PPI for RX/C

National Research Council of Canada. Radio Branch

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NATIONAL RESEARCH COUNCIL OF CANADA

RADIO BRANCH

PPI FOR RX/C

OTTAWA

OCTOBER, 1943

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C O N T E N T S

(See RX/C-430-C for Schematic, and
RX/C-429-B for Parts Layout and
Jack Panel)

This report has been written primarily for the use of personnel operating the RX/C Mark II set built by N.R.C.

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S E C R E T PRA-98

PPI FOR RX/C

I. INTRODUCTION

The Plan Position Indicator (P.P.I.) is a device which indicates the bearing and distance, relative to the ship's head, of all surrounding objects within its range.

This "Plan" or picture is displayed on the screen of a special C.R. tube and the center of the screen represents the ship on which the PPI is fitted. Therefore, by employing a rotating azimuth ring carrying a marker, or cursor, over the face of the tube, the operator can obtain the relative bearing of any echo shown on the screen.

Advantage is taken of the excellent ranging system of the RX/C scanner for range indication, the operator making use of the range gear to superimpose a single range ring with the desired echo on the screen of the PPI tube. The range is then read on the scanner Range Dials.

As the C.R. tube used has a long-persistence phosphor, having a blue exciting flash and a yellow long persistence trace, an amber filter, or "flash screen", is fitted as an integral part of the azimuth ring which suppresses the disturbing blue flash. Viewed through the filter, the PPI tube in operation presents a more or less darkened screen with echoes from surrounding objects and coastline standing out in yellow fluorescence. A range ring of yellow fluorescence, which may be expanded or contracted by means of the RX/C range gear to range on any echo is also available.

II. SWEEP METHOD

The C.R. tube used employs magnetic deflection, a Selsyn stator being used as the deflection coils. This stator is electrically connected to the stator of a Selsyn generator fitted to the antenna unit and whose rotor turns at the same speed as the antenna.

The sweep wave is fed from the PPI chassis to this rotor, induced into the stator and then transmitted electrically to the deflection stator on the P.P.I. tube assembly.

As a result, the sweep starts at the center of the screen and progresses radially outward. At the same time it is slowly rotated about center at 22 r.p.m. due to the rotation of the Selsyn rotor coupled to the antenna, therefore the magnetic field in the stators will also rotate.

Due to the inductance of the Selsyns it is necessary to apply a compensating wave of opposite polarity immediately at the end of the sweep in order to reduce the Selsyn current to zero before the start of the next sweep. Were this not done, the sweep would not rotate about its one end, but rather at some point along its length. A more or less critical compensating control is eliminated by including in the circuit

a 2 mfd. condenser between rack plugs 2 and 4. (See circuit diagram). This condenser is charged on sweeps and discharged during periods of compensation so that the net charge is zero at the completion of the cycle at which time the Selsyn current is zero, therefore the sweep always rotates about one end. This system is stable over a considerable change of sweep and compensation voltages.

The voltage wave applied to the Selsyn is a square wave which causes the current wave through the Selsyn to be a saw-tooth shape.

III. CIRCUIT

The brightening pulse from the RX/C scanner is inverted and fed to plug 9 on the PPI rack. This pulse is used as the sweep for the 30,000 yard range. One section of the range switch cuts in a 60K resistor and the input condensers have such a value that the correct amount of differentiation is effected to give a narrower wave for the short range. Waveforms are shown on the schematic, "A" is short range of 11,000 yards, "B" is long range of 30,000 yards.

The above wave is fed to two tube grids through 100 ohm decoupling resistor, the sweep amplifier V1 and the first compensator amplifier V3.

The square wave from V1 plate is put on V2 grid through a 100 ohm decoupling resistor. The 150K resistor and .002 condenser to ground from the "B" position of the excitation section of the range switch serves to provide the proper sweep length and at the same time improve sweep linearity.

V2 is the sweep tube and works as a cathode follower and tends to pull the hot side of the Selsyn rotor (plug #3) positive when the sweep wave is applied to its grid. A 50 ohm 1/2 watt resistor connected between plugs 1 and 4 permits observation of the Selsyn current wave, as the IR drop across it is a function of the current.

The output wave of V3 resembles that of V1 and is differentiated by means of an R-C network and applied to V4 grid. A third section of the range switch cuts in a parallel resistance to give the proper amount of compensation on the "A" range.

The negative pip due to the downcoming end of the square wave is effective in cutting off V4 grid. This gives a positive square wave of rather poor shape out of V4. This wave, however, need not be a perfect square wave. It will be noticed that, because it is due to the negative pip of the differentiated wave out of V3, it occurs immediately following the sweep wave.

