



H.F. Telegraph and Telephone Transmitter unit type A 219.V

Frequency range:

The transmitter covers the 4, 6, 8, 12, 16 and 22 Mc/s ships' telegraphy and telephony bands. In each band 3 telegraph frequencies are available, i.e. one calling and two working frequencies. For this purpose three 2 Mc/s crystals, the harmonics of which are used in the 4 - 6 - 8 - 12 - 16 Mc/s bands, and three 2,7 Mc/s crystals the harmonics of which are used in the 22 Mc/s band are provided.

Further a total number of 14 frequencies in the 4, 8, 12, 16 and 22 Mc/s ships' telephony bands are available.

Crystals are supplied according to customer's specifications, accomodation for a total number of 20 crystals being available.

Aerial power:

100 watts carrier wave measured in an artificial aerial having a resistance of at least 40 ohms. Means for reducing aerial power to about one tenth.

Modulation:

Modulation up to 95% when transmitting A3. (peak limiter).

Frequency tolerance:

When equipped with crystals supplied by the manufacturer of the transmitter the frequency tolerance is better than 0,02% for telegraph frequencies and better than 0,005% for telephone frequencies as required by the A.C. conference 1947.

Harmonics:

All harmonics radiated from the aerial will be attenuated at least 40 dbs in relation to the fundamental.

Aerial:

A very elaborate aerial matching network render correct loading of the R.F. power stage and correct tuning of the aerial circuit possible with any aerial encountered on board ships.



- 2 -

Such matching takes place merely by turning knobs on the front of the transmitter - no internal adjustments or soldering during installation is needed.

Space for putting down figures indicating the setting of the aerial tuning knobs and dials is provided for each H.F. band.

Measuring instruments:

The transmitter is provided with a milliammeter and a switch by means of which the cathode current of each individual tube may be checked.

Likewise the grid current of the R.F. power tubes may be checked.

Aerial power is indicated by the glow of a neon voltage indicating lamp; tuning being accomplished by means of the above mentioned milliammeter.

Tubes:

4 tubes type 807 (or equivalent: Philips QE 06/50)
2 tubes type QQE 06/40 (Philips).



A 219V - Operation.

Set transmitter selector switch in switching panel to "HF", set power switch to "1/10", set band switch in H.F. transmitter proper to the correct band, set crystal switch to correct channel (according to table in front plate), set "coupling" to 0 (Zero), set cathode current switch to one of the no. 5 tubes. Turn operating switch in switchboard to "stand by". After 15 seconds turn lever to A1, press key and rotate knob "trimmer" till minimum cathode current of the no. 5 tubes is obtained. Set power switch to 1/1 and readjust "trimmer". Cathode current then should amount to 50-55 milliamps.

Next set "coupling" to "1", "aerial coarse" to "1" and rotate "aerial fine" from one end of the dial to the other and note if the cathode current rises to a maximum during this operation. If a maximum has been found note the value of the cathode current of the no. 5 tubes. If the cathode current does not come up to about 175 milliamps (each tube, consisting of two parallel connected systems) set "coupling" to "2" and repeat aerial tuning. If necessary proceed to 3, 4 and so on.

At the same time note light in aerial voltage indicator lamp. Maximum light should be obtained simultaneously with maximum cathode current.

Yet the cathode current should never exceed 200 milliamps. (each tube) as too high cathode current will ruin the tubes - and reduce aerial power.

If no point of resonance has been found with switch "aerial coarse" set to "1" then proceed to "2" and rotate "aerial fine" again for resonance (maximum light in aerial voltage indicator lamp). If necessary proceed to 3, 4 and so on until a true resonance point has been found, and adjust "coupling" (and readjust "aerial fine") until correct value of cathode current of the power tubes is obtained.

It is a good check on correct tuning of the aerial (tuned to zero reactance) to test if the setting of "trimmer" which has been found with unloaded power amplifier (coupling zero) is unchanged when the amplifier is loaded by the aerial resistance. So, with the aerial tuned as prescribed above, try to rotate knob "trimmer" slightly to either side of its original setting and observe if the cathode current of the no. 5 tubes increases; the latter should be the case. - If the cathode current decreases when "trimmer" is rotated either upwards or downwards a new setting of the aerial tuning elements must be found complying with the instructions given above.

