UNITED KINGDOM CONTROL AND REPORTING ORGANISATION

Development. (Pre-war period).

1. The rapid pre-war development of radar, or radio location as it was then called, was the result of efforts to counter the potential threat of aggression by the numerically superior Air Forces of Nazi Germany.

2. In the latter part of 1934 a Committee of Research on Air Defence was appointed under the chairmanship of Mr. H.T. Tizard. The superintendant of the Radio Department of the National Physical Laboratory, Mr. Watson-Watt, was asked to investigate the possibilities of producing high power radio waves which could be used to inflict damage to aircraft or personnel. At the first meeting of the Tizard Committee on the 28th January 1935, a note on the subject was presented by Watson-Watt, which proved conclusively that the radio power required to achieve this aim, was too great to be produced by an extension of any known means. However a comment was included to the effect that the more promising problem of location by radio might be worth pursuing.

3. Watson-Watt was asked to act on this idea, and on the 26th February a practical experiment was arranged about ten miles from the Daventry short wave transmitting station. Reflected short waves from an aircraft in the vicinity were picked up by a receiver mounted in a vehicle.

4. In March 1935 it was decided by the Tizard Committee that large scale experiments should be carried out, and to this end a special laboratory was constructed at Orfordness, an isolated place on the Suffolk coast.

5. On the 16th June the Committee visited Orfordness and saw an aircraft followed for a distance of 40 miles, and by January 1936 bearings and height of aircraft at ranges of about 25 miles were being measured with reasonable accuracy.

6. The Research team was now moved to larger premises at Bawdsey Manor, near Felixstowe, where 240 feet steel aerial towers were built, which resulted in increased range over which aircraft could be detected. On 13th March 1936, am aircraft at 75 miles range was successfully located.

7. In September 1936 the first Air Exercise using the new radio location apparatus took place, and aircraft over the North Sea taking part, were kept under continuous observation. RAF personnel were now trained to use the Bawdsey equipment and by May 1937 the station could be used in operations. In July a second station was opened at Dover and a third in August near Southend. These stations gave the range and bearing of aircraft and the problem now arose of correlating all the information, to present it in intelligible form as quickly as possible to the Headquarters of the Air Defence. An experimental "Filter room" was started at Bawdsey and a complex system of communication lines to interconnect the network was constructed by the GPO.

8. Construction of further stations was put in hand and on Good Friday 1939 a chain of twenty stations, stretching from Ventnor, Isle of Wight to the Firth of Tay, commenced a continuous watch over the East Coast of the U.K. These stations operated on a wavelength of 10 metres which made them inadequate for detecting low flying aircraft. To overcome this drawback a chain of special stations operating on [illegible] ucted. This wavelength required much smaller aerials and it became practicable to mount them on rotating turntables, so that they operated as a kind of radio searchlight continuously scanning the horizon. The two chains of stations were named "Chain Home" (C.H.) and "Chain Home Low (C.H.L.).

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1939-45 Period.

9. During the early stages of the war, the chain of C.H. and C.H.L. radar stations gave early warning of the approach of high and low flying enemy aircraft, and thus avoided the need for Fighter Command to maintain standing patrols. In this way the small number of fighter aircraft and pilots available, were able to intercept the enemy with the minimum waste of effort, and take a high toll of the attacking force.

10. The system could determine the location of enemy aircraft to within about three miles, and could guide the intercepting fighters to a point where they could make visual contact. This procedure was adequate during normal daylight hours, but when the enemy air attack was switched to the hours of darkness, during late 1940 and early 1941, it proved quite inadequate. To carry out night interception it was necessary to be able to guide a fighter to within 300 yds of an enemy aircraft.

11. Part of the solution to this problem was to provide the night fighters with an airborne radio location set, which could be used to locate the enemy. Work on the development of these sets had begun during the summer of 1939, by a team of scientists under Dr. E.G. Bowen at Bawdsey. The main difficulty was, that owing to the requirement to keep the sets small and compact for airborne use, they had very low power and consequently very short range. To guide the night fighters accurately to a point where they could make radar contact with the enemy, required a more accurate type of ground control radar. This was made possible by using a similar equipment to that of the C.H.L. stations, working on 1½ metres, and using an aerial array mounted on a rotating turntable. A tremendous advance was made however by including in the system, a, cathode ray tube with a time-base which rotated in unison with the radar beam. This display, known as a Plan Position Indicator, provided the ground controller with effectively a map of the sky surrounding the station, on which all aircraft movements could be followed.

12. By the use of Ground Controlled Interception (G.C.I.) and Airborne Interception (A.I.) equipment the number of enemy bombers shot down by night fighters mounted from 2 during December 1940 to more than 100 during May 1941. Even with this success the system had considerable limitations, for example, reflections from the ground of the 1½ metre radio energy, limited the range of the airborne radar sets to a distance equal to the altitude of the aircraft, to that interceptions could not be made with success much below 10,000 ft. This factor was one of the main causes of the all-out effort to develop the use of centimetre wavelengths, which was made possible by the invention of new valves and techniques.

Post-war Period.

13. During the immediate post-war period radar cover for the United Kingdom was achieved partly by using re-engineered C.H. stations, but after 1951 mainly by new G.C.I., C.E.W. (Centimetric, Early-Warning).and C.H.E.L. (Chain, Home, Extra Low), equipped with modernised war-time equipment.

14. As the speeds of aircraft increased, the problems of G.C.I. became more acute, since compared with earlier years, any delay in reporting and intercepting an intruding aircraft considerably increased the depth to which the intruder could penetrate.

15. To meet this problem, n[illegible] radar equipment was introduced, for example Radar Type 80, a centimetric search equipment and FPS-6, an American height finding radar, also instroduced were more efficient means of reducing the time required to detect identify and if necessary intercept an intruder.

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16. Although these developments have considerably increased the efficiency of the radar system, the problem remains, as aircraft speeds continue to increase and aircraft themselves give way to controlled rockets. To keep abreast of the problem the system must be continually brought up to date by the use of the latest equipment and techniques.

RADAR TYPE 7 - DESCRIPTIVE DIAGRAM

Transmitting Section.

1. Triggering Facilities.

a. To operate the transmitter a series of trigger pulses are required. These pulses are formed by a trigger unit from a synchronising source.

b. In order to synchronise the Type 7 radar, for operational purposes, a master sine wave is generated by a 250 c/s alternator, which is part of the Type 7 equipment. This sine wave may be used to synchronise all other radar equipments on the G.C.I. station, or for the Type 7 radar only, depending on individual station requirements.

c. For test purposes, the trigger unit can produce its own synchronising sine wave from an internal oscillator, at 250 c/s or 500 c/s.

d. The method of triggering Type 7 equipment depends always on individual G.C.I. station requirements.

2. Transmitter. Two transmitters are provided in a Type 7 installation, to provide operational continuity in case of breakdown. The transmitter selected for operation will, on receipt of a trigger pulse, produce a 4 microseconds duration burst of r.f. energy at a frequency which may be set between 180 and 220 Mc/s.

3. Transmit/Receive Switch. An electronic switch which allows the same aerial array to be used for transmission and reception.

4. Rotating Coupling. An arrangement to provide a continuous path for the r.f. energy between the static and rotating parts of the installation.

5. Aerial Array.

a. A metal framework is supported by rollers at the top of a fixed central column. This framework carries the aerials, reflector screen and feeders, and is capable of being continuously rotated at any speed up to 6 revolutions per minute, by a motor which is part of the Ward-Leonard turning gear system. This provides speed control for the aerial rotation.

b. Two electrical generators which produce voltages varying in synchronism with the aerial rotation, are driven by the aerial array. These generators are known as selsyns. One is used to provide a synchronising voltage to keep the P.P.I. display timebase in step with the aerial, and the other to keep the aerials of associated radar equipments turning in synchronism with the Type 7 aerial.

Receiving Section.

6. Matching Device. R.f. energy from the aerial travels along a twin wire feeder which is under tension and inflexible. To connect this feeder to a flexible co-axial cable, without losing a considerable amount of power, requires a matching device, which in this case consists of a balanced to unbalanced transformer together with a quarter-wavelength ($\lambda/4$) transformer.

