HAM NEWS

CRYSTAL CONTROLLED MOBILE CONVERTERS

PART II of the three-part series on high power mobile radio systems by W8DLD and W8WFH describes their bandswitching and single band converters, plus conversion suggestions for the BC-453 receivers which function as tunable IF amplifiers. This series started with PART I—Mobile Power Supply Ideas—in the July-August, 1960 issue. PART III—MOBILE LINEAR AMPLIFIER—will appear in the November-December issue.

W8WFH's bandswitching converter, and the metering panel and power control box, all form a neat under-dash package in the above view. The tuning dial on the converter actually tunes the BC-453 receiver—tucked up on the firewall at the right side of the car—through a flexible shaft.

—Lighthouse Larry

SEPTEMBER-OCTOBER, 1960

in this issue:

Scanning the Spectrum....................page 2

Bandswitching Mobile Converter....page 3

Single Band Mobile Converters..page 7

BC-453 Conversion Suggestions....page 10

1960 Edison Award Announced....page 12

SCANNING the SPECTRUM

MOBILE SSB RECEPTION . . .

Successful reception of single and double sideband signals in a mobile radio system requires that the receiver have excellent frequency stability, on the order of cycles at several megacycles. Also, sufficient selectivity to attenuate signals on adjacent channels is highly desirable.

The double conversion superhetrodyne receiver circuit, when properly applied, will meet both of these major requirements. It makes possible using crystal control in the high frequency oscillator for the first frequency converter when a band only a few hundred kilocycles wide — such as an amateur band — will be tuned by the receiver.

The tunable portion of the receiver can then be operated much lower in frequency where tunable oscillators for the second converter can easily be built with a stability within a hundred cycles. Some top-performing amateur radio receivers utilize this principle.

The double conversion receiver principle has been applied by W8DLD and W8WFH to attain excellent stability and selectivity at low cost by using the BC-453 Command Set receiver, covering 190 to 550 kilocycles, as a tunable i.f. amplifier preceded by high-frequency converters with crystal-controlled oscillators. The selectivity and stability of the BC-453 are widely recognized in amateur radio circles.

The tunable oscillator in the BC-453 operates sufficiently low in frequency, and is mechanically rugged, to minimize the effects of temperature and power supply voltage variation, and shock and vibration upon its stability. Of course, the crystal-controlled oscillators in the amateur band converters have excellent stability too.

Incidentally, here is a more complete listing of crystal frequencies which can be used in the converters described herein than the crystals covered in the coil tables. The listing also shows the harmonic of the crystal oscillator required for injection to the mixer, the signal frequency ranges covered, and the tuning range of the BC-453 receiver for each crystal.

CRYSTAL FREQUENCY CHART

CRYSTAL FREQ. (MC)	HARMONIC	INJECTION FREQ. (MC)	BAND TUNED (MC)	BC-453 RANGE (MC)
3.2	Fund.	3.2	3.5- 3.85	0.2-0.55
3.5	Fund.	3.5	3.7- 4.0	0.2-0.5
6.8	Fund.	6.8	7.0- 7.3	0.2-0.5
6.9	2nd	13.8	14.0-14.35	0.2-0.55
4.6	3rd	13.8	14.0-14.35	0.2-0.55
6.933	3rd	20.8	21.0-21.35	0.2-0.55
5.2	4th	20.8	21.0-21.35	0.2-0.55
6.967	3rd	20.9	21.1-21.45	0.2-0.55
5.225	4th	20.9	21.1-21.45	0.2-0.55
6.975	4th	27.8	28.0-28.35	0.2-0.55
7.0	4th	28.0	28.2-28.55	0.2-0.55
7.075	4th	28.3	28.5-28.85	0.2-0.55
7.15	4th	28.6	28.8-29.15	0.2-0.55
7.225	4th	28.9	29.1-29.45	0.2-0.55
7.3	4th	29.2	29.4-29.75	0.2-0.55

The BC-453 receiver will work fine with 150 volts on the plates. If 300 or more plate volts are applied, bypass capacitors may fail. W8DLD suggests using a VR-150 or 0A2 regulator tube to hold the plate voltage down to 150 volts. Use a power supply with at least 200 volts output and drop the voltage with a 10-watt adjustable resistor, set so that the VR tube is ignited at all times.

Try the converter/BC-453 receiving combination described in this issue. I'm sure you'll be pleased with its performance.

SUPER POWER RIGS . . .

The one-kilowatt power maximum input of the biggest amateur transmitters is dwarfed by General Electric's new 250-kilowatt short wave transmitters being constructed for the Voice of America. They're also many times larger in size — 22 feet long, 10 feet high and 12 feet wide — as compared with most amateur rigs.

Six of the new transmitters, being built for the U.S. Information Agency's VOA East Coast installation near Greenville, N.C., are the largest high frequency transmitters manufactured by General Electric in its 40 years in the communications field.

Each transmitter will include special engineering devices to meet VOA requirements for increasing the intelligibility of reception in foreign lands, where they lay down a whale of a signal, again by comparison with amateur radio signal levels.

73 until next issue,

—Lighthouse Larry

HOW TO GET *G-E HAM NEWS* . . .

G-E HAM NEWS is available free of charge if you pick it up from your local G-E Tube distributor. Some distributors mail copies locally to their customers. Or, for those who prefer receiving copies directly from us, we have a low-cost subscription plan at $1.00 per year. Order your subscription from: **G-E HAM NEWS**, General Electric Company, Receiving Tube Department, 316 E. Ninth Street, Owensboro, Kentucky, U.S.A.

BANDSWITCHING MOBILE CONVERTER

By W. C. Louden, W8WFH

MOBILE OPERATION on several amateur bands requires that the transmitting and receiving equipment in the installation — as well as the antenna — be constructed to be switched readily to the band on which operation is desired at a particular time. A bandswitching converter with crystal controlled oscillator, designed to work into a receiver covering an established intermediate frequency tuning range, can be constructed in little more space than is needed to house a converter covering only a single band.

The converter used at W8WFH/M, however, also incorporates a remote tuning dial which simply drives a flexible shaft coupled to the receiver, mounted up under the right side of the dash in the car. Other controls for the i.f. receiver — r.f. gain, audio gain, AVC switch, and sideband selector switch — also were built into the converter, although these controls and the dial could easily have been located elsewhere.

