effort. Using regenerative tuners of various types between my car whip and car radio has been most gratifying, especially when parked at Waterfront Park in Boston at sunset when the Trans-Atlantics are rolling in.

Before getting into the particulars of initiation and performance of each mode, the operator of the unit should become familiar with the unit's controls and its input / output connectors as identified in Table 1 and in the schematic drawing (Figure 1). Figure 1 appears in the "Building the MWT-1 Tuner" section of this article. It should be noted that S2 is a 3-position function switch which selects Mode 2 (passive tuning) at its fully counterclockwise position, Mode 1 ("off / bypass" - i. e. direct antenna to receiver feed) at its centre position, and "active" (to be explained more) at its fully clockwise position. The "active" function switch setting actually comprises both the Mode 3 (simple active tuning) and Mode 4 (regenerative tuning) functions: Mode 3 is obtained by setting R3 to fully clockwise (R3's wiper arm to ground); Mode 4 is obtained by adjusting R3's wiper arm to be not at zero ohms to ground.

Table 1: MWT-1 Controls and Input / Output Connectors

Controls

location	designation	operational description
left side	R1	input attenuator pot
top	C1	main tuning capacitor
"	R3	regeneration threshold / output level pot
"	S3	antenna length (coupling compensation) switch
"	S2	function switch (passive, off/bypass, active)
"	C2	vernier (fine) tuning capacitor
"	S1	frequency range (tank coil) switch
"	R2	Q pot / regeneration level vernier pot

Input / Output Connectors

location	designation	operational description	connector type
left side	J2	car antenna cable input	Motorola jack
" "	J4	earth ground input	banana jack
" "	J3	wire antenna input	banana jack
" "	J1	RF source (e. g. phaser) input	BNC jack
right side	J7	9V battery holder	Keystone 1290
" "	J6	RF output to car radio	Motorola jack
" "	J5	RF output	BNC jack

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The tuned modes of a standard MWT-1 provide coverage of 140 - 300 kHz (European / African / Asian longwave broadcasts) and 450 - 2000 kHz (ship traffic, standard AM broadcast band, and 160-metre ham band). A longwave-only unit (LWT-1) could be made to cover 90 - 700 kHz, thereby providing full beacon-band coverage, by using the following tank inductors on S1: (L in uH) L1=15000, L2=6800, L3=3300, L4=1500, L5=680, L6=330, L7=3300, L8=1500, L9=680, L10=330, L11=150, and L12=68.

Operating the MWT-1

Before operating any of the four modes, connections to/from the MWT-1 must be made. The antenna or other signal source may be connected to J1, J2, or J3. Earth ground should be connected to J4 if the cable to the receiver will be longer than 10'/3 m. or if the receiver is not grounded. Earth ground may be a ground rod, a cold water pipe, a 3-prong AC outlet's centre-pin, or even a "dummy ground" such as a Beverage antenna not being used at the time for reception. Grounding helps to reduce interference from locally-generated manmade RF noise. A 9-volt battery should be connected to J7. The RF-output coaxial cable (to the receiver input) may be connected to J5 or J6. A shielded receiver (e. g. communications receiver or a car radio) should be used; successful tuner operation with receivers having coupling coils on ferrite rod aerials is not always possible because of the inherent stray pickup of ferrite rods.

Mode (1) direct feed of antenna to receiver

Initialisation

The following controls are not used in Mode (1): C1, R3, S3, C2, S1, R2. Their positions are irrelevant.

Set R1 initially to fully CCW (the switch on R1 takes this attenuation pot out of the line).

Set S2 to centre (off / bypass function).

Operation

With receiver on desired frequency, check that the wanted signal is of sufficient strength and has no spurious mixing signals or images from strong local stations. If spurs / images are present, adjust R1 until they go away. If the wanted station is now too weak, a different operating mode (2, 3, or 4) is suggested.

Mode (2) passive tuning

Minimum suggested wire length for passive tuning is 50'/15 m. at frequencies below 500 kHz; 26'/8 m. at frequencies above 500 kHz.

Initialisation

C1 is to be adjusted later.

Set R1 to fully CCW (attenuator out of line).

Set R3 to fully CCW = maximum output level.

Set S3 to right = "Normal" length position.

Set S2 fully CCW = passive tuning position.

Set C2 at 12 o'clock pointer position = minimum capacitance.

Set R2 fully CCW = maximum Q.

Set S1 for operating frequency range desired, in accordance with Table 2.

