

SPILSBURY & TINDALL LTD.
Radio Communications
VANCOUVER CANADA

INSTRUCTION MANUAL

PRT-20 PORTABLE RADIOTELEPHONE

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SPILSBURY & TINDALL

MODEL PRT-20-1

PORTABLE RADIOTELEPHONE

GENERAL DESCRIPTION

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REVISIONS (Amended ^{JANUARY} March, 1961)

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All SPILSBURY & TINDALL radiotelephones are built in the factory at 120 East Cordova Street, Vancouver 4, B. C.

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GENERAL DESCRIPTION

The PRT-20 is a single-channel, crystal-controlled, transceiver, complete with dry battery power supply and antenna. It has been designed for portable use and therefore embodies the following features:

Small size and weight - Height 8-1/4";

Frequency Stability Width 11-1/4"; Depth 4-1/2".

Spurious Radiation Weight less antenna - 8 lbs. 14 oz.

Maximum power output for low battery drain:

Audio Response: 1.5 watts RF output with new batteries

Highly sensitive receiver: 1 uv input signal will give powerful speaker output.

Low battery drain: 3 lbs. of batteries give 20 to 40 hours of operation.

Metering facilities: permit measuring of battery voltages and RF power amplifier plate current.

Simple controls: a tuning knob and a loading knob permit the transmitter to be tuned and loaded correctly with an antenna.

Attractive carrying case: re-inforced leather case holds transceiver, batteries and portable antenna.

SPECIFICATIONSNominal RF Power Output:

New batteries	1.5 watts
One-half used batteries	1 watt
Reject battery point	.75 watt

Frequency Range: One crystal-controlled channel transmit and receive between 2 and 6 mc.

Frequency Stability: .005%

Spurious Radiation: 30 db below fundamental.

Modulation Capability: 100% on voice modulation.

Audio Response: Transmitter and receiver designed for maximum response in the intelligence relaying frequency range.

Microphone: Ceramic crystal hand mike.

Receiver Sensitivity:

New batteries	→	1 uv
One-half used batteries	→	2 uv
Reject battery point	→	3 uv

Measuring conditions: 50 ohm antenna input, 50 mw audio output, RF signal modulated 30% at 1000 CPS, signal to noise ratio 10 db.

SPECIFICATIONS (Cont'd.)Selectivity:

Attenuation	Kc off Resonance
6 db	3.5 kc
30 db	12 kc
60 db	25 kc

Image Rejection: Approximately 60 db at 2 mc.

A.V.C.: Approximately 120 db rise in output for input signal increase of 10 uv to 10,000 uv.

IF Frequency: 456 kc.

Audio Output: Full speaker output (250 mw) assured at all battery levels (to reject point).

Antenna: Any resonant antenna. Non-resonant antennae require external tuning device.

Metering: A multimeter is provided to measure:

- (a) Filament battery voltage.
- (b) Transistor battery voltage.
- (c) Receiver "B" battery voltage.
- (d) Comb.rx and tx battery voltage.
- (e) RF amplifier plate current.

SPECIFICATIONS (Cont'd.)Tube and Transistor Complement:

2	1AJ4	(DF96)	Tube
1	1AB6	(DK96)	Tube
1	1AH5	(DAF96)	Tube
2	1U5	(DAF92)	Tube
1	3A4	(DL93)	Tube
2	2N256		Transistors

Quartz Crystals: Spilsbury & Tindall Type "P".

Batteries

Lightweight portable battery complement:

DESCRIPTION	Eveready	Rayovac	Burgess	RCA	Mallory
2 - 90 volt "B" Batteries	490	204	N-60	VS090	M204
6 - "D" size Flash light Cells	950	2LP	2R	VS036	M13
For longer life, use the manufacturer's industrial type of the above flashlight cells.					
For continuous high level speaker volume and modulation, use these "D" size cells	A-100	3LP			

Extra battery cables allow the use of large batteries for fixed station use. These cables will be supplied on special request only.