SEPARATE COILS were used in each of the r.f. circuits of the converter shown in the schematic diagram, Fig. 1, to cover the five amateur bands from 3.5 to 30 megacycles. A 6CB6 sharp cutoff r.f. pentode functions as the r.f. amplifier, while the pentode section of a 6U8 (or 6U8-A) is the mixer. The triode 6U8 section is the crystal oscillator.

(continued on page 4)

TABLE I — PARTS LIST — BANDSWITCHING CONVERTER

C_1	5-35 mmf midget air variable.
C_2	5-140 mmf midget mica padder.
J_1, J_2	auto radio type antenna connectors; or, midget phono jacks.
L_1 to L_4	r.f., mixer and oscillator coils on CTC LS-6 iron slug-tuned coil forms; see COIL TABLE for details on windings.
RFC_1	0.5 millihenry pi-wound r.f. choke.
RFC_2	2.5 millihenry pi-wound r.f. choke, tapped between first and second pies.
S_1	(S_{1A} to S_{1E}) 5-pole, 5-position, 5-section midget rotary tap switch.
S_2, S_3, S_4	1-pole, 2-position midget slide switches.
X_1	Quartz frequency control crystals, 5 required; see COIL TABLE for frequencies.

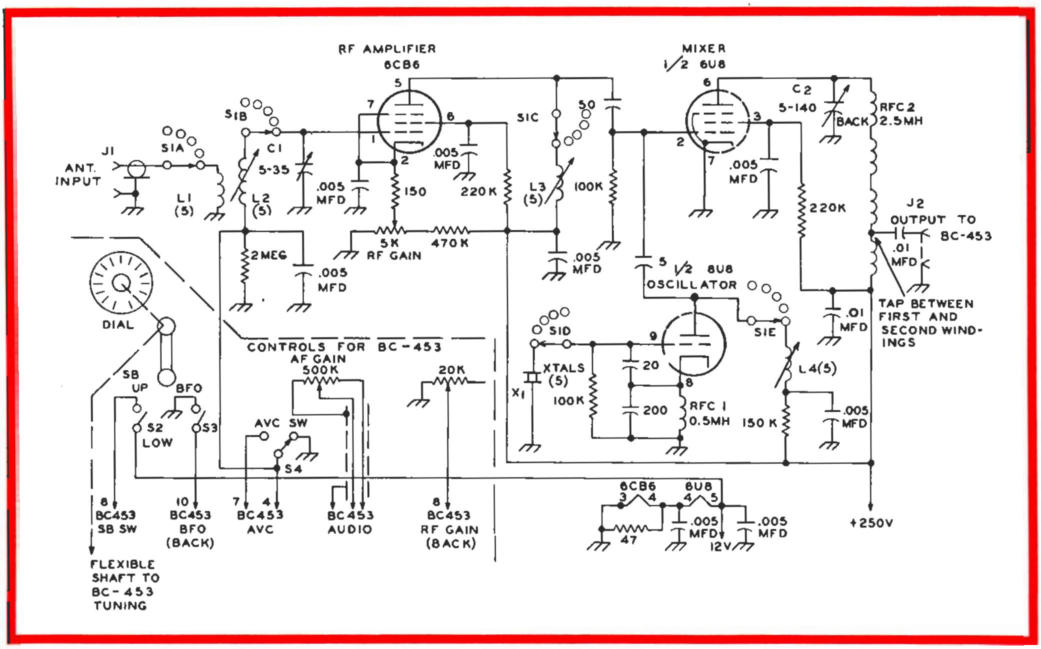
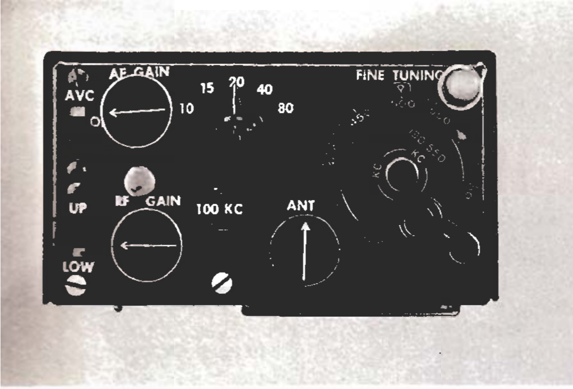


FIG. 1. SCHEMATIC DIAGRAM of the bandswitching mobile converter constructed by W8WFH. All resistances are in ohms, ½-watt rating, and capacitances are in micro-microfarads (mmf), unless otherwise marked. All controls at the lower left corner are for the BC-453 receiver with which this converter is used. Only one set of coils is shown for L_1, L_2, L_3 and L_4; actually there are five coils in each of these locations, each connected to a separate position on S_{1A} to S_{1E}.



PANEL VIEW PHOTO of the bandswitching converter. Only the controls marked "RF GAIN," "ANT.," and "80-40-20-15-10" (the bandswitch) actually control circuits in the converter.

(continued from page 3)

The crystal oscillator functions at the crystal fundamental frequencies to cover the 3.65-4.0 and 7.0-7.3 tuning ranges, as shown in TABLE II—COIL TABLE. For 14.0-14.35 megacycles, the second harmonic (13 megacycles) of the 6.9-megacycle crystal is the injection frequency, while the fourth harmonic of a 5.25-megacycle crystal (21.0 megacycles) is used to cover 21.10-21.45 megacycles. Five crystals in the range of 6.95 to 7.2875 megacycles are required for complete coverage of the 28-megacycle band. However, the fourth harmonic (28.3 megacycles) of a 7.075-megacycle crystal will give coverage of 28.5 to 28.85 megacycles where most sideband operation occurs on this band. Other crystal combinations are suggested in