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Table 2: S1 Frequency Range Switch Settings Chart

S1 Position #	S1 Knob Pointer "o'clock"	Min. Freq. kHz	Max. Freq. kHz	Tank Inductor Values "Main" L #	"Main" L uH	"Tap" L #	"Tap" L uH
1	9:30	140	180	L1	4700	L7	1000
2	10:30	180	300	L2	2200	L8	470
3	11:30	450	620	L3	390	L9	82
4	12:30	620	850	L4	180	L10	39
5	1:30	850	1300	L5	82	L11	18
6	2:30	1300	2000	L6	39	L12	8.2

Operation

Adjust C1 for maximum desired-frequency signal.

If overloading-caused spurious responses QRM the desired signal when C1 is properly peaked, set S3 to "Long" (middle) and re-peak C1. If, after having done that, spurs still exist: adjust R3 to make the spurs go away. Slight re-peaking of C1 may then be necessary.

Mode (3) simple active tuning

Initialisation

C1 is to be adjusted later.

Set R1 to fully CCW (attenuator out of line).

Set R3 to fully CW = wiper arm at GND.

Set S3 to right = "Normal" length position (wire length greater than 10'/3 m.) or to left = "Short" length position (antenna shorter than 10').

Set S2 fully CW = active tuning position.

Set C2 at 12 o'clock pointer position = minimum capacitance.

Set R2 fully CCW = maximum Q.

Set S1 for operating frequency range desired, in accordance with Table 2.

Operation

Adjust C1 for maximum desired-frequency signal.

If spurs occur & S3 is on "Short", set S3 to "Normal" & re-peak C1.

If spurs occur & S3 is on "Normal", set S3 to "Long" & re-peak C1. At that point, use R3 to eliminate any residual overloading-caused spurious responses that may be present. Slight re-peaking of C1 may be required.

Mode (4) regenerative tuning

Perform all Mode 3 steps above except, during initialisation, set C2 to half-meshed (= 3 o'clock) and R2 at half-resistance (= 12 o'clock).

Bring R3 gradually CCW in small steps; after each step, re-peak C1. An increase in signal level and tuning sharpness should be readily apparent. At the "regeneration threshold" the received audio gets muddy; beyond that threshold, oscillation occurs. Once R3 & C1 have been adjusted to the threshold as closely as possible, fine-tuning may be accomplished by successive adjustments of vernier controls R2 & C2.

Occasionally it may be necessary to set length switch S3 to the "next longest" position (e. g. to "Normal" if it had been on "Short") to get a high enough Q for regeneration. Doing this also reduces the likelihood of spurs.

Part 2 (assembly instructions) will appear next week

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1110 VENEZUELA, Carupano YVQT 12/29 0334 : Fast SS talk, "Carupano" ID, way over WBT/CBD. (Connelly-MA)

1120 DOMINICAN REPUBLIC, Santo Domingo HICN 12/23 0204 : Good w/SS mx and SID as "Antillas de Sto. Domingo". In WMOX null. (Ross-ON) (Another fine catch. ed)

1127 unID, 12/29 0459 : Poor w/Sinatra mx; WNEW phased. (Connelly-MA) (Costa Rica's Sonido 1120 is reported here from 1125 per H. Nielsen in 6/15/85 DXWWII. ed)

1555 CAYMAN ISLANDS, George Town 12/29 0516 : MoR vocals at fair to good level. (Connelly-MA)
+0437 1/11 : EZL instrumental mx good through QXR slop. This seems to get harder and harder each season - hope it's my imagination. (Hall-PA)

1610 ANGUILLA, The Valley 12/29 0308 : Carib. Beacon excellent w/EE preaching. (Connelly-MA)
+12/5 0356 : Very good w/rlgs pgm, gospel mx, in EE. Booming in. (Ross-ON)

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What do Kenneth W. Lackie, Gardner Smith, and W.P. Townshend all have in common? They are all residents of Washington D.C. (as far as I know), and are asked to do the DX community a favor: The 12/21/85 issue of DXM has an article about the FCC listing Cuban BC stations on page #10. The list can be publically viewed at the address given, but mail requests must be accompanied by a $25 deposit. I say no more. Sure would be nice to see our government's measurements on the Cubans.