/7

7. Receivers.

a. Each of the two receivers are divided into two separate chassis:

(1) The r.f. amplifying unit on which is mounted an amplifier, mixer and local oscillator. The purpose of this unit is to amplify the received r.f. signals, and convert them to an intermediate frequency of 45 Mc/s.

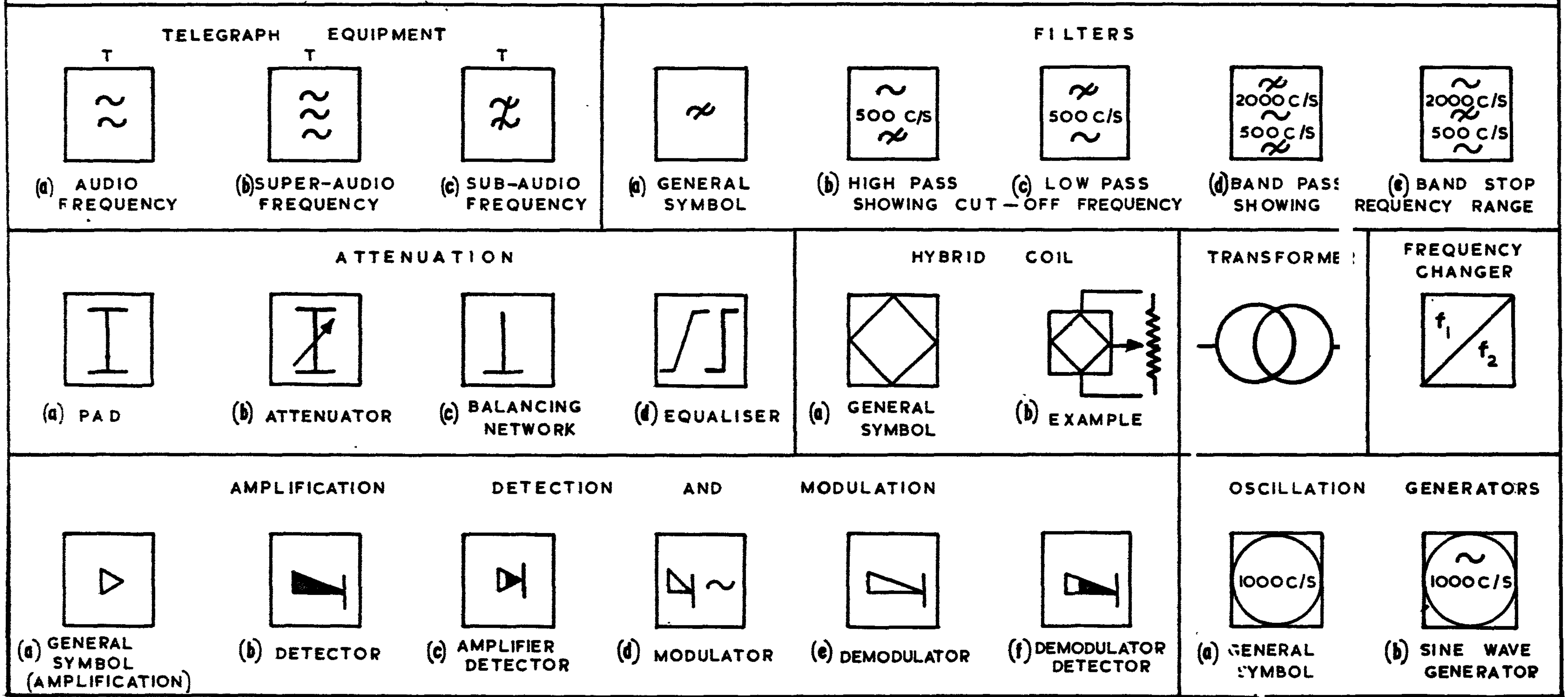
(2) The i.f. amplifying unit, which has five stages of amplification to amplify the 45 Mc/s signals before connection to the radar office equipment.

b. A third chassis is mounted inside each received compartment and on this is the receiver power unit. This unit converts 230V 50 c/s mains voltage to various levels to meet the requirements of the receiver.

8. Monitor. This is a unit of test equipment incorporating a cathode ray tube, on which various waveforms can be displayed for test purposes. To enable the receiver function to be checked, a second 45 Mc/s output is taken from the receiver, through a separate i.f. amplifier, to be available for display on the c.r.t. if required.

9. Channel Changing. Either of the two transmitters may be used with either of the two receivers, by interchanging connections, operating the TRANSMITTER CHANGEOVER switch and changing over a short-circuiting link on the r.f. feeder lines.

TELECOMMUNICATION SYMBOLS
FOR USE IN BLOCK SCHEMATIC DIAGRAMS



TRAINEE HANDOUT

BASIC G.C.I. STATION OPERATION

1. Diagram Layout. In the basic station shown, Type 7 search radar is situated at a remote site 3 to 8 miles from the remainder of the radar equipments, giving certain operational advantages, e.g. dispersal of equipment against conventional air attack. Due to certain design requirements, the Type 7 radar is always used as the master trigger source and also master tuning equipment. If Type 7 radar is not operational, then Type 80 search radar is used for this purpose.

2. Search Radars.

a. Type 7 - Metric transmitter, aerial array and receiver, giving target information for P.P.I. displays.

b. Type 80 - Centimetric radar of later design, has a rotating cabin and aerial array, mounted on a steel gantry.

c. Type 14 - Centimetric radar, re-engineered war-time equipment.

3. Height Finding Radars.

a. Type 13 - Centimetric radar, similar to Type 14, but with vertical "nodding" aerial array. Aerial and cabin may be rotated and aerial trained on any required bearing, by remote control.

b. F.P.S.6 - American centimetric radar, serves same purpose as Type 13, but is of later design. "Nodding" aerial is mounted on a gantry, and may be trained on to any bearing, as required.

4. I.F.F. Equipment. Identification, Friend or Foe, is a means of interrogating a radio equipment mounted in friendly aircraft, which responds with a pre-arranged reply signal. Current I.F.F. equipment is the Mk.10.

5. Fixed Coil Display System. A requirement of the display system is that a number of P.P.I. console operators should be able to select the video output of any one of several search radars, for display purposes. To meet this requirement by using a rotating deflection coil on each P.P.I. c.r.t. would present very difficult technical problems. To overcome these problems, a system is used in which the c.r.t. deflection coils are fixed around the c.r.t. neck and are fed with two deflection waveforms which rise and fall in amplitude following the outline of a sine and cosine curve. The sine and cosine voltages are produced in a "resolver" unit from the information received from a "selsyn" which is turned by the rotating radar aerial (see Type 7 descriptive diagram). By using this system, rotating "machinery" is eliminated from the display colsoles, complicated selection switching is avoided, and there are a number of other technical advantages.

TRAINEE HANDOUT

RECEIVER CHAIN

1. T.R. Switch. Echo signals from the aerial array are connected via a rotating joint to the transmit receive switch. In the case of received signals this switch closes the path to the transmitter and opens the path to the receiver. The switch is an electronic device, consisting of two spark gaps connected across sections of transmission lines of a critical length, which are in turn connected across the main transmission lines.

R.F. Amplifying Unit.

2. Low Noise Amplifier. The first two valves in the receiver, V1 and V2 form a "cascode" circuit, which has the property of providing high amplification to the received signals, without introducing very much "noise". At the frequency to which this circuit is tuned, (approx 200 Mc/s) there is a tendency for the stage to be unstable, which means that it may cease to be an amplifier and break into self-oscillation. To prevent this happening the circuit is "neutralized". This simply means that a very small part of the amplified r.f. voltage is fed back to the input, in opposition to the normal input, to damp down any tendency to oscillate. The degree of neutralization is adjustable, and the setting of the neutralizing control forms part of the receiver tuning procedure.

3. Local Oscillator. This circuit produces oscillations at a frequency which is 45 Mc/s below the received signals. The type of oscillator circuit used is known as a Colpitts. The output frequency is adjustable and the control is set when carrying out the receiver tuning procedure.

4. Mixer. Both received signals and local oscillator output are connected to the mixer stage V3. The output frequency from V3 is the difference between the two input frequencies, i.e. 45 Mc/s.

I.F. Amplifier Unit.

5. Cascode Stage. The first two valves in the i.f. amplifier form part of a cascode circuit (See para 2). The first valve V1 is also neutralized, but there is no adjustment, as with the previous cascode circuit. The gain control is connected to V1.