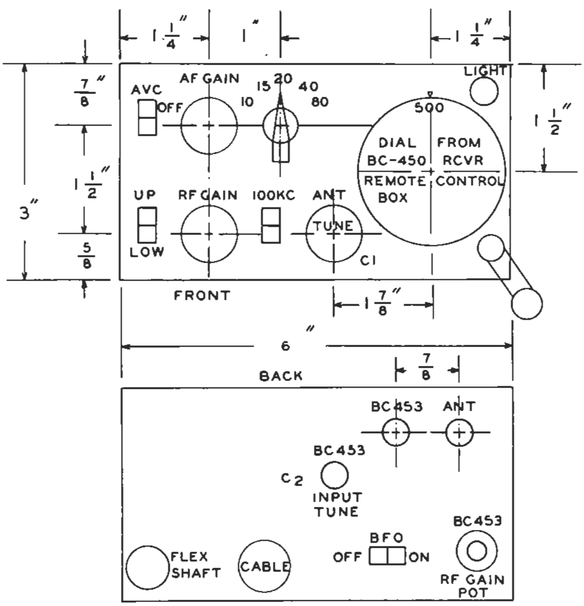


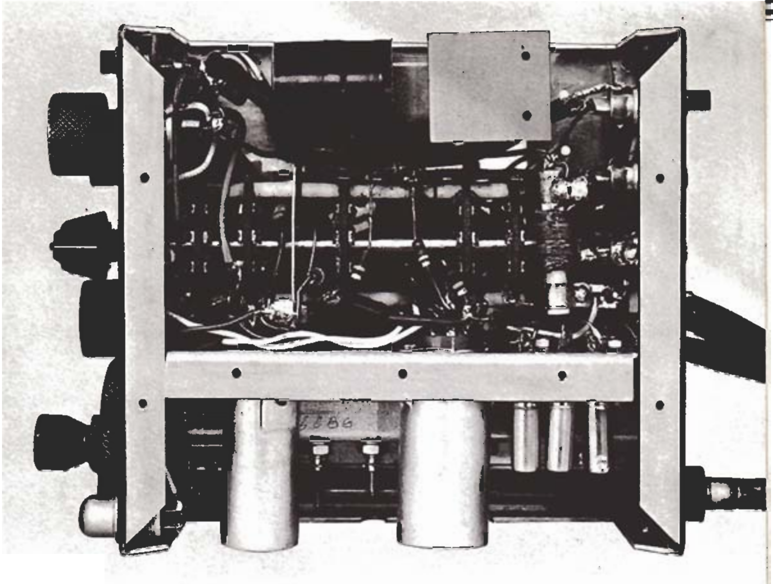
FIG. 2. FRONT AND REAR panel drilling diagrams for the bandswitching converter. The slide switch marked "100 KC" applies plate voltage to a 100-kilocycle crystal calibrator which the author included in his converter, but is not shown in the schematic diagram, Fig. 1. All the BC-453 controls could be mounted on a separate panel to reduce crowding in the converter, if desired.

TABLE II — COIL TABLE — BANDSWITCHING CONVERTER

AMATEUR BAND (MC)	CRYSTAL FREQ. (MC)	INJECTION FREQ. (MC)	COILS (inductance in uh and CTC Part No.)			
			L_1 (turns)	L_2	L_3	L_4
4	3.5	3.5	10 of #30 enam.	16-30 + 30* (X2060-5)	61-122 (X2060-7)	61-122 (X2060-7)
7	6.8	6.8	7 of #30 enam.	10-18 (X2060-4)	16-30 + 30* (X2060-5)	28-63 (X2060-6)
14	6.9	13.8	5 of #30 enam.	3.4-7.0 (X2060-2)	3.4-7.0 + 10* (X2060-2)	16-30 (X2060-5)
21	5.25	21.0	3 of #30 enam.	2.0-3.7 (X2060-1)	2.0-3.7 (X2060-1)	2.0-3.7 (X2060-1)
28	7.075	28.3	2 of #30 enam.	17 turns of #24 enam.	22 turns of #26 enam.	22 turns of #26 enam.
				(Wind 28-MC coils on CTC LS-6 Forms)		

*Small ceramic capacitor across coil where indicated — otherwise only circuit capacitance.

TOP VIEW PHOTO of the band-switching converter model. The 100-kilocycle crystal calibrator components are fastened to the small angle bracket in the upper portion of this view. The band-switch was built up from a Centrolab midget tap switch index assembly (PA-302), and five switch wafers (PA-31). Although this 6 x 6 x 3-inch box was fabricated by the author, the converter can easily be housed in a 7 x 5 x 3-inch Minibox if the BC-453 controls are not included.



the CRYSTAL FREQUENCY CHART for the converters on page 2 of this issue. Oscillator coils (L_4) tune to the crystal harmonic frequency being used.

A 2.5-millihenry r.f. choke, tapped between the first and second pies from the end to which plate voltage is applied, serves as the converter output circuit and is peaked at the desired frequency in the 190 to 550-kilocycle tuning range of the BC-453 receiver with C_2. An alternate output circuit, shown in Fig. 2 of the single band converter article on page 8, also is suitable for this converter.

CONSTRUCTION of the model shown in the photos was accomplished in a 6 x 6 x 3-inch home-fabricated box made in two sections. However, the converter can be constructed into a 7 x 5 x 3-inch Minibox (Bud CU-3008) if the remote tuning dial and BC-453 controls are not included in the box. Or, these controls can be included when the converter is constructed in a Minibox 8 x 6 x 3½ inches (Bud CU-3009) in size.

Dimensions are given in the panel layout diagram, Fig. 2, the box layout diagram, Fig. 3, and the subchassis layout diagram, Fig. 4, for the 6 x 6 x 3-inch box, but will serve as a guide for the larger standard Miniboxes suggested above. It is best to select the box size to fit into the space available in each individual mobile installation.

Major parts were mounted in the locations shown in the above diagrams, and should be kept in the same relative positions in the larger boxes. The subchassis has a ½-inch step, as shown in the side view, and was made with narrow flanges along the upper, lower and rear edges to facilitate rigid mounting.

Wiring should be handled in the usual manner for high-frequency circuits: Shortest possible grid, plate and coil leads; disc ceramic bypass capacitors soldered with shortest possible leads; power wiring run well away from r.f. coils; and short lengths of coaxial cable for the antenna input and output connections to the BC-453 receiver.

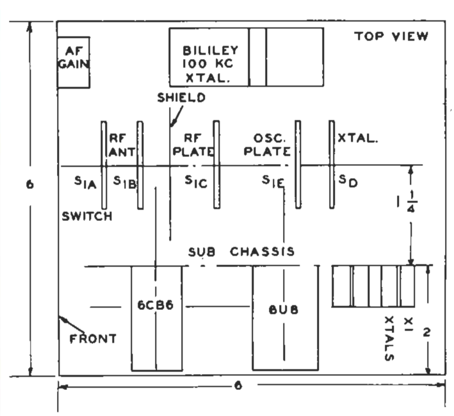


FIG. 3. TOP LAYOUT DRAWING of the converter. The subchassis should be trimmed to clear the top flanges on the box.