This positive square wave is applied to the grid of the compensator tube, V5. The output of this tube tends to pull the hot side of the Selsyn (plug #3) negative and compensation is thus effected.

A square wave from V1 screen grid is used to brighten the tube during sweeps and blank it off during retrace and compensation periods. A corrective network consisting of a .005 condenser and a 100K pot. shapes the brightening pulse to provide for even screen illumination.

The pips from the RX/C scanner are fed to the grid of V_6, positive pips appearing in the plate circuit. These pips go to the grid of V_7, whose suppressor is connected to the fast sweep; because of this gating action only the pip on the fast sweep gets through. The suppressor bias is variable for range-ring intensity.

V7 and the second video tube, V9, have a common plate circuit in a 1K 2W resistor and the combined outputs are fed to a DC restorer and limiter diode, V10, and thence to the cathode of the PPI tube.

IV. OPERATION

When the RX/C scanner has been turned on and is in operation, close the LT switch on the PPI chassis.

Start the antenna motor.

Turn "Intensity" control full to the left, counter-clockwise.

After 2 or 3 minutes for tube warm-up, turn on the HT switch.

Adjust "Intensity" control for proper brilliance.

Turn "Range Ring Intensity" slowly until a series of range rings cover the tube.

Adjust "Brightening Compensation" for even screen illumination. The use of range rings enables the operator to make this adjustment more precise, as it is easier to detect the variation of brilliancy of each ring than it is to estimate overall brilliancy. Adjust so that all rings are equally bright. Make this adjustment on the "B" range.

Retarding the "range ring intensity" control futher will cause all range rings to fade out, except for one ring which will become brighter. It will be found that this range ring can be cranked in or out by turning the range handwheel on the RX/C scanner. When this ring has been super-imposed on an echo, the range dials on the RX/C scanner indicate the range. The azimuth cursor is then turned to intersect the echo and the relative bearing is indicated on the azimuth ring.

The "Intensity" control is adjusted so that the sweep is just visible as a sparkling line. This is the most sensitive adjustment. If the intensity is adjusted so that no sweep is visible, weak echoes will not be registered, or if the sweep is adjusted for a thick solid line, the definition of the picture suffers and weak echoes will be masked by the background luminosity.

Adjust "Magnetic Focus" for best definition if necessary.

The picture is centered on the screen as follows: Turn the Range switch to the "B" position. Advance "Range Ring Intensity" until the range ring appears and crank the ring out to 30,000 yards. Adjust the "Vertical Centering" and "Horizontal Centering" controls until the range ring is concentric with the circumference of the PPI tube.

In use, the RX/C scanner range switch is left on the 30,000 yard range and the gain control of the receiver advanced to full on.

For ranging close in on the "A" range, the gain is turned down and individual echoes may be ranged upon in to about 350 or 400 yards.

The range ring may be turned off during normal watch-keeping if desired and used only to range on an echo when one is detected.

A third range of 75,000 yards may be had by leaving the PPI range switch in the "B" position and turning the scanner range switch to the 75,000 yard range. The sweep will not cover the entire screen, but this range may prove useful in navigation although no range ring is available.

Low flying aircraft show up as echoes which are not registered consistently. These echoes may be traced at every revolution of the antenna for a few revolutions or may be traced only once in a number of revolutions. Generally, each trace varies in size, and the echo is seen to move on the screen.

V. TO REPLACE PPI TUBE

Remove chassis from rack. Remove socket from PPI tube, also Selsyn and focussing coil leads. Loosen Selsyn rotor and slide it back against the focussing coil, tightening the screws just enough to hold it in position. Loosen the front clamp holding the PPI tube face, and remove the IIT clip from the anode. Slide the tube back so that it barely touches the Selsyn. Turn chassis on its side and remove the four screws under the PPI tube pan, holding the PPI tube assembly to prevent it from falling out. Turn chassis down and it will be found that by lifting the rear of the tube assembly that the front will clear the azimuth gear and the assembly may be lifted out.

In replacing the Selsyn leads, if they are not correct the sweep will move counter-clockwise and the picture will be a mirror image. To remedy, interchange two of the Selsyn leads.

If the picture does not center or focus correctly, interchange the focussing coil leads.

VI. FAULTS

1. Sweep does not extend to edge of tube and bright spot occurs in center of screen.

Fault in compensator circuit. Replace the rectifier, V11, the compensator tube, V5, or compensator amplifier, V3 and V4 in above order as necessary.

2. Sweep does not extend to edge of tube and large dark area appears in center of screen.

Fault in sweep circuit. Replace the rectifier, V12, the sweep tube V2, or the sweep amplifier V1. Failure of V1 will cause a sweep of about an inch long, not centered, as the intensity is turned up.