6. I.F. Amplifier Stages. V3, V4 and V5 are three amplifiers forming part of a circuit which has two alternative bandwidths, either 1 Mc/s (narrow) or 3-5 Mc/s (wide). The wide bandwidth is not normally used in a Type 7 installation but is provided so that the i.f. amplifying unit may be used in other installations. Two 45 Mc/s outputs are taken from the amplifier unit, one to feed the information generator (see G.C.I. station diagram) and the other to feed signals to a built in monitor for test display purposes.

Monitor Display Facilities.

7. I.F. signals for test purposes, are fed to a small receiver unit, which is mounted on the trigger unit chassis. The receiver consists of a gain adjustment potentiometer, a detector and a video amplifier.

8. Video signals are then connected to a monitor which is built in to the transmitter rack. The video signals may be selected for monitor display, by a rotary selector switch,

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WARD LEONARD TURNING GEAR

1. Besides having facilities for a common trigger time for all transmitters on a G.C.I. Station it is necessary to have remote control facilities both for the transmitter and the turning gear.

2. The three phase supply is fed through a stop start circuit, push button controlled, either from the Well, or remotely, from the Radar Office into a three phase motor. This motor is mechanically coupled to a d.c. generator and also to a d.c. exciter.

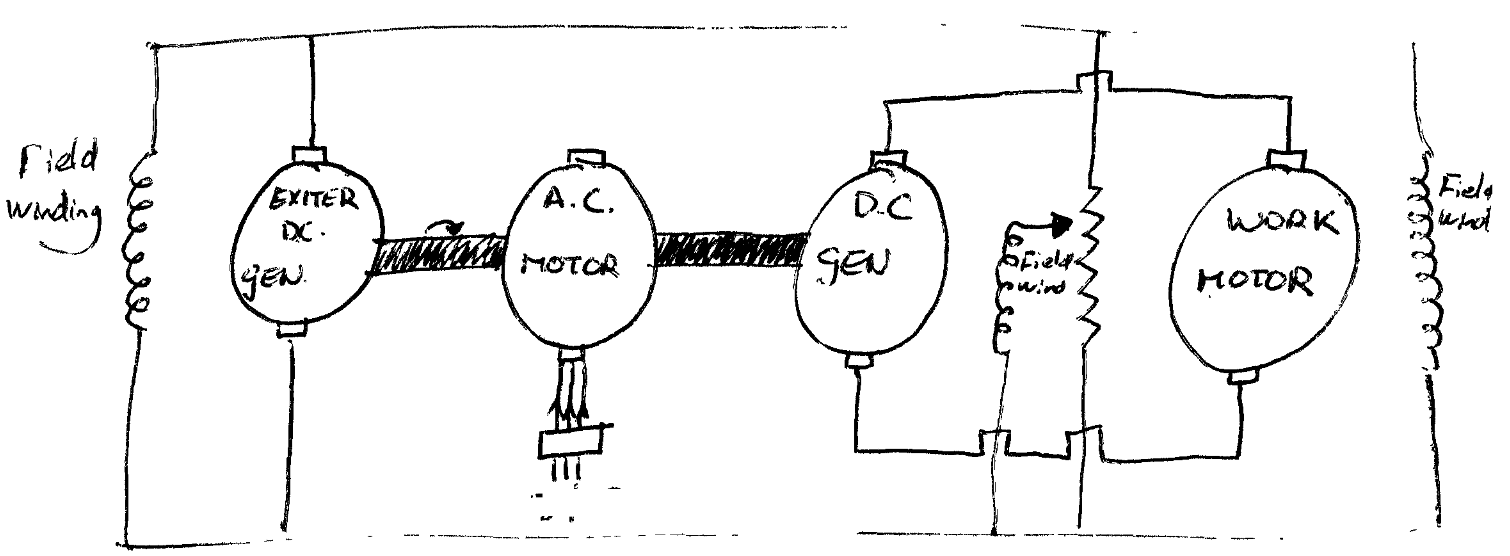
3. Considering the exciter first, it produces a d.c. output, which is kept constant in value by the Isenthal Regulator a device for switching resistance into and out of the circuit to compensate for any tendency for the output to rise or fall. One output of the exciter is fed, via a fuse, to the generator. While this output is constant in value it will maintain the Generator output constant. An ammeter gives a continued check of the current flowing in this circuit.

4. The input to the generator fold can be varied by altering the value of the series speed resistance. This resistance is motor operated by the speed adjust motor, a machine which is push button controlled and capable of turning in two directions, one to increase resistance (reduce output) and the other to decrease resistance (increase output).

5. Output of the Generator is used to supply the aerial turning motor armature via a fuse. The larger the input to this motor the faster it will turn the aerial, a voltmeter and ammeter in the circuit indicate circuit condition. A second fused output of the exciter is fed to the field of the aerial turning motor. It is a similar supply to that fed to the generator, but is not variable in value. A voltmeter and ammeter in the exciter circuit give an indication of the total exciter output.

6. A tachometer which received a input directly proportional to the serial turning speed. Gives a constant check upon that speed. Controls are usually set for an aerial rotation speed of 6 r.p.m.

7. The aerial is chain driven through a reduction gear by the aerial motor.



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MODULATOR SECTION (TRANSMITTER DIAGRAM)

1. The e.h.t. from Rectifier Type 26 is led through the charging choke and diode to the pulse forming network. The capacitors in this network charge up, and remain so, because when they are charged the diode acts as an open circuit preventing discharge.

2. Switch Unit Type 407 in the 'ON' position locks the doors of the transmitter. When it is turned to the 'OFF' position it earths the main smoothing capacitor via a limiting resistor and also connects the pulse forming network to Earth. Do not rely upon this switch to discharge all e.h.t. points, always use the earthing rod. The spark gap acts as an overload protection device.

3. 550 volts from Power Unit 877 feeds a low level pulse forming network, through a charging resistor. At a suitable time a trigger from the trigger unit is fed to the small thyration which interconnects to pulse forming network to the pulse transformer.

4. The Pulse transformer steps the voltage up to a suitable level to operate the main thyration, this in its turn interconnects the high voltage pulse forming network to the high voltage pulse transformer discharging the high voltage pulse forming network producing a pulse whose width is governed by the constants of the network.

5. The spark gap insulation breaks down for a correct transmission pulse, with little loss, but the resistance of the spark gap is too high for small transients in the charging cycle to break down the resistance of the spark gap.

6. The bursts of e.h.t. voltage cut the oscillator on so that it can produce the required pulses of radio frequency which are passed to the TR Switch.

7. A TR Switch allows a common aerial to be used for transmission and reception. It protects the receiver when the transmitter fires. Prevents the oscillator circuits from absorbing energy on reception.

8. Finally the rotating coupling allows energy from the stationery transmitter circuits to be transferred to the rotating aerial.

TYPE 7

SETTING UP MAXIMUM & MINIMUM

1. Control Unit 616.

   a. RV1 adjusts minimum setting.

   b. RV4 adjusts maximum setting.

2. Adjust Minimum

   a. Making sure that everything is switched off and is electrically dead. Connect Multimeter (AVO) to top two terminals of h.t. variac.

   b. Switch meter to a.c. 400V.

   c. Increase RV1 (CU616) to maximum resistance (maximum clockwise) switch on and run up. (Door open).

   d. Allow AVO reading to run up to about 100V.

   e. Press reset button, let it run down, note point at which RL/D energises (meter stops reading).

   f. Release h.t. reset and allow equipment to run up and at 40V try to catch the voltage by lifting RL/F.

   g. Adjust RV1 until variac down light comes on.

   h. Release RL/F and let it run up.

   j. Then press reset, let it run down, check that RL/D comes in at 40V.

3. Adjust Maximum.

   a. Increase h.t. set to position 10, turn RV4 to maximum clockwise.