THE TUNEUP PROCEDURE is quite simple, once construction is completed and a check has been made of the heater and plate power circuits to ensure that the correct voltages appear on both tubes. Plate voltages will be the same as the power supply voltage, and screen voltages will range from 100 to 120 volts on both the 6CB6 and 6U8 tubes.

The crystal oscillator should be adjusted first. A general coverage receiver is helpful in checking to see that the oscillator works on all bands, and that the plate coils (L_4) are tuned to the correct harmonic frequency. Set S_1 to the 3.5-megacycle position, tune the receiver to 3.5 megacycles, and tune the 3.5-megacycle L_4 for maximum signal in the receiver.

Next, switch S_1 to 7 megacycles, set the receiver at 6.8 megacycles and tune the 7-megacycle L_4 for maximum signal. For 14

(continued on page 6)

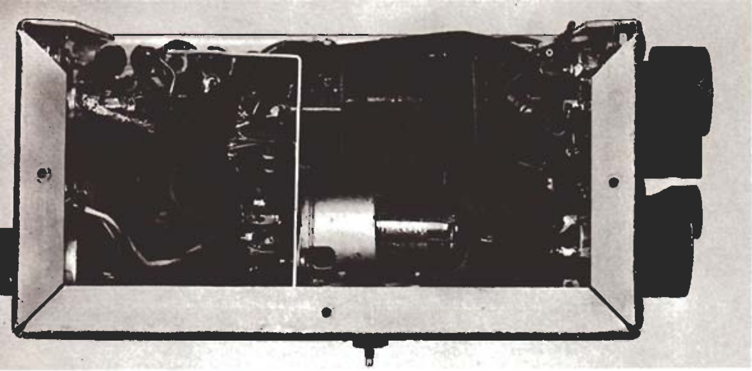


PHOTO SHOWING LEFT side of the converter. The crystal calibrator components—tube, crystal, tuning capacitor (extending out bottom) and angle bracket—are in the center. Flanges on box are 3/8 of an inch wide.

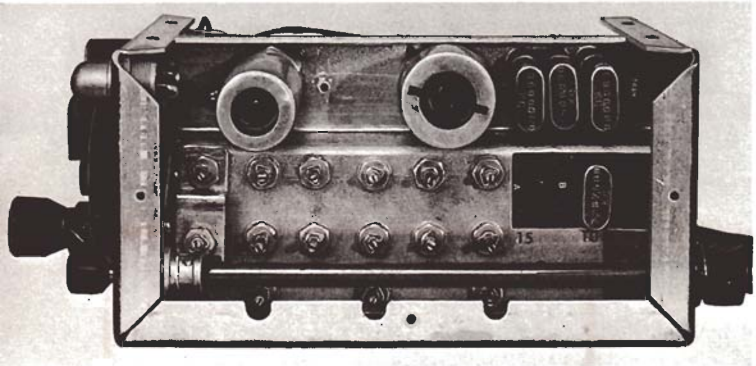


PHOTO SHOWING RIGHT side of the converter, with some crystals (X_1) removed to show double crystal sockets. Positions of the coils on the subchassis are shown in Fig. 4. The remote tuning dial shaft runs back through the converter just below the coils.

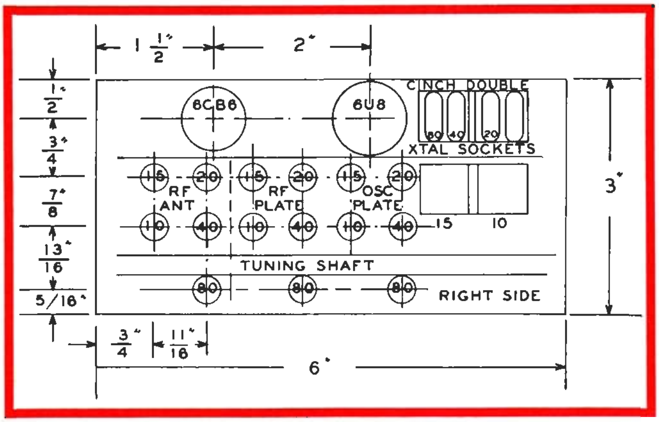


FIG. 4. LAYOUT DIAGRAM for the converter subchassis on which the tube sockets, coils and crystal sockets are mounted. Holes not marked for location and size should be drilled to suit the components used. The subchassis has a 1/2-inch step between the coils and tube sockets.

(continued from page 5)

megacycles, set S_1, tune the receiver to 13.8 megacycles, and tune the 14-megacycle L_4 for maximum signal. For 21 and 28 megacycles, calculate the correct harmonic frequency of the crystal being used, set the receiver at that frequency, and peak the proper L_4 coils.

FRONT-END ALIGNMENT consists simply of peaking the mixer grid (L_3) and r.f. amplifier grid (L_1-L_2) coils at the center of the tuning range for each band. The converter output should, of course, be connected to the BC-453 receiver, and a signal generator — or amateur band signals from an external antenna — should be fed into the converter input, J_1.

Set the BC-453 receiver at about 350 kilocycles and set C_1—the r.f. stage grid peaking capacitor — at mid-capacitance. Tune the mixer grid coils (L_3) first for maximum signal at these frequencies, and then peak the r.f. coils (L_1-L_2) for each band. Either the signal generator, or external signals close to the specified frequencies, may be used.

The alignment may be completed before the converter is "buttoned up" by installing the top half of the box, since the coils are sufficiently removed from it to have little effect on the inductance values.

Both converter power and remote control connections were made through a 12-pin plug and cable running to the BC-453 receiver. Length of this cable, and the flexible shaft for tuning, will be determined by the space available in the constructor's car, and probably will be from 24 to 36 inches long.

SINGLE-BAND MOBILE CONVERTERS

By. A. F. Prescott, W8DLD

THE SINGLE BAND approach appeals to many mobile amateur radio operators who concentrate their operations mainly on one or two bands because of space limitations, or the nature of local activity. The equipment can be constructed easier because of the absence of a bandswitch and multiple sets of coils. Those amateurs who work two bands can construct plug-in r.f. units for the receiver front end — and transmitter too — and achieve optimum performance on each band.