This was indeed a spectacular edition of DXWW-E - nice to hear from everyone. And I'm finally christening my R-71 - I got it right before I went to Erie and only heard one DX station (Portugal-1575) on it until now. It performs well and I urge potential radio purchasers to consider it. 73's

CREDITS:

(Ross-ON)	Robert S. Ross, Box 4373, Stn. C, London, ON CANADA N5W 5J2 (Kenwood TS430S, Panasonic RF1115, RealisticTRF, 120' lw, 4' box loop)
(Townshend-DC)	Bill Townshend, 4500 Connecticut Ave. NW #901, Washington, DC 20009 (Realistic DX-160)
(Connelly-MA)	Mark Connelly, 7 Trowbridge Path, W. Yarmouth, Cape Cod, MA 02673 (Kenwood R-600, 30-m sloping wire phased against Palomar loop; output of MWDX-4A phaser fed thru MWT-1 Regen. Tuner)
(Wyllie-MA)	William Wyllie, 95 Peck St., Franklin, MA 02038 (SHARP GF-450)
(Eckman-PA)	Richard Eckman, 2328 Griffith St., Philadelphia, PA 19152 (HQ-180A, SB-620, Sony ICF-7600D, Sanserino loop)
(Hall-PA)	Jim Hall, 240 Byron Road, Pittsburgh, PA 15237 (Kenwood R-600, R-71A, //Bev's., //275' lw's 70°, 400' south wire term. in crick, loops)

to Spanish radio, they're listening to me. That's quite a privilege," he said.

Demos Kakridas, 85, has been host of the program "Greece Speaks" for 47 years. Station officials said that because of his loyal following and prominence in the community, Kakridas, unlike other announcers, is allowed to pepper his program with political commentary.

"The Greek people listen to me," ...id. "I bring them the right news. I try to bring back the glory that was Greece."

Jane A. Dunklee, WUNR general manager, said that during her 17 years at the station she has occasionally mediated in rivalries between the program hosts, including one between two Spanish programs that resulted in a fistfight in the studio.

"This is a bunch of little stations that make up one big station," she said. "I'm your basic WASP, so I can set myself aside as a neutral party."

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Building the MWT-1 tuner

For the sake of brevity, I am keeping construction data to a bare minimum. The MWT-1 system schematic (Figure 1), the RFE-A front-end card subassembly schematic (Figure 2), and the RFE-A "roadmap" (Figure 3) are the principal construction drawings. Remaining construction documentation includes Table 3 (Hole Drilling List), Tables 4/5/6 (Parts Lists), Table 7 (Wiring List), and Table 8 (Control Conventions). Experienced builders who want to build an MWT-1 should have no trouble. Much of the construction information in the recent MWDX-4 / Mini-MWDX-4 Phasing Unit article (available from IRCA / NRC as a reprint) is directly applicable to the MWT-1 project. For instance, C1 must have its two mounting holes tapped to 6-32 threads: it is then mounted in the same fashion as C1 of the MWDX-4 series of phasers. Ground lugs, the battery holder, and the Motorola jacks use the same hardware as their corresponding components in the MWDX-4 article. The RFE-A circuit card (M1 of MWT-1) is mounted with the same type of hardware as the BBA-B circuit card (A1 of the MWDX-4). Those who need parts to build the MWT-1 tuner should first consult the vendors on the parts list. I can arrange to supply constructed subassemblies (S1 with all inductors, M1 front-end card, drilled chassis boxes) as well as completed MWT-1's.