3. Bright spot appears in center of screen, rest of screen dark. TURN OFF PPI H.T. SO SCREEN WILL NOT BE BURNED. Faults in both sweep and compensator circuits. Try replacing V11, V12, V2, V5, V1, V3 and V4 in above order. Where an oscilloscope is available and tube replacement does not clear the fault proceed as follows:

Short-circuit plugs #2 and #4 and connect the scope between this common junction and ground. If the fault lies in the compensator circuit but the sweep circuit is working, a saw-tooth wave will appear on the scope. If the fault lies in the sweep circuit and the compensator circuit is working the wave appearing on the scope is similar to a square wave.

Above tests to be carried out with transmitter and local oscillator OFF and antenna stopped. The scanner should be turned on. It should be remembered that the scanner is used to drive the PPI, therefore if scanner is not functioning properly, one cannot expect good performance from the P.P.I.

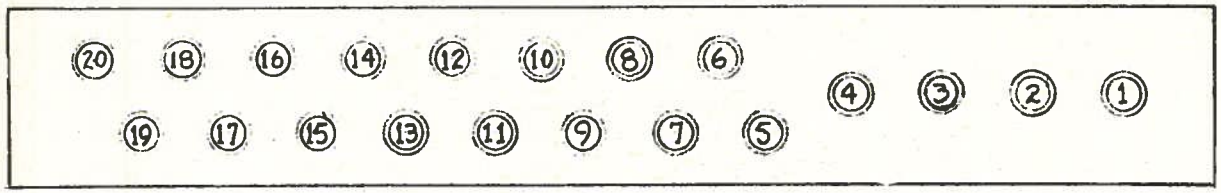
4. No range ring on screen with range ring intensity turned up, but echoes visible.

Replace V6 and/or V7.

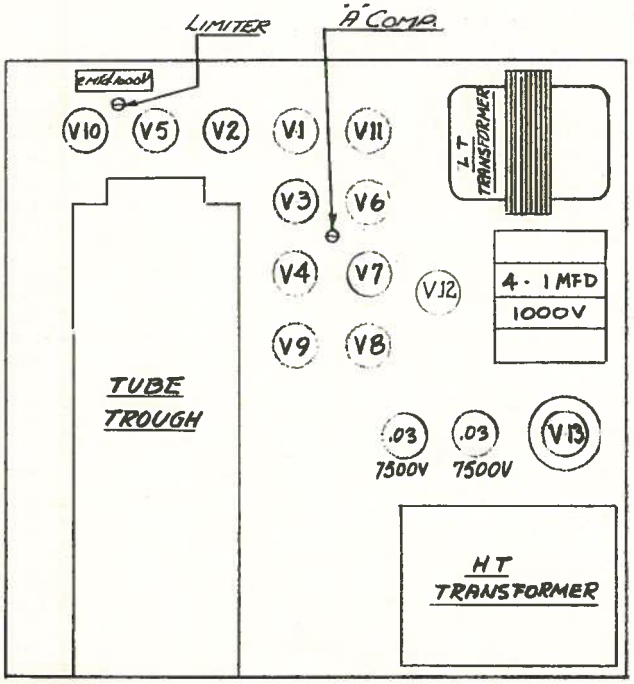
5. No echoes on screen with gain turned up, but range-ring visible. Replace V8 and/or V9.

6. Poor and uneven registration of echoes.
Replace the diode, V10.

W. M. Cameron



BACK VIEW OF JACK PANEL



FRONT

V1 - 6AC7 - SWEEP AMPLIFIER
V2 - 6V6G - SWEEP TUBE
V3 - 6AC7 - FIRST COMP. AMPLIFIER
V4 - 6AC7 - SECOND COMP. AMPLIFIER
V5 - 6V6G - COMPENSATOR TUBE
V6 - 6AC7 - P.P. INVERTER
V7 - 6AC7 - RANGE RING TUBE
V8 - 6AC7 - FIRST VIDEO
V9 - 6AC7 - SECOND VIDEO
V10 - 6H6 - LIMITER & D.C. RESTORER
V11 - 5U4G ETC. - NEGATIVE LT RECTIFIER
V12 - 5U4G ETC. - POSITIVE LT RECTIFIER
V13 - 2V3G - H.T. RECTIFIER

REV. - 8/10/43 - D.C.