At W8DLD/Mobile, five single-band converters were constructed to cover the amateur bands from 3.5 to 30 megacycles. All units have plug-in connections for easy changing, and follow the same basic circuit. Because of the fairly low frequency chosen for the tunable i.f. range — 200 to 550 kilocycles — four tuned circuits at the signal frequency were included in each converter for maximum rejection of image signals. These image signals will be twice the frequency to which the BC-453 is tuned away from the amateur band signal frequency: An image frequency 400 kilocycles below the signal frequency when the BC-453 is tuned to 200 kilocycles; and an image frequency 1,000 kilocycles below the signal frequency when the BC-453 is tuned to 500 kilocycles.

The triode section of a 6U8 pentode-triode functions as a grounded-grid r.f. amplifier, as shown in the schematic diagram, Fig. 1. The antenna input circuit is untuned, with only a 2.5-millihenry r.f. choke in the cathode DC return. Coils L_1 and L_2 form a bandpass coupler which feeds the pentode section of the 6U8 as a second r.f. amplifier, with an r.f. gain control in its cathode circuit.

(continued on page 8)

TABLE I — PARTS LIST — SINGLE BAND CONVERTER

C_1............midget silvered mica or ceramic capacitor; try values from 1 mmf to 5 mmf for optimum oscillator injection without excessive oscillator harmonic signal input.

C_2............5-140 mmf midget air capacitor.

J_1............midget phono jack.

L_1 to L_5......Bandpass transformers made from Merit TV-104 or TV-108 shielded coils; see TABLE II—COIL TABLE, and text for details.

P_1............6-pin male chassis type power plug (Jones P-306-AB).

RFC_1..........1 millihenry pi-wound r.f. choke (National R-50, 1 mh.).

RFC_2..........2.5 millihenry pi-wound r.f. choke, tapped between first and second pies.

X_1............Quartz frequency control crystals; see TABLE II — COIL TABLE, for frequencies.

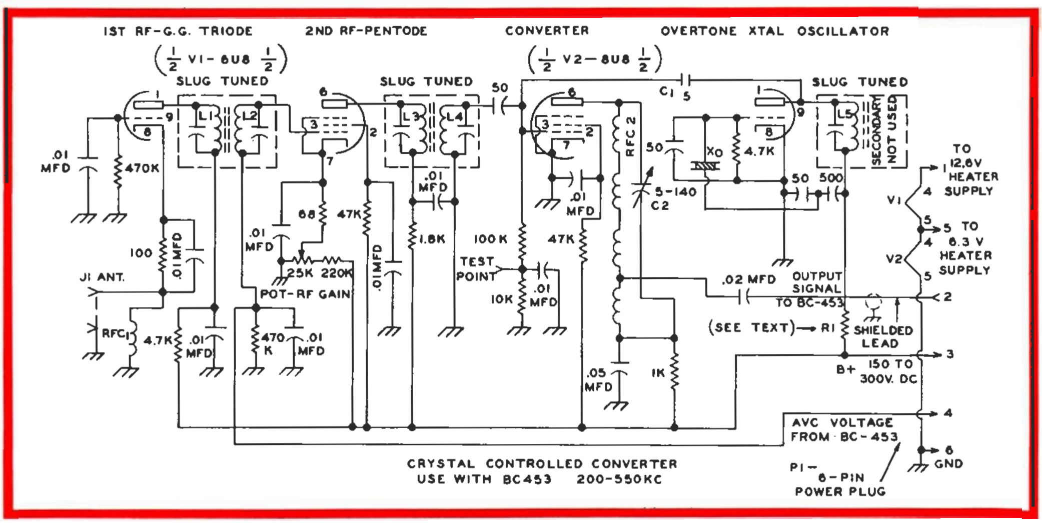


FIG. 1. SCHEMATIC DIAGRAM for the single band converters designed and constructed by W8DLD. All resistances are in ohms, ½-watt rating, and capacitances are in micro-microfarads, if not otherwise marked. The output signal runs through pin 2 on the power plug, P_1. Note that 6 volts DC should be applied to pin 5, and pin 1 grounded, for operation of the converter from 6 volts.

TABLE II — COIL TABLE — SINGLE-BAND CONVERTERS		
AMATEUR BAND (MC)	PART NO. (MERIT)	ALTERATIONS TO BE PERFORMED ON COILS L_1 TO L_5, INCLUSIVE
4	TV-108 (4.5-MC TV IF)	Remove coils from forms. Replace with single pies (same position) from 2.5-mh. r.f. choke. Remove turns from inside of pies until coils fit on forms at original coil positions. Remove more turns until circuits tune to 4.3 MC with slug out and 25-mmf capacitors across each coil in place of original capacitors.
7	TV-108	Remove 50-mmf capacitors across TV-108 coils and replace with 20-mmf capacitors. Remove turns from original coils until each circuit tunes to 7.5 MC with slug all the way out.
14	FM-251 (10-5-MC FM IF)	Turn slugs nearly all the way out of coils and remove turns from each coil until each circuit tunes to 14.8 MC. Use original capacitors across coils.
21	TV-104 (21-MC TV IF)	No alterations required in either coils or capacitors. Tune each circuit to 21-MC band to achieve proper bandpass.
28	TV-104	Turn slugs nearly all the way out of coils and remove turns from each coil until each circuit tunes to 30 MC.

(continued from page 7)

The second pair of coils, L_3 and L_4, couple the signal into the pentode section of a second 6U8, operating as a mixer. The triode section of this tube is the crystal oscillator, operating either on the fundamental or harmonics of the crystal, as described in the bandswitching converter. Oscillator signal injection is through a small coupling capacitor. Values from 2 to 5 mmf should be tried, to obtain optimum oscillator injection.

Plate circuit of the mixer is again a 2.5-millihenry r.f. choke (RFC_2), with the i.f. output signal tapped off between the first and second pies. An optional mixer output circuit, using a Miller No. 70-A broadcast receiver antenna coupling coil, is shown in Fig. 2. The antenna winding is used for the output link to the power plug, P_1.