Batteries (Continued)
 Heavy Duty Portable or Fixed Station Battery Complement:

DESCRIPTION	Eveready	Rayovac	Burgess	RCA	Mallory
1 - 1-1/2 volt "A" Battery	742	P94A	4F	VS004	M4
2 - 6 volt "A" Batteries	744	-	F4P1	VS009	M6
4 - 45 volt "B" Batteries	482	202	M30	VS013	M202

NOTE:

Reverse the position of the "B" batteries on the connectors occasionally to ensure the highest reading possible on meter Position #3. This also applies to Lightweight Portable "B" batteries.

CIRCUIT DESCRIPTION

The PRT-20 consists of a receiver and transmitter combined on one chassis. The audio amplifying and power stages, consisting of tubes V6, V7, and transistors TR1 and TR2, are common to both transmitter and receiver.

On "receive" operation, the audio section is switched to the second detector output via the receiver volume control, and the speaker is connected to the output transformer. On "transmit" the audio amplifier is switched to the microphone and the high impedance winding of the output transformer modulates the plate voltage of the 3A4RF power amplifier tube. The tank circuit of the RF power amplifier is also the receiver RF input coil. The circuit has been so arranged that when the tank coil is tuned to resonance in the "transmit" condition, it will automatically be in resonance when switched to the receiver. (This condition only applies when the transmitter and receiver are operated on the same frequency.) The receiver RF amplifier tube is a 1AJ4 miniature pentode (V3). The mixer-oscillator tube (V-4) is a 1AB6 tube. A crystal operates in a pierce oscillator circuit, using grids #9 and 2 of the mixer tube. The remaining IF tube is also a 1AJ4 (V5).

CIRCUIT DESCRIPTION (Cont'd.)

Audio detection, as well as AVC voltage generation, is carried out by the diode section of V6. AVC is fed to V3, V4, and V5.

The transmitter consists of a 1U5 tube (V1) as oscillator and a 3A4 tube (V2) as the RF power amplifier. The modulator has previously been described. The tank coil and antenna coupling consists of a close wound layer of wire over a coil form. A variable compression mica capacitor is mounted on the end of the coil for rough tuning the tank circuit. Fine tuning of the tank is permitted from the front panel by the knob ("TUNE") fastened to the coil slug screw. As this knob is turned, the tuning slug in the coil moves in or out, depending on the direction of rotation.

Coupling from the tank coil to the antenna is achieved by means of a tank coil wound with 11 taps. A stepping switch labelled "LOAD" on the front panel permits selection of the correct antenna loading. Rotating the "LOAD" knob toward "11" increases and towards "1" reduces the loading.

CIRCUIT DESCRIPTION (Cont'd.)

The stepping switch contact is connected to any one of the eleven tank coil taps at all times. Therefore "dipping" of the tank tuning is to be made with the antenna lead removed from the antenna binding post.

The battery connector (marked "BAT") on the front panel allows the use of an additional battery cable for larger batteries if more economical operation is desired and portability is not required. In portable use, the standard portable set of batteries includes six flashlight cells, two of which supply the filament current for the vacuum tube, the remaining four supplying the current for the transistors. Two 90 volt "B" batteries supply the high voltage for the vacuum tubes.

The metering circuit consists of a 0 - 1 ma DC milliammeter, with series resistors and a shunt. These are switched as required to read battery voltages and RF power amplifier plate current for transmitter tuning and loading.

OPERATION (Cont'd.)

To "tune" the transmitter, proceed as follows:

- (a) Switch the "POWER" switch to "ON".
- (b) Switch the meter switch to Position #5.
- (c) Hold the "TRANSMIT-RECEIVE" switch to the "TRANSMIT" position.
- (d) Rapidly turn the "TUNE" knob through its range until the reading on the meter dips to its lowest point (between approximately .2 to .4 on the meter, depending on frequency and battery conditions, etc.)

To "load" the transmitter with the antenna:

- (a) Having completed the above tuning procedure, connect the antenna and ground leads to the terminals on the front panel of the transceiver, marked "ANT." "GND."
- (b) Turn the "LOAD" knob to #1.
- (c) Hold the "TRANSMIT-RECEIVE" switch in the "TRANSMIT" position.