Yet when a very high value of "coupling"-setting (9-10-11) is necessary for correct loading of the tank circuit a small reaction from the aerial may be inevitable. The knob "trimmer" then should be readjusted and



- 2 -

a setting chosen which will give minimum cathode current with aerial tuned to resonance, but with the difference that the minimum cathode current with loaded amplifier amounts to 170-180 milliamps. per tube (compared with 50-60 milliamps. unloaded.)

In order to facilitate future tuning the settings of the levers and knobs "trimmer", "coupling", "aerial coarse" and "aerial fine" for crystal channel no. 1 (crystal 1) should be put down (in ink or pencil) on the calibration dial which appears behind the window immediately above the band switch.

Future adjusting of the said knobs then may take place immediately according to the calibration figures which appear in the window and the operating switch (in switching panel below) may be rotated directly to the mode of transmission wanted. After a warming up period of 15-20 seconds the transmitter is ready for use.

Please note: The calibration figures mentioned hold strictly for crystal 1 only. When other crystals are switched in a slight readjustment of "trimmer" may be necessary (adjust to cathode current "dip".) The settings of the remaining levers and knobs will hardly be affected by the small change of frequency within the limits of the ships' transmitting bands.

Placing of the crystals in their holders may require a small explanation.

The 10 octal tube sockets can hold a total number of 20 crystals. The positions of the crystals corresponding with the 15 positions of the crystal switch is indicated on the drawing inside the lid covering the crystals. Moreover the holders intended for 2 Mc crystals are painted red (designated "a" in the drawing) and holders for 2,7 Mc crystals are painted blue (designated "b" in the drawing). Position 1a and 1b are intended for crystals corresponding with ship's calling frequency (telegraphy) and 2a, 2b and 3a, 3b are intended for ship's working frequencies (telegraphy) in the 4, 6, 8, 12, 16 and 22 Mc bands. Positions 4a-14a are intended for 2 Mc crystals for individual telephony frequencies in the 4, 8, 12 and 16 Mc bands (frequencies not harmonic) while positions 13b, 14b and 15b are intended for 2,7 Mc crystals for telephony frequencies in the 22 Mc band.



Trimming:

The whole transmitter is correctly trimmed when leaving the factory. If for any reason new trimming has to take place proceed as follows:

Set power switch to "1/10" set band switch to "4" set crystal switch to 2 Mc-crystal with highest frequency (no. 3) set "cathode/grid current" switch to "cathode 2" and adjust trimmer C1a, labelled "4-6-8-12" for minimum cathode current (2 Mc/s); set switch "cathode/grid current" to "grid 4" and readjust C1a for maximum grid current. Set "cathode/grid current" switch to "grid 5" and adjust C8 labelled "4" for maximum grid current (4 Mc/s).

Next set crystal switch to 2 Mc-crystal with lowest frequency (a telephone frequency) and readjust trimmer C8 slightly for increasing grid current in the "low" end of the 4 Mc-band. Shift a couple of times between crystals with highest and lowest 2 Mc-frequency and adjust C8 for equal grid current of the no. 5 tubes on the highest and lowest 4 Mc-frequency. Check setting of trimmer C1a; it might be advantageous to readjust it a trifle to get maximum grid current in the no. 4 tubes and consequently also in the no. 5 tubes in both ends of the band.

Next set band switch to "6". As the same anode circuit (2 Mc/s) of tube no. 2 is used on 6 Mc/s as on 4 Mc/s adjustment of C1a should not be changed. Set "cathode/grid current" switch to "grid 5" and adjust C9, labelled "6", for maximum grid current (6 Mc/s). Shift between crystals with highest and lowest 2 Mc-frequency as above and adjust C9 for equal grid current in the no. 5 tubes on the highest and lowest 6 Mc-frequency.

Next set band switch to "8". As the same anode circuit (2 Mc/s) of tube no. 2 is used on 8 Mc/s as on 4 Mc/s C1a remains untouched. Set "cathode/grid current" switch to "grid 4" and adjust C4, labelled "8", for maximum grid current (4 Mc/s). Set "cathode/grid current" switch to "grid 5" and adjust C10, labelled "8", for maximum grid current (8 Mc/s). Shift between crystals with highest and lowest 2 Mc-frequency as above and adjust C10 for equal grid current in the no. 5 tubes on highest and lowest 8 mc-frequency.