THE CHASSIS on which all converters were constructed is a 5¼ x 3 x 2⅛-inch Minibox (Bud CU-3006) and provides plenty of room

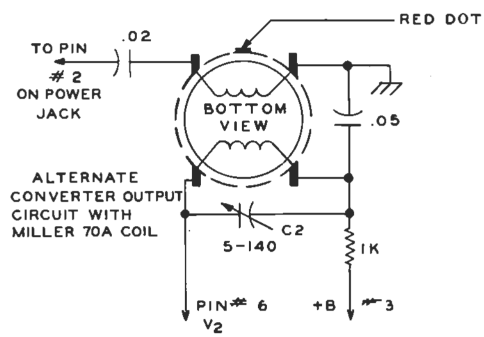


FIG. 2. OPTIONAL OUTPUT CIRCUIT for the converters, using a Miller 70A miniature broadcast receiver antenno coil with the primary as the output link coil. This circuit can be substituted for RFC_2 in either the bandswitching or single-band converters.

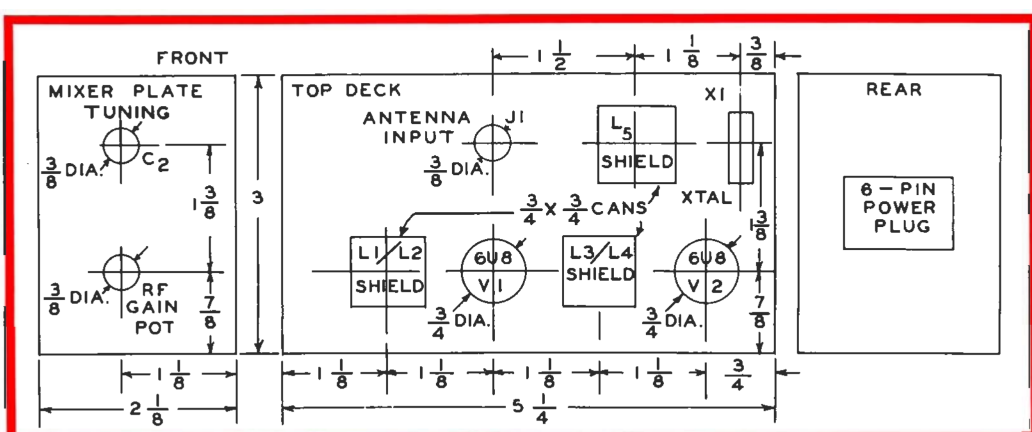
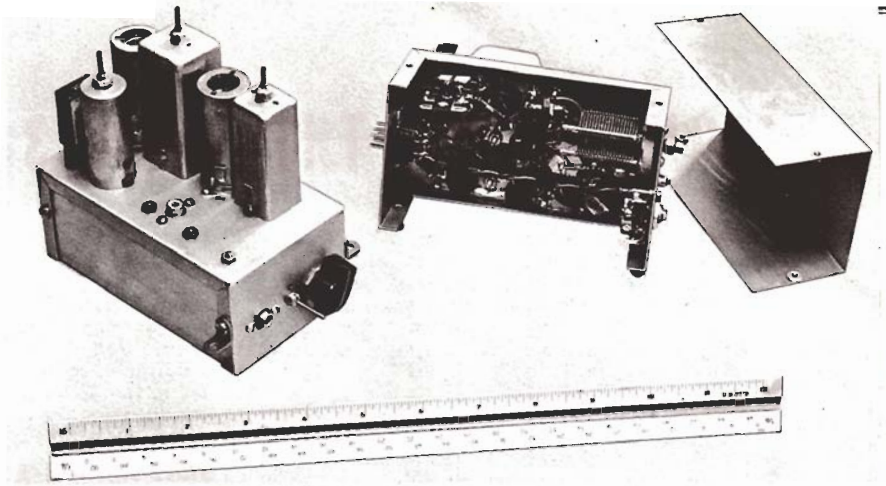
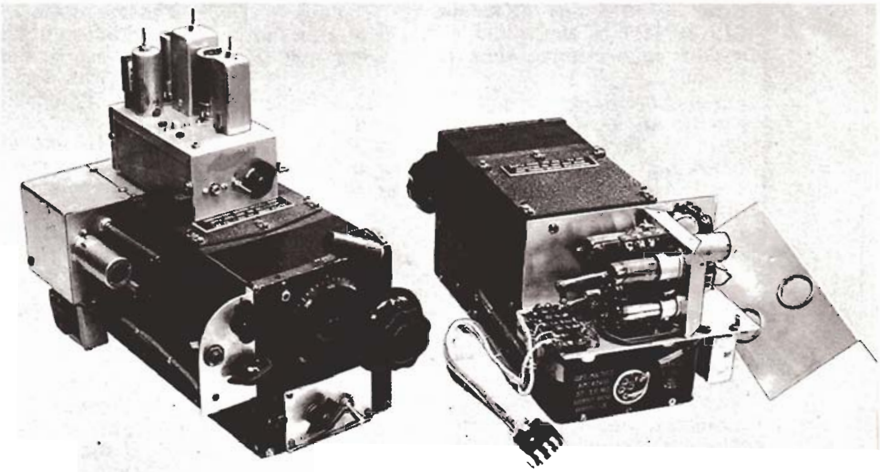


FIG. 3. CHASSIS LAYOUT DIAGRAM for the single-band converters. The chassis is a 5¼ x 3 x 2⅛-inch Minibox (Bud CU-3006). The same parts layout was used for all five of W8DLD's converters.



SINGLE-BAND converter views, with completely assembled model at left, and model with bottom cover removed at right. Placing all tuned circuits in shields above the chassis reduces interaction and leaves plenty of room for small components under the chassis.



COMPLETE RECEIVER, composed of BC-453, modified as described on pages 10 and 11, and the crystal controlled converter mounted on the top shield (at left). Rear view at right shows audio amplifier constructed on small plate, occupying space in which dynamotor mounts on original receiver.

for the components specified in TABLE I—PARTS LIST. The same general parts layout, shown in the drilling diagram, Fig. 3, was used for all converters.

The alterations necessary on coils L_1 through L_5 — as described in TABLE II — COIL TABLE, and the coils checked for proper frequency coverage with a grid-dip oscillator — should be made before the shield cans are fastened to the chassis.

The usual precautions regarding short r.f. wiring and bypass capacitor leads apply to all converters, and especially the 21 and 28-megacycle models. The tube heaters may be operated from either a 6 or 12-volt supply by making the proper connections when wiring the Jones cable jack which connects to P_1.