OPERATION (Cont'd.)

- (d) Turn the "LOAD" knob slowly clockwise, while watching the meter reading (meter switch in position #5). As the "LOAD" knob is being advanced, it will be noted that the meter readings will increase in steps as the "LOAD" knob is being turned.
- (e) When the meter reading (meter switch in position #5) approximates the reading obtained by switching the meter to position #4, the transmitter is loaded to the correct value.
- (f) Before completing the loading, however, the "tune" knob must be re-adjusted for the "dip" reading, with the antenna load connected. If the antenna is completely in resonance, the loaded dip reading will occur in the same position of the "tune" knob as the unloaded "dip" reading. In most cases, however, some detuning of the transmitter will occur. (This is due

OPERATION (Cont'd.)

(f) (Cont'd.)

to the de-tuning required in the tank circuit of the transmitter to offset the reactance of the antenna.) This procedure may have to be repeated several times.

To transmit, press the "TRANSMIT-RECEIVE" switch and speak clearly into the microphone. The microphone should be held at a distance from the mouth which will result in a noticeable slight movement of the meter pointer upon speaking in a normal voice. Meter switch in position 2. Constant and considerable movement of the meter pointer indicates heavy over-modulation of the carrier, and in this case the microphone should be moved further away. If no meter movement is discernible, the microphone may be brought closer to the mouth, or a louder voice should be used. To receive, release the "TRANSMIT-RECEIVE" switch. The knob marked "VOLUME" adjusts the volume to the desired level.

OPERATION (Cont'd.)

If the "tune" knob has to be rotated more than three or four turns from the unloaded dip position, the antenna should be altered in length to permit better operation of the transmitter. This alteration of the antenna length may be a physical or electrical alteration.

After the tuning procedure is complete, the set is ready for use.

To transmit, press the "TRANSMIT-RECEIVE" switch to "TRANSMIT" and speak clearly into the microphone. The microphone should be held at a distance from the mouth which will result in an occasional slight movement of the meter pointer upon speaking in a normal voice. (Meter switch in position #5). Constant and considerable movement of the meter pointer indicates heavy over-modulation of the carrier, and in this case the microphone should be moved further away. If no meter movement is discernable, the microphone may be brought closer to the mouth, or a louder voice should be used.

To receive, release the "TRANSMIT-RECEIVE" switch. The knob marked "VOLUME" adjusts the volume to the desired level.

BATTERIESOPERATION (Cont'd.)NOTE:

The transistor output power available is greater than the power handling capability of the speaker. Care should be taken in adjusting the volume to loud signals to prevent over-loading of the speaker with consequent distortion of the received signal. Prolonged over-loading of the speaker may also result in damage to the speaker.

BATTERIES

A list of portable batteries is given under "Specifications".

The batteries are installed in the following manner:

- (a) Remove the battery connector from the front panel of the transceiver by rotating the metal barrel of the battery connector to the left as far as it will go, then pull up.
- (b) Unbuckle the battery strap and pull up gently on the rear strap (to the rear of the battery compartment) while holding the case down. This action lifts the battery box up and out of the battery compartment.
- (c) Open the lid of the battery box and place the six flashlight cells in the box, with the negative or flat end of the batteries toward the brass contact spring. (See also diagram of battery box in bottom of battery compartment).
Close the lid carefully (while pressing inward on the "catch" end of the box), until the catch snaps on to the stud bolt.
- (d) Place the battery box back in the battery compartment with the connecting wires at the back, the cable coming out to the

BATTERIES (Cont'd.)

- (d) (cont'd.) right towards the transceiver. The strap should go under the battery box and up behind it to the left of the plastic cable clamp.
- (e) The two "B" batteries should be placed on top of the battery box with their connecting terminals up and nearest each other. The connector strap for the "B" batteries may then be snapped on. Care should be taken when connecting this strap to the batteries to avoid damage to the snaps.
- (f) The leather strap may now be buckled snugly over the batteries.
- (g) The battery connector should be plugged in last, using the procedure outlined in (a) in reverse.