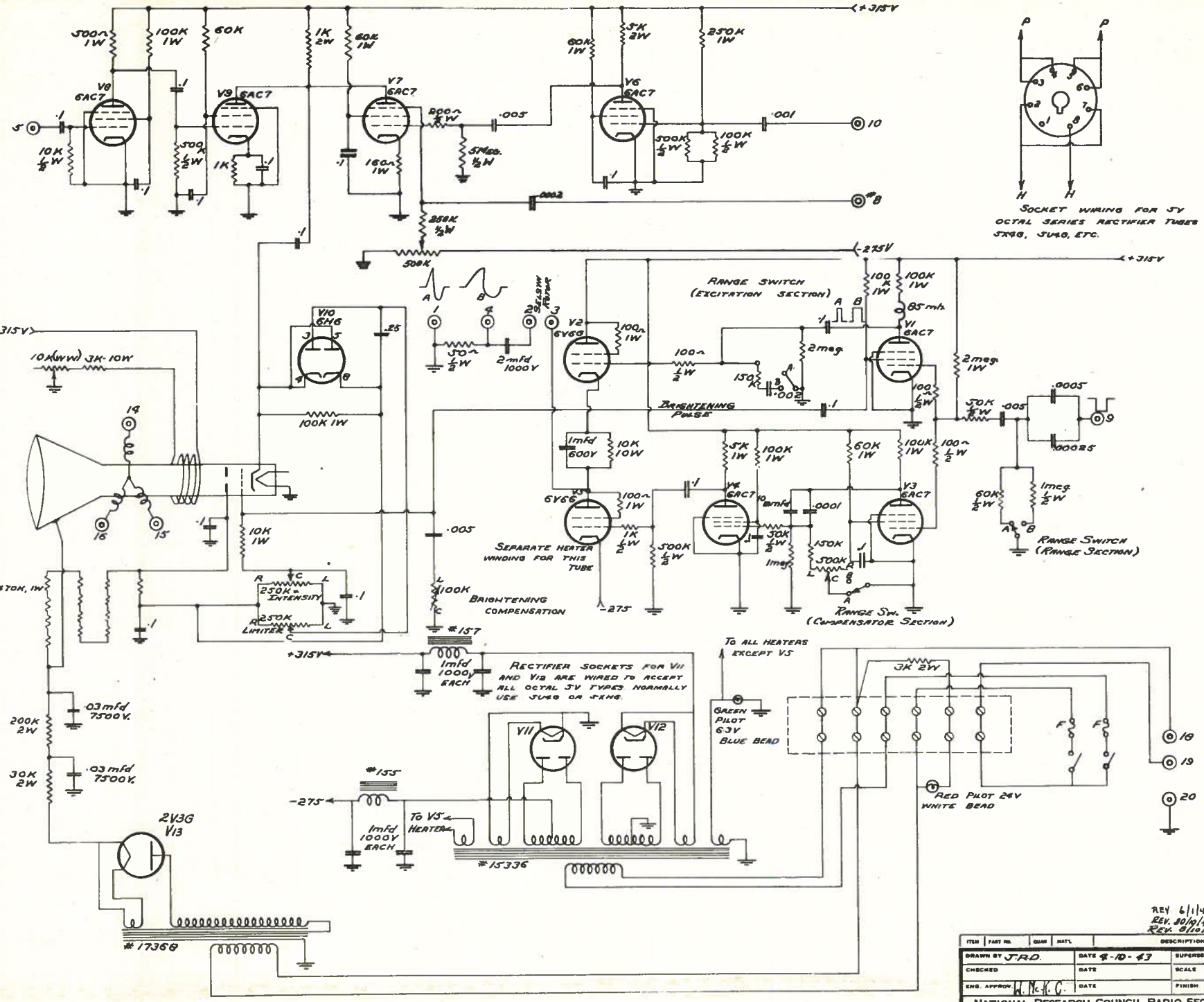
ITEM	PART NO.	QUAN.	MAT'L	DESCRIPTION

DRAWN BY K-E-K	DATE 8-9-43	SUPERSEDES
CHECKED	DATE 9-9-43	SCALE N.T.S.
ENG. APPROV. W.M.K.C.	DATE 12-10-43	FINISH.

NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA

NAME P.P.I. CHASSIS PARTS LAYOUT AND JACK PANEL

DWG. NO. D-P RX/C -429-B



REV 6/1/44 D.C.
REV. 30/9/43 D.C.
REV. 8/10/43 D.C.

ITEM	PART NO.	QUAN	MAT'L	DESCRIPTION
DRAWN BY J.R.D.	DATE 8-10-43			SUPERSEDES
CHECKED	DATE			SCALE
ENG. APPROV. H.M.C.	DATE			FINISH

NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA, CANADA

NAME RX/C PPI

DWG. NO. RX/C-430-C