ALIGNMENT of the crystal oscillator stage consists simply of peaking L_5 for maximum signal in a receiver tuned to the proper harmonic frequency for the crystal and band in use. After coupling the BC-453 receiver to the output, and feeding in a signal of the proper frequency into J_1, the signal circuits, L_1 to L_4, may be aligned. Peak coils L_2 and L_4 (the bottom adjustments) about 50 kilocycles inside the high edge of the amateur band for which the converter is designed (3.95 megacycles on the 4-megacycle converter). Peak coils L_1 and L_3 from 100 to 200 kilocycles lower in frequency, so that the converter has nearly uniform gain across the portion of the amateur band most used. Coils L_1 and L_3 are made the top adjustments so that the converter bandpass can be easily changed for maximum performance either in the American phone, or CW assignments of the amateur bands.

The converters, when completed and aligned, may be mounted on top of the BC-453 receiver, as shown in the picture above.

At W8DLD/Mobile, the converters were mounted on top of the linear amplifier for the sideband transmitter in the rear of the station wagon (as shown in the view on the top left corner of page 7 in the July-August, 1960 issue). This permits a short connection to the antenna changeover relay — also on the linear amplifier — and changing converters when bands are switched in the amplifier. A coaxial cable feeds the i.f. output signal from the converter to the BC-453 receiver, mounted below the dash (see picture on page 4 of the July-August, 1960 issue).

Converters of this type have traveled over 120,000 miles in W8DLD's mobile installations, and the models described incorporate the lessons learned during this vast amount of "field testing."

CONVERTING THE BC-453 RECEIVER

By A. F. Prescott, W8DLD, and W. C. Louden, W8WFH

CONVERSION DATA for the BC-453 Command Set Receiver has been widely published. However, here are suggestions for making the basic conversion, plus adding a more powerful audio amplifier, fast-acting AVC and S-meter circuit, and a sideband selector switch.

HEATER CIRCUIT— To operate the BC-453 tube heaters from a 6-volt supply, rewire all heater connections to the sockets in parallel. Install 6-volt tubes: three 6SK7's, one 6K8, one 6SR7, and one 6J5 or 6C5 in the audio (V8), changing no socket connections other than tying pin 7 to pin 1.

For 12-volt heater supply operation, either rewire all heaters in parallel and use the original 12-volt tubes (three 12SK7's, one 12K8, one 12SR7, and substituting a 12J5 for the 12A6); or, use the original heater circuit and install 6-volt heater tubes which each draw 0.3 amperes (same 6-volt tubes as shown above).

AUDIO AMPLIFIER— The original audio amplifier in the BC-453 may be sufficient for home-station operation under quiet conditions, but more volume is sorely needed to overcome the various noises encountered in mobile operation. A 5-watt amplifier and speaker in the 6 to 8-inch diameter range will provide plenty of sound.

A 3-stage amplifier circuit, shown in the schematic diagram, Fig. 1, was devised, and is easily driven by a 6J5 or 12J5, substituted for the original 12A6 pentode power audio amplifier in the BC-453. One section of a 12AX7 twin triode is a voltage amplifier; the other section functions as a phase inverter, driving the grids of a push-pull output stage with 12AQ5's (6AQ5's for a 6-volt heater supply).

The circuit constants shown provide good frequency response, but the higher audio frequencies will be accentuated if a 0.1-mfd capacitor is wired across the cathode resistor of the 12AX7 audio amplifier. A 0.006-mfd capacitor across the output transformer attenuates higher audio frequencies.

The audio amplifier was constructed on a small metal plate about 4 inches square with flanges on all sides for mounting. Wiring should follow the usual practices for audio amplifiers. Note that the audio output signal from the BC-453 was taken from pin 2 of the plug on the rear of the chassis, as shown in the view on page 9.

FAST-ACTING AVC/S-METER CIRCUIT— The operation of this fast-acting AVC circuit which can be added to the BC-453 receiver must be heard to be appreciated. The S-meter was designed to work on CW, sideband or amplitude modulated phone signals. The two-tube package, added in a small box to the left side of the receiver in the view on page 9, is well worth its weight in operating convenience.

Note in the schematic diagram, Fig. 2, that the 85-kilocycle signal from the BC-453 is picked up at the control grid of the first i.f. amplifier (V_5) so that the AVC amplifier stage, a 12AU6 pentode, will be completely free of stray BFO voltage. The selectivity of this amplifier must be broader than the signal channel in order to reduce the gain of the receiver when strong adjacent channel splatter is present. The "Q" of L_1 should not be too high, or the 85-kilocycle tuned circuit formed by it and the 190-760-mmf padder will be too sharp. A 5.5-millihenry iron core r.f. choke (Bud CH-922W, or equivalent) should be used for L_1.

The AVC voltage is rectified by the 1N34 diode and applied through a decoupling network back into the BC-453 receiver at the lower end of L_9, the secondary of the interstage i.f. transformer which drives the second i.f. amplifier stage (V_6). The AVC voltage also is applied to one control grid of a 12AT7 twin triode in a vacuum tube voltmeter type S-meter circuit. An SPDT switch provides for full AVC voltage for higher "DX" S-meter readings, or lower AVC for "Local" S-meter readings from strong signals.

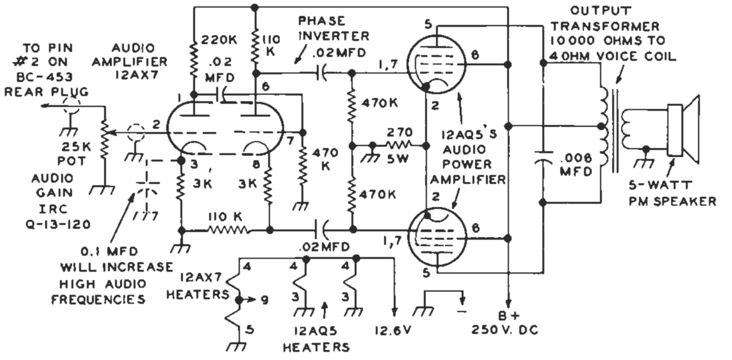


FIG. 1. SCHEMATIC DIAGRAM of a 5-watt audio amplifier for the BC-453 receiver. Audio output from the receiver is taken from the output transformer through pin 2 of the plug on the rear of the receiver chassis. Capacitances are in microfarads, and resistances are in ohms, ½-watt unless marked.