BATTERY CONDITION

The meter with its switch indicates battery voltages in positions 1, 2, 3, and 4. The battery voltage readings must be made with the power switch in the "ON" position.

BATTERY CONDITION (Cont'd.)

A meter reading of .75 indicates new battery voltage in each meter position. The "1/2" and "Reject" battery voltage points have been selected to correspond with approximately the one-half usable life of the batteries, and the point where transmitter power falls to about one-half of the starting power.

Batteries may, of course, be used below these points, but the amount of life left is questionable and transceiver performance decreases rapidly below these voltages.

Meter accuracy is plus or minus 5%.

NOTE: For more accurate battery voltage readings, the set should be operated a short while before taking the readings (receiver as well as transmitter).

Batteries recover their terminal voltages on standing idle for some time. After a few minutes of use, a more realistic battery condition will be apparent.

The meter switch should be left in position #5 at all times other than when actually taking battery voltage readings. This precaution reduces battery drain.

Leakproof flashlight batteries should be used in the battery box. Non-leakproof batteries may corrode the battery contacts and gradually ruin the entire battery box.

MAINTENANCE

Battery Box and Cable

Inspect occasionally for loose connections or bent spring clip connectors. Contacts inside box should be kept clean.

Antenna load spring on tank coil

Should not be tampered with unless contact becomes intermittent. In this event, clean underside of tank coil carefully with carbon tetrachloride or naphtha, being very careful of the spring slider and contact.

Switches

Clean with carbon tetrachloride or naphtha only when necessary.

Tubes

Should be checked occasionally, especially before any extended use in a remote area for important communication work.

Transistors

Life expectancy indefinite. Should not require replacement for several years.

MAINTENANCE (Cont'd.)Trouble

The schematic diagram and parts list include all parts values, important voltages, and the position of major components on the chassis as an aid to servicing.

Transmitter Tuning

- (a) Plug in a crystal of the correct type and frequency (between 2 and 6 mc.) to the transmitter crystal socket (see chassis drawings).
- (b) Set the "tune" knob (counting from the all out position) to the following position:

Frequency No. of turns from all out position

6 mc/s	3
5 mc/s	7.5
4 mc/s	12
3 mc/s	16.5
2 mc/s	21

MAINTENANCE - Transmitter Tuning (Cont'd.)

- (c) With the power switch "ON", the "TRANSMIT-RECEIVE" switch in the "TRANSMIT" position and the meter switch in position #5, turn the compression mica trimmer, C17 (located on the tank coil - see chassis drawing) carefully, beginning from the "all the way in" position until the lowest dip reading results on the meter.

The transmitter is now fully tuned.

Receiver AlignmentIF Alignment

- (a) Connect an output meter across the speaker terminals.
- (b) Turn the power switch on.
- (c) Inject a 456 kc modulated RF signal from an RF signal generator between pin #6 of 1AB6 tube and chassis.
- (d) Tune the top and bottom slugs of IF-1 and IF-2 for maximum output.

RF Alignment

- (a) Plug in a crystal of the correct type and frequency (456 kc above or below transmitting or operating frequency) to the receiver crystal socket (see chassis drawings).

MAINTENANCE - Receiver Alignment (Cont'd.)RF Alignment (Cont'd.)

- (b) Inject a modulated RF signal of precise operating frequency (RF signal generator may be zero'd in to the transmitter crystal) to the antenna and ground terminals of the transceiver.
- (c) Tune the slug of L-2 (see chassis drawings) and adjust C-18 for maximum output. IF-1 and IF-2 should be retuned also for any improved performance. L-2 and C-18 constitute the tuned plate circuit of V-3. Highest sensitivity is usually obtained by using as little capacity and as much inductance as possible for a given frequency. The antenna coil (tank coil of transmitter) is tuned with the transmitter and needs no further adjustment when aligning the receiver.