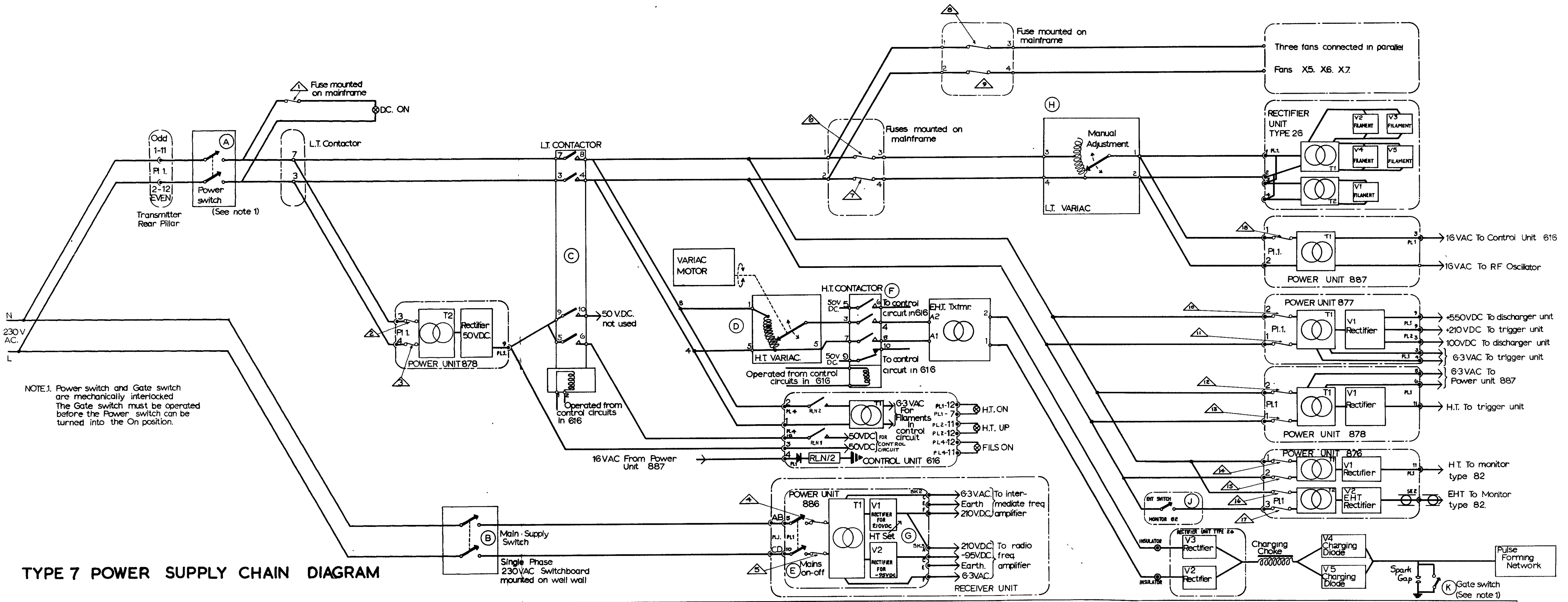
   b. Press h.t. reset and allow transmitter to run down and run up again.

   c. Note when h.t. up lamp lights.

   d. Adjust RV4 in small steps clockwise. Press reset and note new maximum reading.

   e. Repeat in small steps until 7kV is reached.

   f. Reduce power back to zero and switch off in the usual manner not forgetting to earth e.h.t. points.



TYPE 7 POWER SUPPLY CHAIN DIAGRAM

FUSES	1 Fuse1.500mAmp; 2 Fuse.2. 3Amp; 3 Fuse.1. 3Amp; 4 Fuse.1. 5Amp; 5 Fuse.1.5Amp; 6 Fuse.2. 15Amp; 7 Fuse.3. 15Amp; 8 Fuse.4 5Amp; 9 Fuse.5.5Amp; 10 Fuse25Amp; 18 Fuse.1. 3Amp; 11 Fuse 1 5 Amp; 12 Fuse.4. 5Amp; 13 Fuse.3. 5Amp; 14 Fuse.1.5Amp; 15 Fuse.3.5Amp; 16 Fuse 2. 5Amp; 17 Fuse.4. 5Amp
CONTROLS	A Main on/off switch mounted on switch unit 407 (See note 1); B Receiver Main supply switch; C LT Contactor; D H.T. Variac, motor driven; E Switch1 Mains on/off; F HT Contactor; G HT. Set; H L.T. Variac manual adjust; J EHT Switch; K Gate switch (See note 1)

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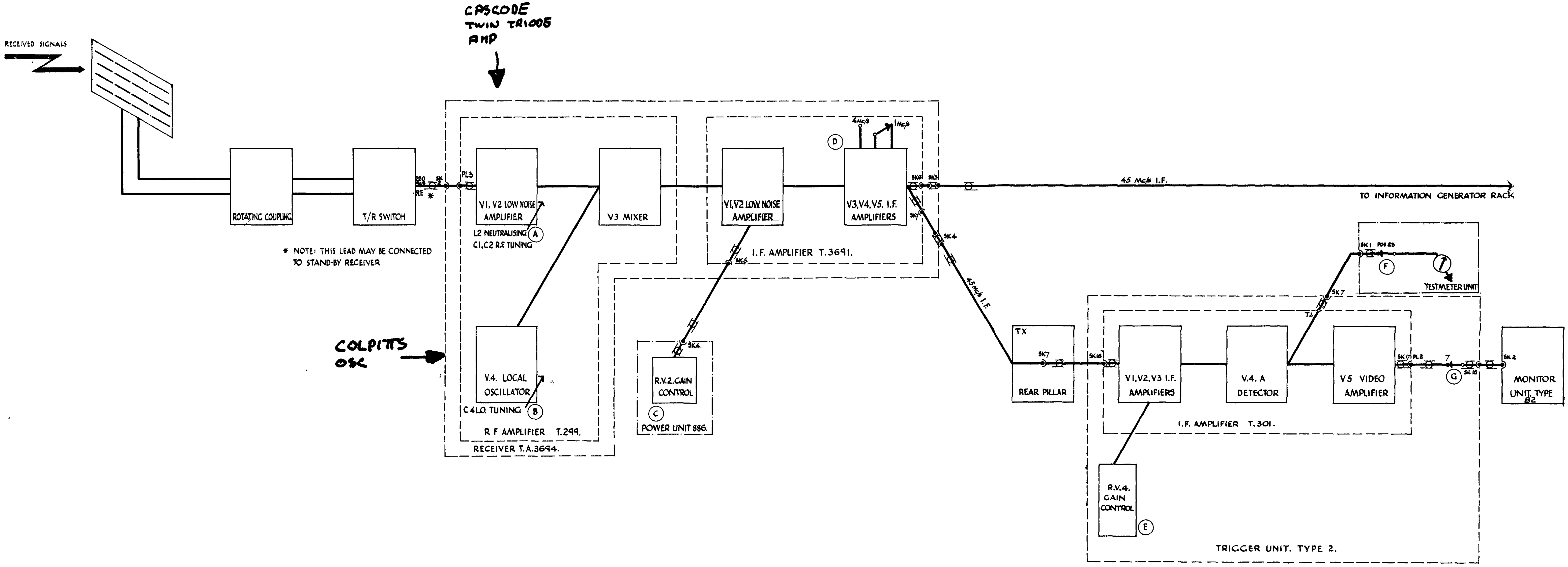

RADAR TYPE 7 RECEIVER UNIT.

D720

CONTROLS	(A) MANUAL NEUTRALIZING & R.F. TUNING. (B) MANUAL L.O. TUNING	(C) R.V.2. MANUAL GAIN CONTROL	(D) SWITCH 1, BANDWIDTH SWITCH, WHICH IS ALWAYS IN THE NARROW BANDWIDTH ON TYPE 7.	(E) R.V.4. MANUAL GAIN CONTROL	(F) S1. ON TESTMETER UNIT
TEST POINTS					(G) MONITOR SELECTOR SWITCH S.2.