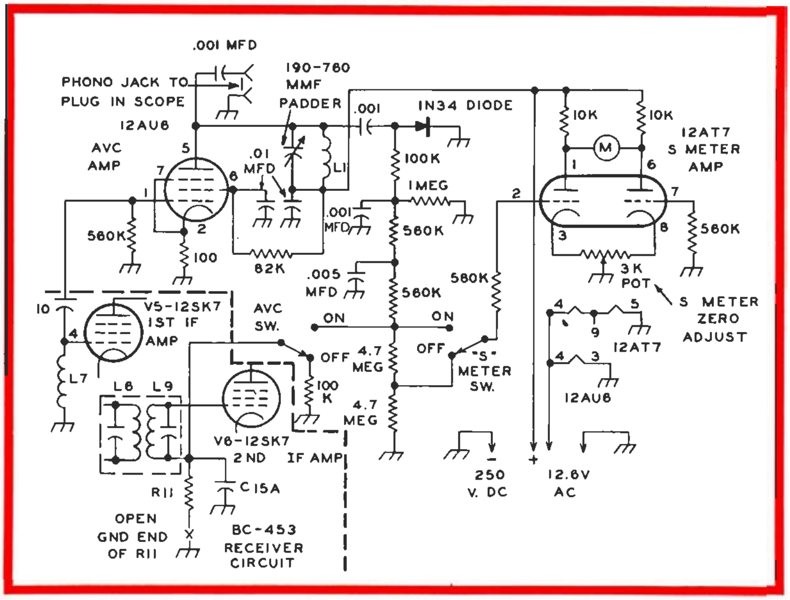


FIG. 2. FAST-ACTING AVC and S-meter circuit for the BC-453 receiver. Area inside dashed line at lower left corner of diagram shows points in the BC-453 circuit from which the i.f. signal is taken at pin 4 of the 12SK7 first i.f. amplifier; and connection to the lower end of L_9 into which AVC voltage from the AVC circuit is fed into the BC-453.

Note that a phono jack connection to the plate of the 12AU6 AVC amplifier provides a place to feed the i.f. signal to the vertical plates of an oscilloscope. By setting the horizontal sweep on the scope at 30 to 60 cycles, both incoming signals, and your own transmitter, may be checked for linearity.

The AVC/S-meter unit was constructed in a 4 x 2¾ x 2-inch Minibox (Bud CU-3015) and mounted on the left side of the BC-453. Extension shafts run from the controls to knobs, with the shafts supported on a small bracket. Exact arrangement of the AVC and S-meter circuit components will depend on the space available on each side of the BC-453 receiver in each mobile installation.

SIDEBAND SELECTOR SWITCH—

When properly aligned, the 85-kilocycle i.f. amplifier in the BC-453 has a bandwidth of about 2.5 kilocycles. This makes possible good SSB reception with considerable rejection of the unwanted sideband when the BFO signal is injected at either the upper or lower edge of the i.f. amplifier passband.

It is necessary only to install an SPST switch to add a 30-mmf capacitor across the BFO tuned circuit to change the frequency of the BFO so that it will provide the proper exalted carrier signal for reception of either upper or lower sideband signals. This addition, shown in the schematic diagram, Fig. 3, also includes increasing the plate voltage on the 12SR7 BFO tube by shunting R_{15} and R_{16} in the BC-453 with a 100,000-ohm, 1-watt resistor. This greatly increases the BFO injection for improved operation of the detector on SSB signals.

With the SPST switch open, adjust C_{28} in the BFO coil shield can so that upper sideband signals are properly received (BFO will be at upper edge of i.f. amplifier passband). Then, close the sideband selector switch and tune in a signal transmitting lower sideband, which also should sound normal.

When a station transmitting, say, lower sideband is properly tuned in, and the station shifts to upper sideband, the SPST switch should then be opened, and the BC-453 receiver dial be tuned 3 kilocycles higher in frequency to properly receive the upper sideband. A bit of practice in changing sidebands will allow this shift to be made in a matter of seconds.

The combination of the amateur band converters and BC-453 receiver modified as described herein is capable of providing excellent amateur radio mobile reception.

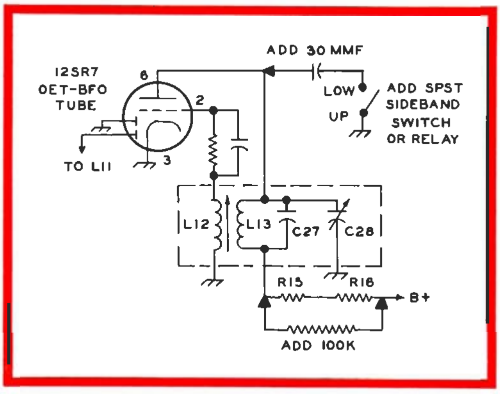


FIG. 3. SIDEBAND SELECTOR switch is added to BFO in BC-453 by adding a 30-mmf capacitor across BFO coil to shift BFO frequency. Locate switch and capacitor as close as possible to BFO tube to prevent radiation of signal from wiring.

1960 EDISON AWARD ANNOUNCED

NOMINATIONS for the 1960 Edison Radio Amateur Award are now open. All radio amateurs and others who know of a worthy public service which has been performed during 1960 by a duly licensed radio amateur while pursuing his hobby within the limits of the United States, are urged to nominate that person.

Simply state the candidate's name, call letters, full address, and a description of the service performed, in a letter to the Edison Award Council, General Electric Company, Electronic Components Division, Owensboro, Kentucky.

Full details of the Edison Award are given in the full-page announcement (at right) which appears in the October issues of amateur radio magazines. The award is sponsored annually by General Electric.

You will help increase the stature of *all* radio amateurs by naming a suitable candidate for the acclaim, distinctive Edison Award trophy, and $500 gift that the recipient is presented at a public ceremony in Washington, D.C.

Nominating letters must be postmarked not later than January 2, 1961. Compile the public service record during 1960 of your candidate *now* and mail it before the deadline approaches!

HAM NEWS

SEPTEMBER-OCTOBER, 1960

VOL. 15 — NO. 5

BUILD-IT-YOURSELF IDEAS
from the 999 radio amateurs at
GENERAL ELECTRIC

Available FREE from your G-E Tube Distributor

E. A. Neal, W4ITC — Editor

published bi-monthly by
RECEIVING TUBE DEPARTMENT
Owensboro, Ky.