** For a price / time estimate, please write to: **
** Mark Connelly - 30 William Road - Billerica, MA 01866 USA. **

Figure 1: MWT-1 system schematic

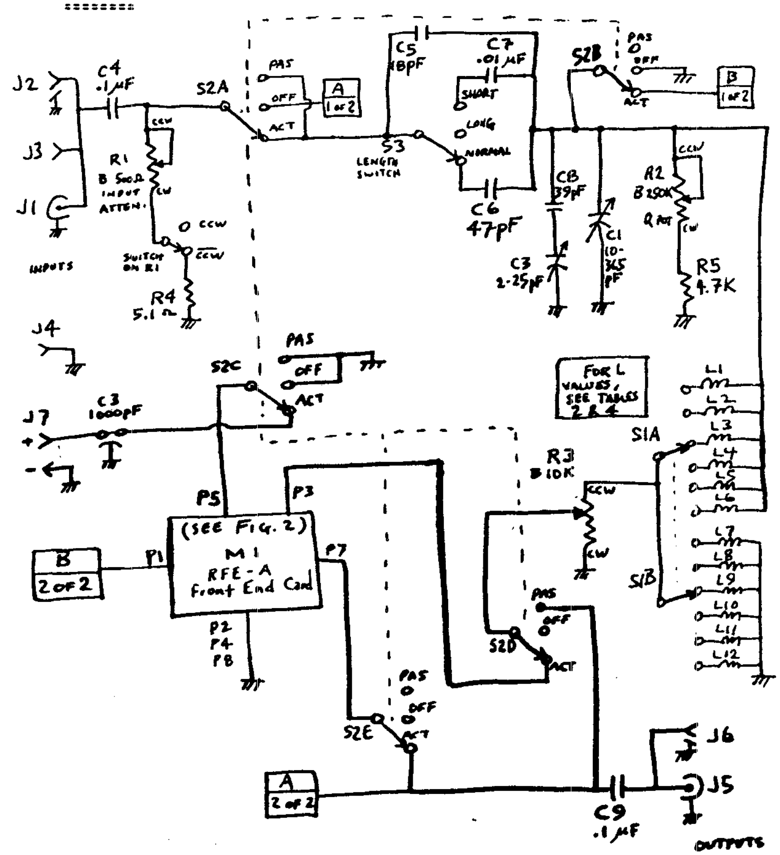

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Figure 2: RFE-A Regenerative Front-End Card subassembly schematic
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Notes: This is M1 of the MWT-1. The designations of components in this subassembly are a completely separate entity from the designations of components shown on Figure 1.