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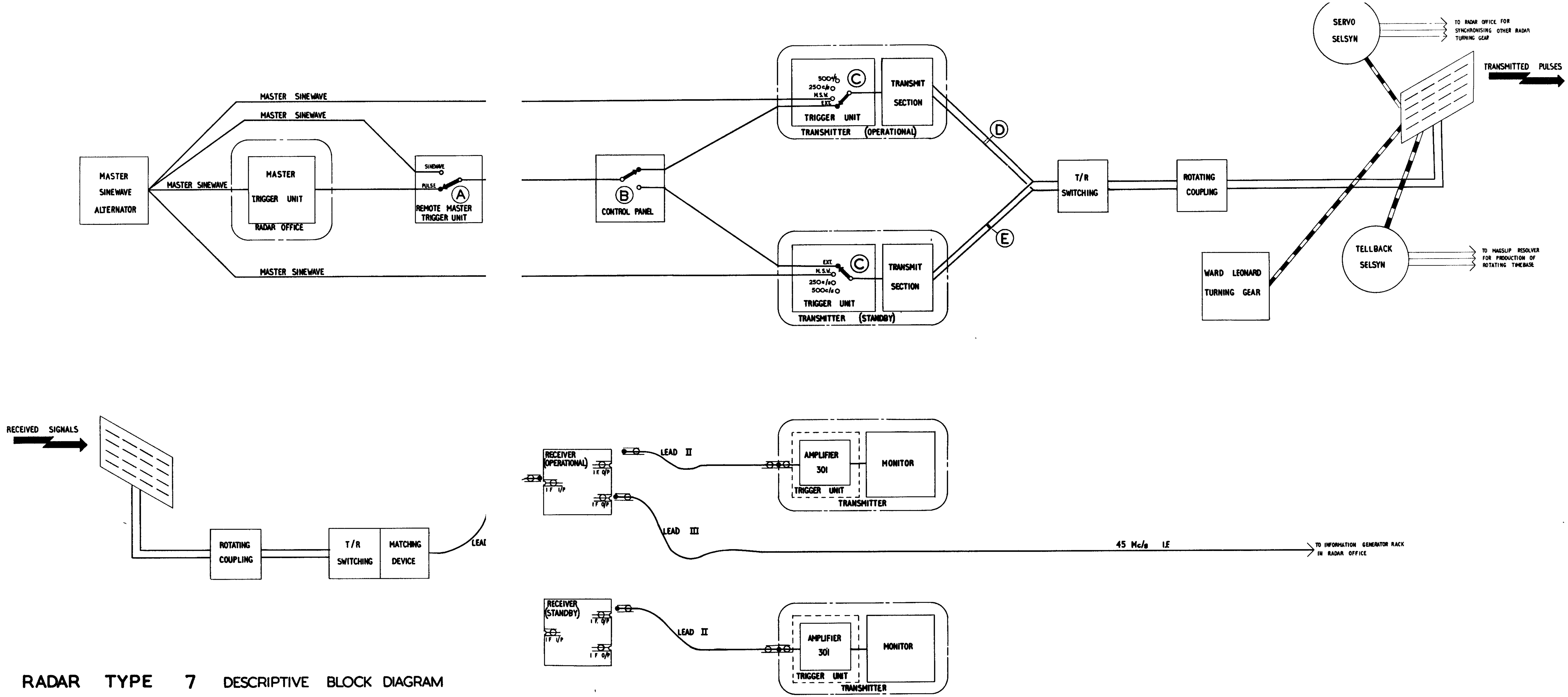

RADAR TYPE 7 DESCRIPTIVE BLOCK DIAGRAM

D 702

CONTROLS	(A) SWITC SINEWAVE/PULSE) (B) TX. CHANGEOVER SWITCH (C) TRIGGER SELECTOR SWITCH (D) WHEN CHANGING TO STANDBY, TX. LINK (E) MUST BE CHANGED TO POSITION (D)
NOTE	TO CHANGE TO STANDBY RECEIVER, LEAD I MUST BE CHANGED TO THE R RECEIVER LEADS II CONNECT THE OPERATIONAL RECEIVER TO OPERATIONAL MONITOR LEAD III MUST BE CONNECTED TO THE OPERATIONAL RECEIVER

D LOC850 461399 S.W. 3 65

TRIGGER CHAIN

Introduction.

1. The trigger output pulses from the trigger chain may be derived from one of several different sources. These are:

a. An external trigger pulse. (This is the normal method of operation, and the pulse is supplied by a master trigger unit, on a G.C.I. station).

b. A 250 c/s sine wave, generated by an alternator which forms part of a Type 7 installation.

c. From an internal free-running oscillator. This source is normally only used for test purposes).

2. Whichever source is selected, the trigger chain will produce the following outputs, all locked in time to the input waveform:

a. Trigger pulses for the modulator, each one of 6 microseconds duration and approx 125V amplitude.

b. Trigger pulses for the monitor, each one of 9 microseconds duration and approx 110V amplitude. These pulses occur 9 microseconds before the trigger pulses for the modulator and are therefore called pre-triggers. The reason for triggering the monitor before the modulator, is to ensure that waveforme started by the main trigger can be displayed on the monitor timebase.

c. Pre-trigger pulses for external test equipment. These triggers also occur 9 microseconds before the modulator trigger, for similar reasons to b. above.

3. External.

a. With the trigger selector switch in the external position, a series of pulses from the master trigger unit are fed into socket 5. These pulses "fire" a square wave generator circuit, which produces square pulses of 10 microseconds duration, one for each input trigger pulse. The 10 microseconds pulses are applied to a "ringing" circuit, which, for each trigger produces a train of oscillations. These oscillations are damped away between trigger pulses, since only the first half-cycle is required. The first half-cycle is 9 microseconds wide and this 9 microseconds pulse is shaped and used to trigger any external test equipment, from socket 3. A similar 9 microseconds pulse from the same ringing circuit, is fed into two more amplifiers and then used to trigger the monitoring unit, from socket 1.

b. A second ringing circuit is used to produce the main trigger from socket 2, which is used to "fire" the modulator circuits. A 9 microseconds pulse, from the first ringing circuit, is shaped and amplified and fed to the second ringing circuit. The second circuit is so arranged that it "rings" at the end of the 9 microseconds pulse period. It then produces a damped train of oscillations, each half-cycle of 6 microseconds duration. The first half-cycle only is used, and after being shaped is fed via a cathode follower (a matching stage) to socket 2. This pulse is therefore delayed by 9 microseconds on the trigger pulses from sockets 1 and 3. (see page 2 of this handout).

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4. Master Sine Wave. In this case a 250 c/s sine wave from the master sine wave alternator is fed via the trigger selector switch to V13. This valve and associated circuit clips off the upper and lower extremities of the sine wave, so that it resembles a square waveform. The amount clipped from the waveform is determined by the setting of RV2, the phasing control. This waveform is fed to V14, which is a pulse generator. V14 and its associated circuit produce a series of sharp pulses, one for each cycle of the master sine wave. These pulses are amplified by one section of V15, (the other section is inoperative on m.s.w. operation) and fed to the ringing circuit. From this point the remainder of the chain operates as for "external operation". (see para 3 a of this handout).