Next set band switch to "12". As the same anode circuit (2 Mc/s) of tube no. 2 is used on 12 Mc/s as on 4 Mc/s C1a remains untouched. Set "cathode/grid current" switch to "grid 4" and adjust C5, labelled "12" for maximum grid current (6 Mc/s). Set "cathode/ grid current" switch to "grid 5" and adjust C11, labelled "12", for maximum grid current (12 Mc/s) and shift between crystals with highest and lowest frequency as above.

Next set band switch to "16". Set "cathode/grid current" switch to "grid 3" and adjust trimmer C2, labelled "16", for maximum grid current (4 Mc/s). Set "cathode/grid current" switch to "grid 4" and adjust C6, labelled "16", for maximum grid current (8 Mc/s). Set "cathode/grid current" switch to "grid 5" and adjust C12, labelled "16", for maximum grid current (16 Mc/s) and shift between crystals with highest and lowest frequency as above.



- 4 -

Next set band switch to "22". By doing so 2,7 Mc-crystals are automatically switched into the oscillator circuit instead of 2 Mc-crystals. Set "cathode/grid current" switch to "grid 3" and adjust trimmer C3, labelled "22", for maximum grid current (5,5 Mc/s). Set "cathode/grid current" switch to "grid 4" and adjust trimmer C7, labelled "22", for maximum grid current (11 Mc/s). Set "cathode/ grid current" switch to "grid 5" and adjust C13, labelled "22" for maximum grid current (22 Mc/s). Shift between crystals with highest and lowest 2,7 Mc-frequency and adjust C13 for equal grid current in the no. 5 tubes on highest and lowest 22 Mc-frequency.

Trimmer C18, which has its shaft brought out through the front plate and provided with knob and dial must be adjusted for minimum cathode current of the no. 5 tubes for each frequency in each band according to instructions given in section "Operation".

Check the values of grid and cathode currents with the values stated in the "Normal Meter Readings" (attached to the description).

When trimming the transmitter it may be convenient to use a small neon indicator lamp as a tuning indicator. The lamp is held in its brass socket and the glass envelope held against the anode of the tube, the anode circuit of which is being tuned. Maximum light in the neon lamp indicates resonance of the anode circuit, which condition gives rise to maximum grid current in the succeeding stage.

Care should be taken not to touch the anode of the tube with the brass socket of the neon indicator as the 550 volt high tension is dangerous. For safety: Stand on a dry wooden floor or otherwise insulated from ground, and never touch chassis or grounded metal objects with the idle hand - and finally, use a well insulated screwdriver for trimming.

S a f e t y f i r s t.

15/10-56 HB/lh-



A 219 V - Diagram.

The transmitter covers the following H.F. bands allotted for ships' telegraphy and telephony:

4063	-	4238	kc/s
6200	-	6357	-
8195	-	8476	-
12330	-	12714	-
16460	-	16952	-
22000	-	22400	-

Crystal control is employed throughout, an 807 valve acting as a crystal controlled Pierce-oscillator.

The plate circuit of the oscillator is coupled direct to the grid of the 807 buffer tube (tube no. 2), the plate circuit of which by means of coil L1 and trimmers C1a+C1b is tuned to 2 Mc/s when transmitting on 4, 6, 8 and 12 Mc/s, by trimmer C2 to 4 Mc/s when transmitting on 16 Mc/s and by C3 to 5,5 Mc/s when transmitting on 22 Mc/s.

The plate circuit of tube no. 2 is for transmitting on 4 and 6 Mc/s connected direct to the grid of tube no. 4, while for transmitting on 8, 12, 16 and 22 Mc/s it is connected to the grid of tube no. 3. On bands 4 and 6 Mc/s the grid of tube no. 3 is connected to ground by a large capacitor, cutting the tube quite out of action. When transmitting on 8, 12, 16 and 22 Mc/s the plate circuit of tube no. 3 is by means of coil L2 and trimmers C4, C5, C6, C7 tuned to 4, 6, 8, and 11 Mc/s.

The plate circuit of tube no. 3 is for transmitting on bands 8, 12, 16 and 22 Mc/s connected to the grid of tube no. 4. The latter consequently is fed with 2, 2, 4, 6, 8 and 11 Mc/s oscillations when transmitting on frequencies 4, 6, 8, 12, 16 and 22 Mc/s. The plate circuit of tube no. 4 is by means of coil L3 and trimmers C8, C9, C10, C11, C12 and C13 tuned to 4, 6, 8, 12, 16 and 22 Mc/s.