NOTE:

When aligning the receiver, the RF signal must be kept at the lowest possible level at all times, otherwise mis-alignment will occur. Care must also be taken when tuning the RF stage (L-2 and C-18) to prevent the harmonic, or image frequency being

MAINTENANCE - Receiver Alignment (Cont'd.)

selected instead of the operating frequency. Operating frequencies below 2 mc/s may be used by soldering small mica capacitors (similar to C-1) across C-17 and C-18 to lower the frequency of these circuits.

PARTS LIST

<u>Symbol</u>	<u>Description</u>	<u>S & T Part No.</u>
	Capacitors:	
C-1	33 uuf 500 v Mica	15-005
C-2	250 uuf 500 v Mica	15-004
C-3,5, 10,12, 16	.001 uf 1000 v ceram	24-087
C-4	.005 uf 1000 v ceram	24-073
C-6	100 uuf 500 v mica	15-002
C-7,14, 15,20, C-8,9 21	.1 uf 200 v paper	24-088
C-11,19	5 uuf 500 v mica	15-017
C-13	.01 uf 600 v ceram	24-022
C-17	4 uf 250 v elect.	24-106
C-18	Comp.mica 350 PF max.	17-013
C-22	Comp.mica 250 PF max.	17-012
DF-1	.01 uf 600 v ceram	24-022
	Diode Filter - 1 - 47 K Resistor and 2 - 100 PF condensers	19-017
	IF Transformers:	
IF-1	3/4" sq. x 2" high 455 kc input	01-021
IF-2	3/4" sq. x 2" high 455 kc output	01-022

PARTS LIST (Cont'd.)

<u>Symbol</u>	<u>Description</u>	<u>S & T Part No.</u>
L-1	Tank Coil - 1/2 OD x 2-1/2 h	00-033
L-2	RF Coil - 16-24, uh. miniature	01-051
M-1	Meter O - 1 ma	31-037
Mic.	Microphone - ceram. cartridge	32-009
PL-1	Lamp	PR-3
Resistors:		
R-1, 9, 11, 14, 17	2.2 M 1/2 w carbon	09-023
R-2	15 K 1/2 w carbon	09-011
R-3	100 K 1/2 w carbon	09-016
R-4	6.8 K 1/2 w carbon	09-009
R-5	20.8 ohm 1/2 w w.w.	09-076
R-6, 7, 15	1 M 1/2 w carbon	09-022
R-8	27 K 1/2 w carbon	09-055
R-10, 12, 20	47 K 1/2 w carbon	09-014
R-13	10 M 1/2 w carbon	09-025
R-16	4.7 M 1/2 w carbon	09-024
R-18	180 ohm 1/2 w carbon	09-063
R-19	1.5 ohm 1/2 w carbon	09-032
R-21	Potentiometer 500 K miniature	13-039

PARTS LIST (Cont'd.)SymbolDescriptionS & T Part No

Resistors (Cont'd.)

R-22	500 ohm	Rheostat		13-023
R-23	1.5 K	1/2 w	carbon	09-072
R-24	7.5 K	1/2 w	carbon	09-073
R-25	120 K	1/2 w	carbon	09-074
R-26	240 K	1/2 w	carbon	09-075
R-27	2.2 K	1/2 w	carbon	09-042
RFC-1	RF Choke	1 mh	125 ma	02-015

Switches:

SW-1	4-pole 2-pos.	spring return		36-047
SW-2	4-pole 2-pos.	positive index		36-040
SW-3	2-pole 5 pos.			36-046
SW-4	1-pole 11 pos.			36-061
Speaker	Speaker			23-010

Transformers: (audio)

T-1	Min. 80000 ohm - 140 ohm			03-034
T-2	Multi-tapped secondary			03-019
TR-1,2	Transistor, Power	5 watt		2N256

PARTS LIST (Cont'd.)

<u>Symbol</u>	<u>Description</u>	<u>S & T Part No.</u>
	Tubes:	
V-1, 7		1U5
V-2		3A4
V-3, 5		1AJ4
V-4		1AB6
V-6		1AH5
X-1, 2	Crystal	Type "P"