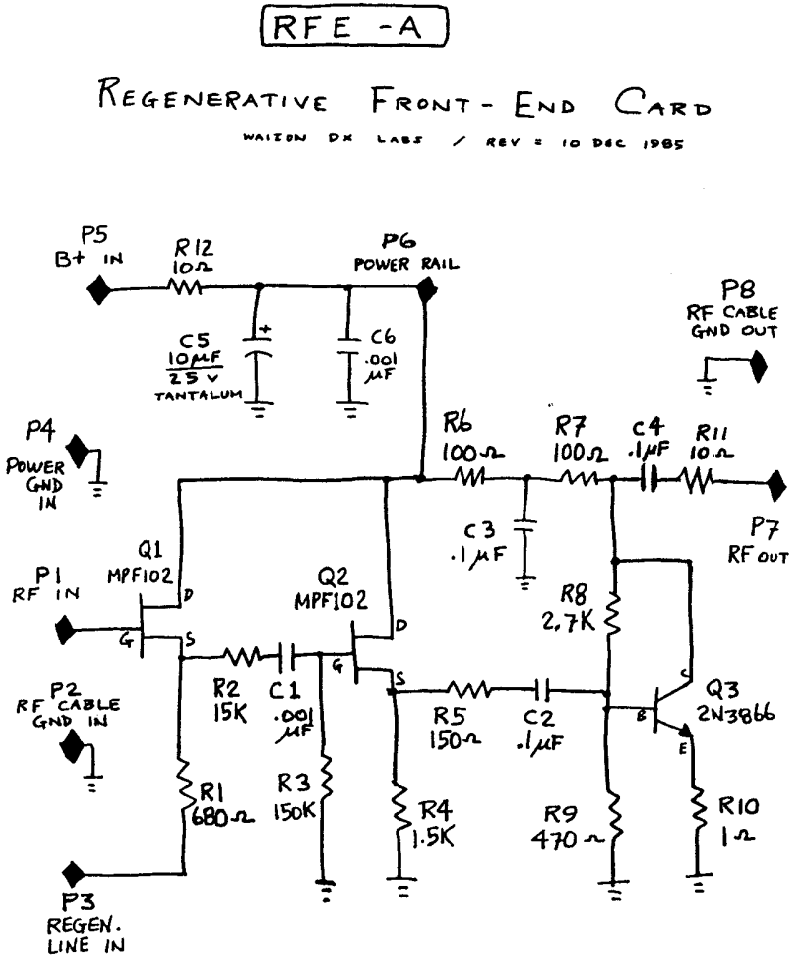

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Figure 3: RFE-A Regenerative Front-End Card subassembly "roadmap"
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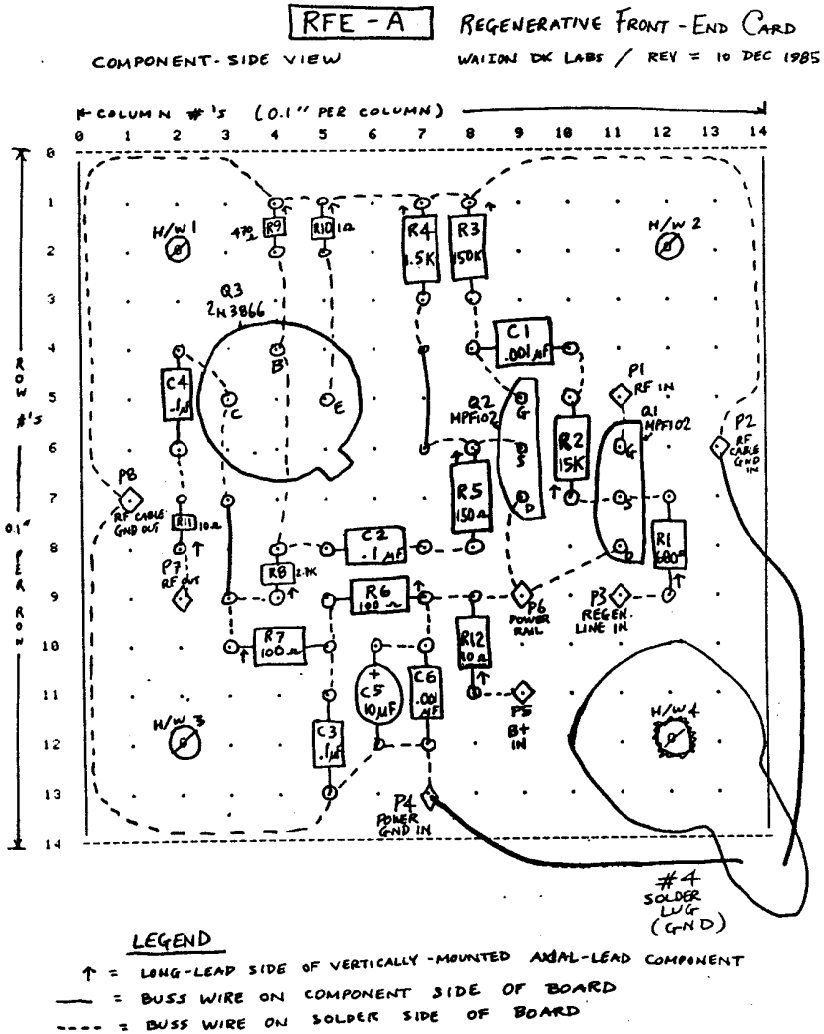

Table 3: Hole List for MWT-1 Medium-Wave Tuner 475-7-5

BOX USED = Mouser 537-TF-779 (5" x 4" x 3")

X = horizontal distance, in inches, from the vertical centreline (VCL) on the side observed. Negative values of X are left of VCL; positive values of X are right of VCL.

Y = vertical distance, in inches, from the bottom horizontal edge of the side observed.

D = hole diameter in inches.

LEFT SIDE

Hole #	Comp. Desig.	Description	X	Y	D
1	J2	car ant. in - H/W 1	-1.5	1.269	0.14
2	J2	car ant. in - body	-1.5	0.875	0.5
3	J2	car ant. in - H/W 2	-1.5	0.481	0.14
4	J4	GND in -black banana jack	-0.75	1.25	0.3125
5	J3	Wire Ant.In-red ban. jack	-0.75	0.5	0.3125
6	G1	GND H/W - int. lug	0.0	1.125	0.113
7	J1	RF source in - BNC jack	0.0	0.5	0.375
8	R1	Input Atten. Pot - shaft	1.25	0.75	0.3125
9	R1	Input Atten. Pot - tab	1.5625	0.75	0.14

TOP SIDE

Hole #	Comp. Desig.	Description	X	Y	D
1	C1	Main Tuning Cap. - H/W 1	-1.875	3.213	0.14
2	C1	Main Tuning Cap. - shaft	-1.625	2.75	0.5
3	C1	Main Tuning Cap. - H/W 2	-1.875	2.287	0.14
4	R3	Reg.Threshold/Level-shaft	-1.875	0.625	0.3125
5	R3	Reg.Threshold/Level- tab	-1.5625	0.625	0.14
6	G2	GND H/W - int. lug	-1.25	1.125	0.113
7	S3	Length switch - tab	-0.25	2.0	0.113
8	S3	Length switch - shaft	0.0	2.0	0.25
9	S2	Function switch -shaft	0.0	0.875	0.375
10	S2	Function switch - tab	0.0	0.375	0.14
11	C2	Vernier Tuning Cap. - shaft	0.125	3.25	0.28
12	G3	GND H/W - int. lug	1.5	3.0	0.113
13	S1	Freq. Range switch - shaft	1.0	2.125	0.375
14	S1	Freq. Range switch - tab	1.5	2.125	0.14
15	R2	Q/Regen.Vernier Pot - shaft	1.5	0.625	0.3125
16	R2	Q/Regen.Vernier Pot - tab	2.0	0.625	0.14