5. Test Trigger (500 c/s or 250 c/s.

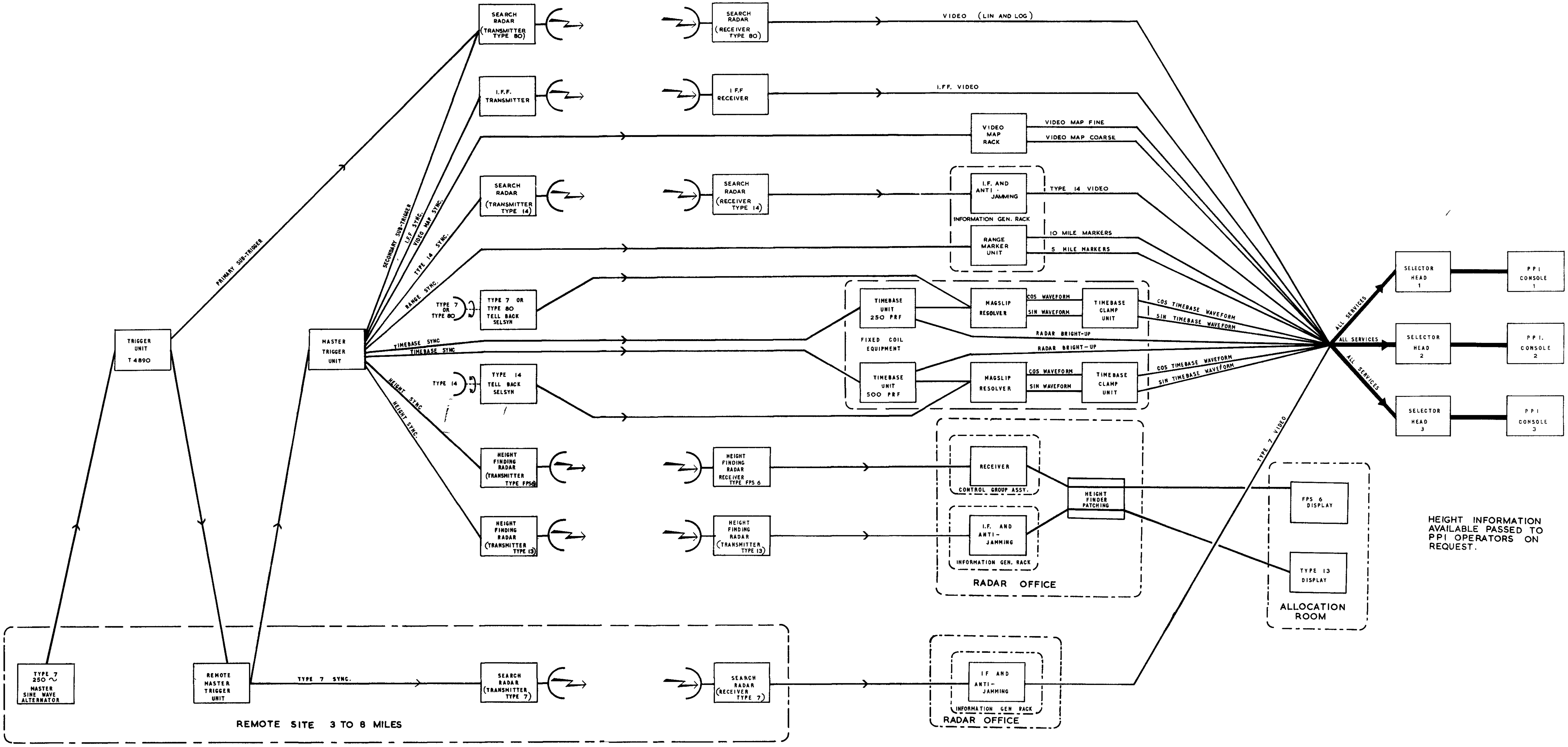
a. This facility is not normally used with a Type 7 installation and a switch marked 15/7 renders the circuits inoperative, when the "7" position is selected. If the 15 position is selected, then the trigger unit may be used in a Type 15 installation, which saves duplication of types of unit.

b. An explanation of test trigger is included although the use of this facility is limited on operational installations.

c. A free-running 500 kc/s oscillator provides sine waves which are fed to V13. (See para 4 of this handout). With the trigger selector switched to 500 c/s the remainder of the circuit operates as for m.s.w. operation. In the 250 c/s position of the switch, 15a ceases to act as an amplifier and works in conjunction with V15b to form a multivibrator circuit. In this application the circuit produces a pulse output for each two incoming pulses. It therefore effectively divides the 500 c/s input pulses by two, and produces a 250 c/s output. The remainder of the circuit works as for "external" operation. (See para 3 of this handout).

d. It should be noted that the 500 c/s test facility is no longer required, since normal Type 7 operation is at 250 c/s only, and later marks of the equipment include a modified version of the original trigger unit, which has no 500 c/s test facility.

6. Valves V10 to V12 inclusive, form a square wave generator circuit. This is triggered by the selected trigger source and produces a square wave, which has a variable duration between 15 and 25 microseconds. The duration is adjustable by control RV1. This square wave was originally intended to effectively switch off the associated receiver during the period of the transmitted pulse. The facility is not required on a Type 7 installation, and the output socket SK4 is not connected.



BASIC G.C.I. STATION SYSTEM DIAGRAM

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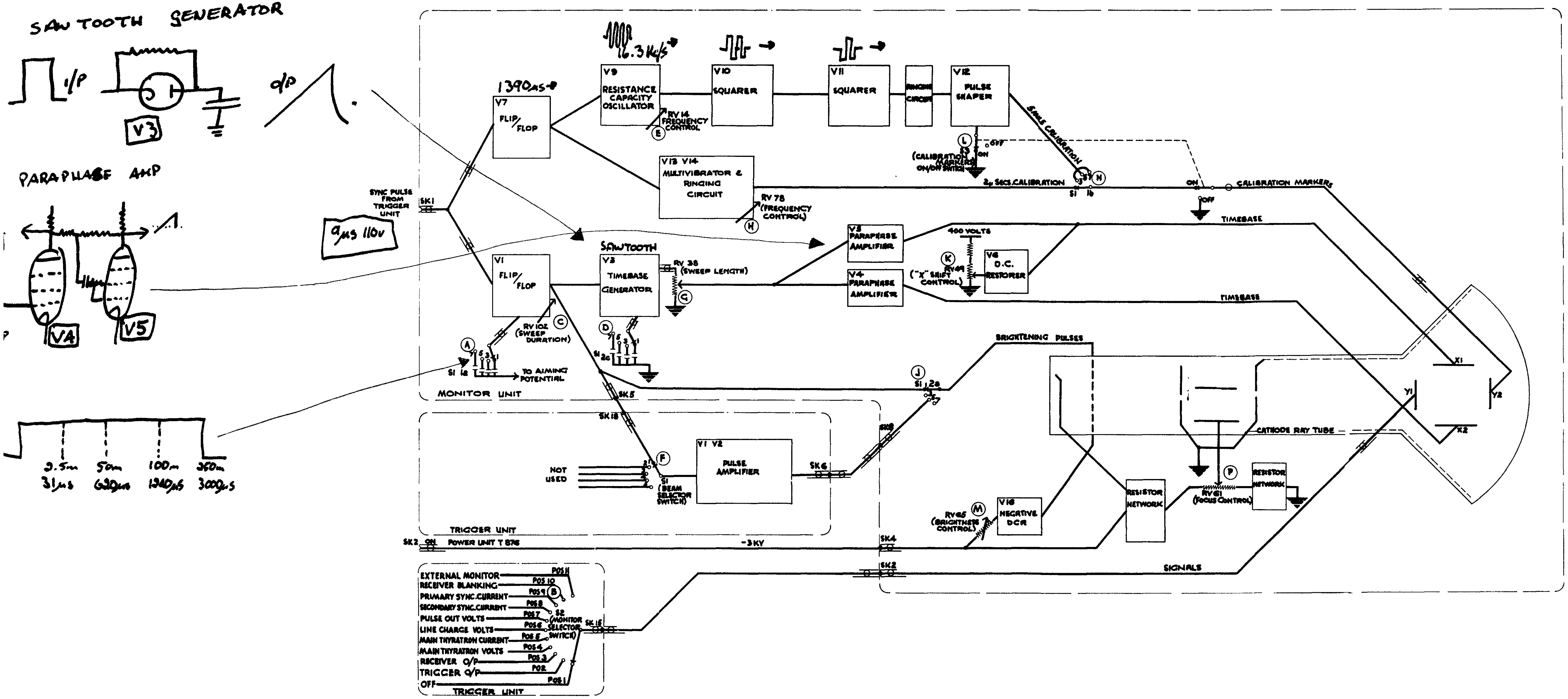
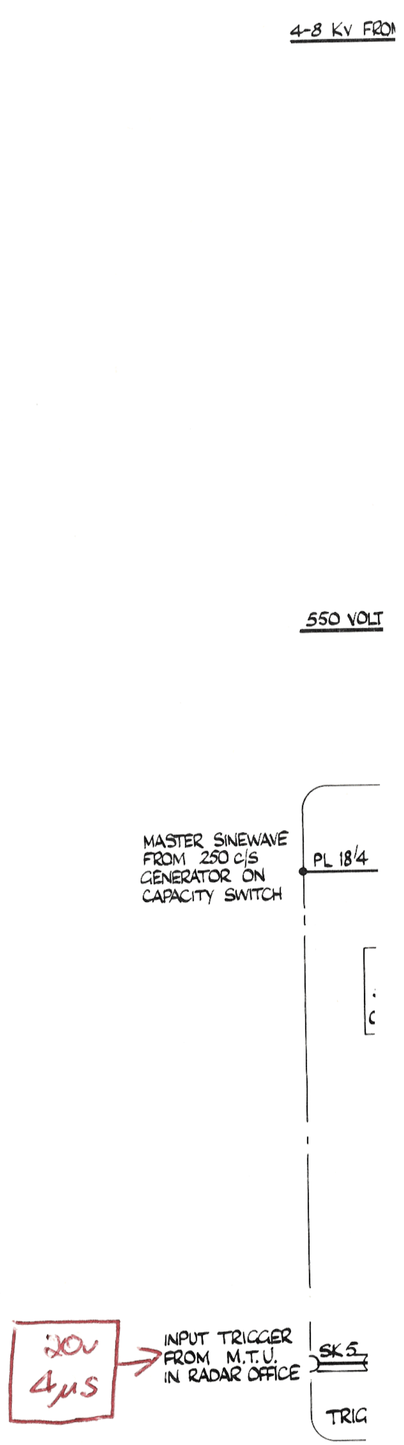
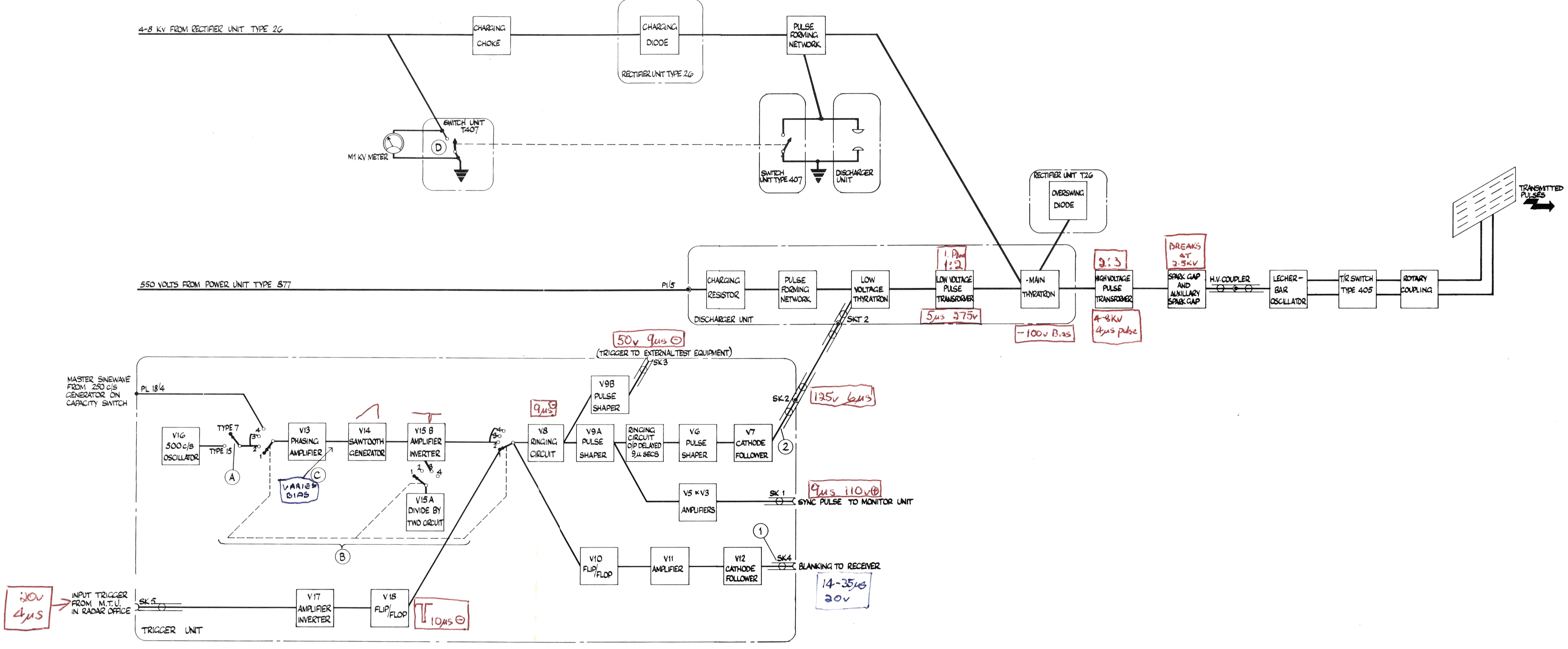