The plate circuit of tube no. 4 is connected direct to the grids of the two parallel connected twin tubes QQE 06/40 (each glass envelope containing two electrode systems). These tubes are working as plain class C amplifiers with their plate circuit tuned to the same frequency as their grid circuit. The plate circuit of the power amplifier has been built as a pi-filter, consisting of an anode-cathode capacitor, an inductance coil and a coupling



capacitor. Two sections of the frequency switch take care that suitable fixed capacitors are cut in and suitable taps on the coil are cut in on the different bands, while a trimmer C18 with its shaft brought out in the front panel and provided with a knob covers the individual bands. The anode-cathode capacitors are: C14: 525 pF (4 Mc/s), C15: 160 pF (6 Mc/s), C16: 170 pF (8 Mc/s). On bands 12, 16 and 22 Mc/s the trimmer is the only tuning capacitor (besides tube capacities etc.)

The coupling capacitor consists of a 280 pF capacitor, C52, consisting of 11 series connected capacitors of different value, with taps brought out to an 11 position switch. The coupling capacity, that means the part of the coupling condenser which is common to the tank circuit and the aerial circuit, in this way may be varied between about 1700 and 280 pF without noticeable detuning of the tank circuit.

In order to keep the proportion between the anode-cathode capacity and the (total) coupling capacity approximately constant fixed capacitors are switched in in parallel with the 280 pF coupling capacitor on the bands where extra capacitors are switched in parallel with the anode-cathode capacitor. The extra coupling capacitors are: C53: 1150 pF (4 Mc/s), C54: 667 pF (6 Mc/s), C55: 412 pF (8 Mc/s).

As the transmitter covers as well the telegraph as the telephone frequencies on all H.F. bands allocated to ships' radio communication certain precautions have been made to simplify operation within the bands. The power amplifier tank circuit is tuned correctly by the trimmer in the front.

The doubler (tripler) circuits with coils L1 and L2 are so broadly tuned (so heavily damped) that they cover the bands without retuning and without special precautions. The circuit consisting of coil L3 and the trimmers (semi fixed) C8-----C13 must produce drive of correct amplitude for the grid circuit of the power amplifier on all bands and on all frequencies within the bands. This is accomplished by suitable damping resistors connected across different parts of the coil L3 on the different bands.

Grid bias for all tubes in the H.F. transmitter is derived from a bias generator in the A 218 transmitter section, connected in series with the filament voltage the positive pole of which normally is grounded.

Screen grid voltages are derived from the plate voltage through suitable dropping resistors. Screen grid voltage for the power amplifier is taken from the modulated plate voltage of the power amplifier, also through a dropping resistor. In order to keep the screen grid voltage below about 300 volts also with key up (in which case the screen grid current is zero and the voltage across the dropping resistor consequently zero) two series connected neon stabilizers have been connected between screen grid and chassis.



- 3 -

In order that the modulation voltages (when transmitting A3) at the screen grids of the power amplifier should not be shortcircuited by the stabilizers an A.F. choke (about 9 henries) is connected in series with the stabilizers.

Modulating power for A3 transmitting is provided by the modulator built into the A 218 section.

As mentioned above keying takes place by means of a keying relay which by key down condition shorts a resistor in a voltage divider across the high tension. All cathodes are brought to the tap on the voltage divider which is grounded at key down. At key up all cathodes adopt a positive voltage of some 80-90 volts (while the grids keep their negative voltage). In this way plate and screen grid current of all tubes are cut completely off.

Without grid drive (no crystal inserted or crystal not oscillating) but key down, the cathode current of the power amplifier is also practically zero

Aerial circuit:

A very elaborate aerial matching system has been provided for correct tuning of the aerial circuit and correct loading of the power amplifier irrespectively of the size of the aerial.

The aerial tuning elements consist of a coil L5 with taps (0-17 microhenries) and a variable capacitor 25-275 pF. By means of an 11 position switch ("aerial coarse") part of the coil and the variable capacitor may be connected in series (position 1-6) or in parallel (position 7-11) rendering possible outbalancing of positive or negative reactances within very wide limits. Correct loading of the tank circuit of the power amplifier is accomplished by the 11 position switch "coupling".

For correct matching and tuning so three levers and dials are available: "coupling", "aerial coarse" and "aerial fine". Once the settings have been found for each band (only slight retuning will generally be necessary within the bands) the figures of the settings are put down in the "window" above the band switch, making resetting of dials and knobs very quick and easy. For convenience also the setting of "trimmer" for crystal frequency no.1. (i.e. calling frequency) is put down in the same window