RIGHT SIDE

Hole #	Comp. Desig.	Description	X	Y	D
1	J7	battery holder - H/W 1	-1.625	2.625	0.113
2	J7	battery holder - H/W 2	-1.625	1.75	0.113
3	J6	RF out to car RX - H/W 1	-1.5	1.269	0.14
4	J6	RF out to car RX - body	-1.5	0.875	0.5
5	J6	RF out to car RX - H/W 2	-1.5	0.481	0.14
6	C8	B+ input feedthrough cap.	-0.6875	1.0	0.188
7	G4	GND H/W - int.& ext. lugs	0.0	1.125	0.113
8	J5	RF out - BNC jack	0.0	0.5	0.375
9	M1	Regen.Front End Card-H/W 3	0.5625	1.5	0.113
10	M1	Regen.Front End Card-H/W 1	0.5625	0.5	0.113
11	M1	Regen.Front End Card-H/W 4	1.5625	1.5	0.113
12	M1	Regen.Front End Card-H/W 2	1.5625	0.5	0.113

Parts Lists for MWT-1 Tuner

Table 4 = "upper level" of electrical & major mechanical components
Table 5 = M1 (RFE-A) Regenerative Front-End Card subassembly components
Table 6 = small hardware

Vendor Abbreviations

DK = Digi-Key - P. O. Box 677 - Thief River Falls, MN 56701
MOU = Mouser Electronics- 11433 Woodside Ave.- Santee, CA 92071
NEW = Newark Electronics- (many locations)
RS = Radio Shack - (many locations)

Table 4: "upper level" of electrical & major mechanical components

Component Designation	Description	Vendor	Stock #
BOX			
-	chassis box (5" x 4" x 3")	MOU	537-TF-779
SUBASSEMBLY			
M1	RFE-A regenerative front-end card	[see Table 5]	
CONTROLS			
C1	10-365 pF variable capacitor	MOU	524-A1-227
C2	2-25 pF variable capacitor	MOU	530-189-0569-1
R1	500 ohm linear pot w/ switch	MOU	31CT205
R2	250 K linear pot	MOU	31VA503
R3	10 K linear pot	MOU	31CR401
S1	2-pole 6-position rotary switch	MOU	10WW026
S2	8-pole 3-position rotary switch	MOU	10WR083
S3	SPDT on/off/on toggle switch	RS	275-325
JACKS / CONNECTORS			
J1	BNC jack UG-1094	RS	278-105
J2	Motorola jack	MOU	16PJ107
J3	banana jack (red)	RS	274-662
J4	banana jack (black)	RS	274-662
J5	BNC jack UG-1094	RS	278-105
J6	Motorola jack	MOU	16PJ107
J7	battery holder (Keystone 1290)	MOU	534-1290
ELECTRICAL COMPONENTS			
B1	9 volt battery	RS	23-553
C3	1000 pF B+ feedthrough cap.	NEW	19F2861
C4	.1 uF monolithic cap.	DK	P4525
C5	18 pF disc cap.	MOU	21CB018
C6	47 pF disc cap.	RS	272-121
C7	.01 uF disc cap.	RS	272-131
C8	39 pF disc cap.	MOU	21CB039
C9	.1 uF monolithic cap.	DK	P4525
L1	4700 uH inductor	MOU	43LH247
L2	2200 uH "	MOU	ME434-1120-223K
L3	390 uH "	MOU	43LR394
L4	180 uH "	MOU	43LR184
L5	82 uH "	MOU	43LS825
L6	39 uH "	MOU	43LS395
L7	1000 uH "	MOU	43LS103
L8	470 uH "	MOU	43LS474
L9	82 uH "	MOU	43LS825
L10	39 uH "	MOU	43LS395
L11	18 uH "	MOU	43LS185
L12	8.2 uH "	MOU	43LQ826
R4	5.1 ohm resistor	DK	5.1Q
R5	4.7 K resistor	RS	271-1330