MONITOR CHAIN

D. 725.

CONTROLS	(A) SWITCH 1 (MONITOR UNIT) RANGE CALIBRATION SWITCH. (G) RV 38 SWEEP LENGTH CONTROL. (J) SWITCH 1 (MONITOR UNIT) RANGE CALIBRATION SWITCH. (N) SWITCH 1 (MONITOR UNIT) RANGE CALIBRATION SWITCH. (B) SWITCH 2 MONITOR SELECTOR SWITCH. (H) RV 78 FREQUENCY CONTROL. (K) RV 49 "X" SHIFT CONTROL. (P) RV61 FOCUS CONTROL. (C) RV 102 SWEEP DURATION. (F) SWITCH 1 (TRIGGER UNIT) BEAM SELECTOR SWITCH. (L) SWITCH 3 CALIBRATION MARKERS ON/OFF SWITCH. (D) SWITCH 1 (MONITOR UNIT) RANGE CALIBRATION SWITCH. (M) RV 65 BRIGHTNESS CONTROL. (E) RV 14 FREQUENCY CONTROL.
NOTE	SWITCH 1 (MONITOR UNIT) IS THE RANGE CALIBRATION SWITCH. THE WAFERS 1a. 1b. 2a AND 2c ARE GANGED TOGETHER.





CONTROLS	(A) SWITCH 4 FOR TYPE 7 EXTERNAL TRIGGER SELECTED FOR TYPE 15 500 c/s SELECTED (B) SWITCH 3 TRIGGER SELECTOR SWITCH POSITION 1 EXTERNAL, POSITION 2 500 c/s, POSITION 3 250 c/s, POSITION 4 MASTER SINEWAVE (C) RV2 PHASING CONTROL (D) GATE SWITCH
TEST POINTS	(1) AND (2) AVAILABLE VIA SKT 15 ON TRIGGER UNIT VIA POSITIONS AND RESPECTIVELY ON MONITOR SELECTOR SWITCH TO MONITOR TYPE 82 (FOR DETAILS REFER MONITOR CHAIN DIAGRAM)

TYPE 7 TRANSMITTER CHAIN DIAGRAM

D721

TRAINEE HANDOUT CR 3303/47

MONITOR CHAIN

1. a. The Monitor Type 82 is used to check waveforms of the transmitter and receiver at various selected points.

b. Sync pulse from the Trigger Unit is fed to V1 a flip flop, a square wave generater producing four differert widths of square waves to cover the four ranges of 2.5M, 50M, 100M and 250M.

c. One output goes to V3 a time base generator also with four ranges. Its output is fed to V4 and V5 a paraphase amplifier which gives balanced deflection of the time base voltages to the X plates.

d. Another output of V1 is fed as bright up to the grid of the C.R.T., either direct, via S1 or to the trigger unit via S1 the beam selector switch, and two stages of amplification, back into the monitor and via the range calibration switch to the c.r.t. grid to give extra intensity of bright up when required.