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KNOBS

-	knob for C1	RS	274-415 (pk 2)
-	knob for C2	MOU	45KN013
-	knob for R1	RS	274-415 (pk 2)
-	knob for R2	MOU	45KN013
-	knob for R3	MOU	45KN013
-	knob for S1	MOU	45KN013
-	knob for S2	MOU	45KN013

Table 5: M1 (RFE-A) Regenerative Front-End Card subassembly components

Designation(s)	Description	Vendor	Stock #	Qty.
BD	perfboard (1.4" x 1.4")	RS	276-1396(cut)	1
C1,C6	.001 uF disc cap.	RS	272-126	2
C2,C3,C4	.1 uF monolithic cap.	DK	P4525	3
C5	10 uF / 25 V tantalum cap.	DK	P2049	1
H1,H2,H3,H4	4-40 x .25 screw	DK	H142	4
H1,H2,H3,H4	4-40 x .5 spacer	MOU	565-2332	4
H1,H2,H3	#4 split lockwasher	MOU	572-00649	3
H4	#4 solder lug	MOU	565-1416-4	1
P1,P2,P3,P4, P5,P6,P7,P8	flea-clip for .042" hole	MOU	574-T42-1/100	8
Q1,Q2	MPF102 N-channel JFET	RS	276-2062	2
Q3	2N3866 NPN	MOU	511-2N3866	1
R1	680 ohm resistor	DK	680Q	1
R2	15 K "	RS	271-1337	1
R3	150 K "	DK	150KQ	1
R4	1.5 K "	DK	1.5KQ	1
R5	150 ohm "	RS	271-1312	1
R6,R7	100 ohm "	RS	271-1311	2
R8	2.7 K "	DK	2.7KQ	1
R9	470 ohm "	RS	271-1317	1
R10	1 ohm "	DK	1.0Q	1
R11,R12	10 ohm "	RS	271-1301	2
W	buss wire	RS	278-1341 approx.1'	

Table 6: small hardware

Note: Mounting hardware is supplied with the following components: C2, C3, J1, J3, J4, J5, R1, R2, R3, S1, S2, S3, knobs, & chassis box.

Hardware is required by the following component designators: C1, G1, G2, G3, G4, J2, J6, J7, and M1. All required hardware is listed below:

Description	Vendor	Stock #	Qty.
screw, 4-40 x .25	DK	H142	10
screw, 6-32 x .25	DK	H154	2
screw, 6-32 x .375	DK	H156	4
split lockwasher, #4	MOU	572-00649	6
split lockwasher, #6	MOU	572-00650	8
solder lug, #4	MOU	565-1416-4	5
hex nut, 4-40	DK	H216	6
hex nut, 6-32	DK	H220	4

Table 7: Wiring / Component Connections for MWT-1

Notes: I = insulated wire, approx. #22 AWG
B = bare solid (buss) wire
TP = twisted pair of insulated wires

Wires:

OUTSIDE BOX

Wire #	From	To	Description
1	J7 + terminal pin	C3 external pin	2" I
2	J7 - terminal pin	G4 external GND lug	2" I

INSIDE BOX

Wire #	From	To	Description
3	J1	J3	1" B
4	J3	J2	1" B
5	J4	G1 internal GND lug	1" B
6A	C4 side B	S2A arm	3" TP
6B	J4	G2 internal GND lug	3" TP
7	C4 side B	R1 CCW pin	2" I
8	R1 CCW pin	R1 arm	0.5" B
9	R1 CW pin	R1 switch pin near CW pin	0.5" B
10	R1 switch pin near CCW pin	R4 side B	2" I
11	jct C5/C6/C7	C1 stator	1" B
12	S2A "passive" pos.	S2A "active" pos.	1" I
13	S2A "off/bypass" pos.	S2E "active" pos.	3.5" I
14	S2A "active" pos.	S3 arm	1" I
15	S2B arm	C1 stator	1.5" I
16	S2B "off/bypass" pos.	S2C "off/bypass" pos.	1" I
17A	S2B "active" pos.	P1 of M1	5" TP
17B	S2B "off/bypass" pos.	P2 of M1	5" TP
18	S2C "off/bypass" pos.	S2C "passive" pos.	0.5" B
19	S2C "passive" pos.	G2 internal GND lug	2" I
20A	S2E arm	P7 of M1	3" TP
20B	S2C "passive" pos.	P8 of M1	3" TP
21	S2C arm	P5 of M1	5" I
22	S2C "active" pos.	C3 internal pin	4" I
23	S2E "active" pos.	C9 side A	2" I
24	S2E "active" pos.	S2D "passive" pos.	2" I
25	S2D "active" pos.	P3 of M1	4" I
26	S2D arm	R3 arm	3.5" I
27	R3 CW pin	G2 internal GND lug	1.5" I
28	R3 CCW pin	S1B arm	4" I
29	S1B arm	S1A arm	0.5" B
30	jct L7/L8/L9/L10/L11/L12	G3 internal GND lug	2" I
31	jct L1/L2/L3/L4/L5/L6	jct C5/C6/C7	2" I
32	jct L1/L2/L3/L4/L5/L6	R2 arm	1.5" I
33	R2 arm	R2 CCW pin	0.5" B
34	J6	J5	2.5" I

Components:

INSIDE BOX

Component	Side A to:	Side B to:
C4	J1	wires 6A & 7 (see list above)
C8	C1 stator	C2 stator
C7	S3 "Short" pos.	jct C5/C6/C7
C5	S3 arm	jct C5/C6/C7
C6	S3 "Normal" pos.	jct C5/C6/C7
R4	J4	wire 10
L1	S1A "1" pos.	jct L1/L2/L3/L4/L5/L6
L2	S1A "2" pos.	jct L1/L2/L3/L4/L5/L6
L3	S1A "3" pos.	jct L1/L2/L3/L4/L5/L6
L4	S1A "4" pos.	jct L1/L2/L3/L4/L5/L6
L5	S1A "5" pos.	jct L1/L2/L3/L4/L5/L6
L6	S1A "6" pos.	jct L1/L2/L3/L4/L5/L6
L7	S1B "1" pos.	jct L7/L8/L9/L10/L11/L12
L8	S1B "2" pos.	jct L7/L8/L9/L10/L11/L12
L9	S1B "3" pos.	jct L7/L8/L9/L10/L11/L12
L10	S1B "4" pos.	jct L7/L8/L9/L10/L11/L12
L11	S1B "5" pos.	jct L7/L8/L9/L10/L11/L12
L12	S1B "6" pos.	jct L7/L8/L9/L10/L11/L12
C9	wire 23	J6
R5	R2 CW pin	jct L7/L8/L9/L10/L11/L12

Table 8: Control Orientation Conventions

Ensure that components are mounted and wired in accordance with this table; align knob pointers to clock positions indicated.

Side	Control	Orientation Conventions
left	R1	CCW=maximum level (no attenuation)=7:00 CW=minimum level (maximum attenuation)=5:00
top	C1	maximum C (plates fully meshed) at 6:00 minimum C (plates fully open) at 12:00

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Table 8: Control Orientation Conventions (continued)
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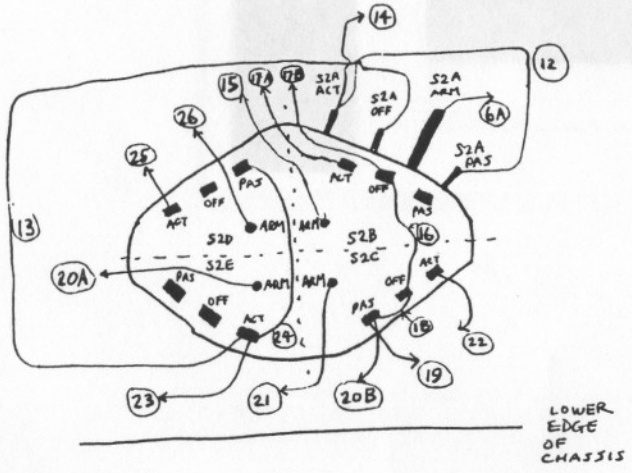
Side	Control	Orientation Conventions
top	R3	arm at GND = fully CW = 4:00 arm at jct S1A/S1B = fully CCW = 8:00
top	C2	maximum C (plates fully meshed) at 6:00 minimum C (plates fully open) at 12:00
top	S3	"Short" = left; "Long" = middle; "Normal" = right
top	S2	passive = CCW = 11:00; off/bypass = centre = 12:00; active = CW = 1:00
top	S1	[see Table 2]
top	R2	maximum Q = CCW = 7:00; minimum Q = CW = 5:00

Figure 4: S2 Function Switch Orientation

Interior view (view from back of switch)

S2A section is on wafer closest to chassis, S2B/S2C/S2D/S2E sections are on wafer closest to observer. Wire numbers correspond to Table 7.



/* end */

AM 83 KNCO
All the Best