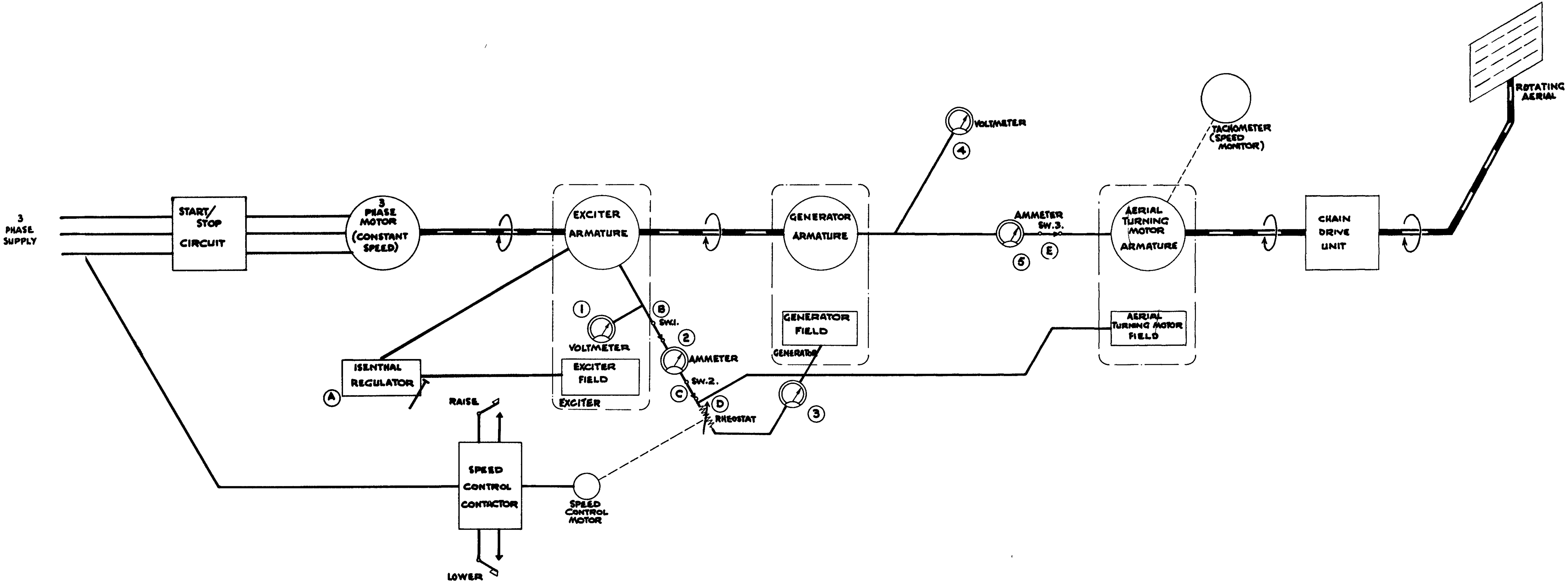
e. The sync pulse from the trigger unit is also fed to V7 another flip flop producing square waves.

f. V7 has two outputs one going to V9 10 11 and 12 which produces 5 mile calibration markers. V9 a resistance capacity oscillator whose frequency can be varied by RV14. V10 V11 two squaring circuits shaping the waveform to the desired shape, followed by a ringing circuit which produces the pips needed for calibration markers, finally V12 sharpens them up into a suitable form for application to the c.r.t. ½ plate via the range calibration switch on positions 3 5 and 7.

g. The other output of V7 is fed into another shaping and ringing circuit to produce 2 micro seconds range marks for use of the range of 2.5M. RV18 providing a control of frequency. This output will be fed to the Y2 plate when the range calibration switch is in position 1.

h. The eleven position Monitor Selector Switch has an off position, nine positions to monitor waveforms at selected points in the transmitter and receiver. A final position can be used as an external monitor, this facility is seldom used.

j. -3kV is fed from Power Unit 876 through a resistor chain to the various electrodes of the c.r.t. The resistor chain dropping the voltage to a suitable level for the different electrodes.

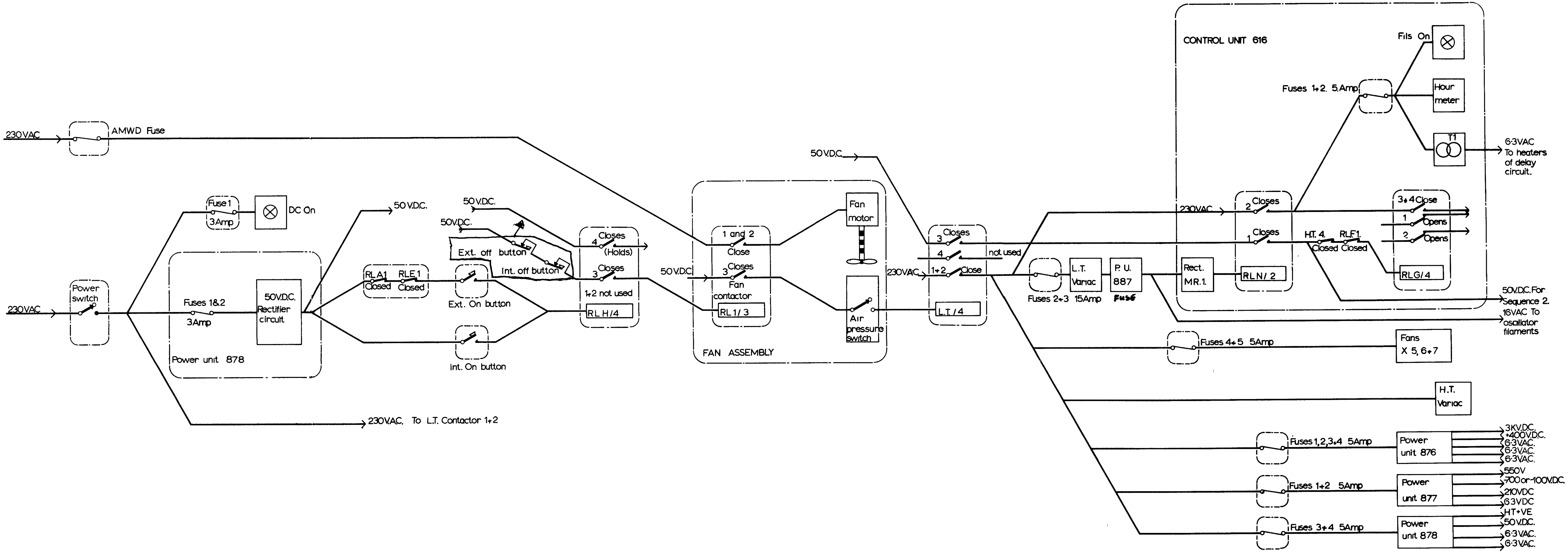


CONTROLS	(A) REGULATOR LEVEL ADJUSTMENT. (B) SWITCH 1. 230 VOLTS D.C. ON/OFF SWITCH FOR EXCITER FIELD. (E) SWITCH 3. SAFETY SWITCH. (C) SWITCH 2. GENERATOR FIELD ON/OFF SWITCH. (D) SPEED CONTROL RHEOSTAT.
METERS	(1) EXCITER VOLTAGE METER 0-300 VOLTS. (3) GENERATOR FIELD CURRENT METER 0-3 AMPS. (4) GENERATOR ARMATURE VOLTAGE METER 0-300 VOLTS. (2) AERIAL TURNING MOTOR FIELD CURRENT METER 0-12 AMPS. (5) GENERATOR ARMATURE CURRENT METER 0-100 AMPS.

D LOC858 4650101 S.W 4/45

WARD-LEONARD SYSTEM DESCRIPTIVE DIAGRAM.

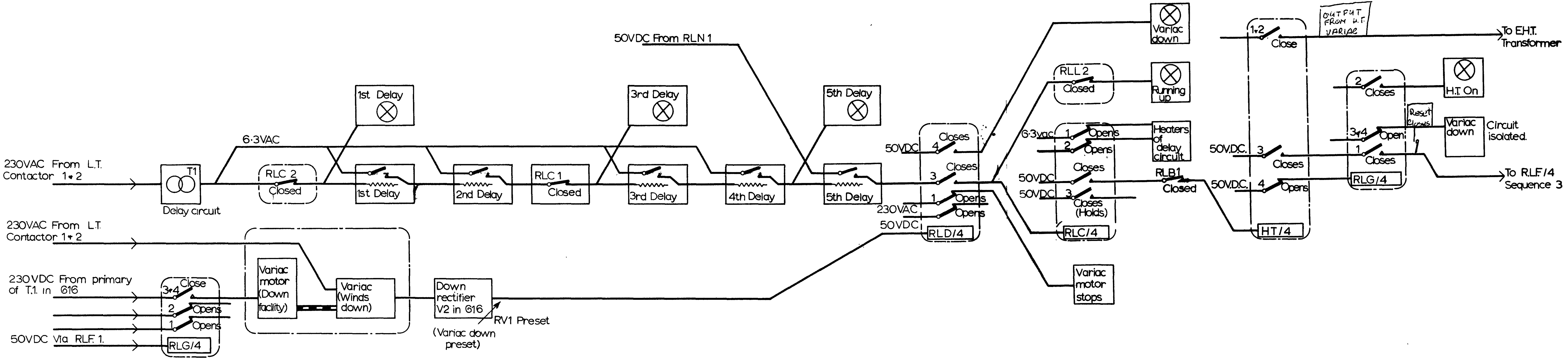
D. 726



RADAR TYPE 7 SEQUENCE 1.

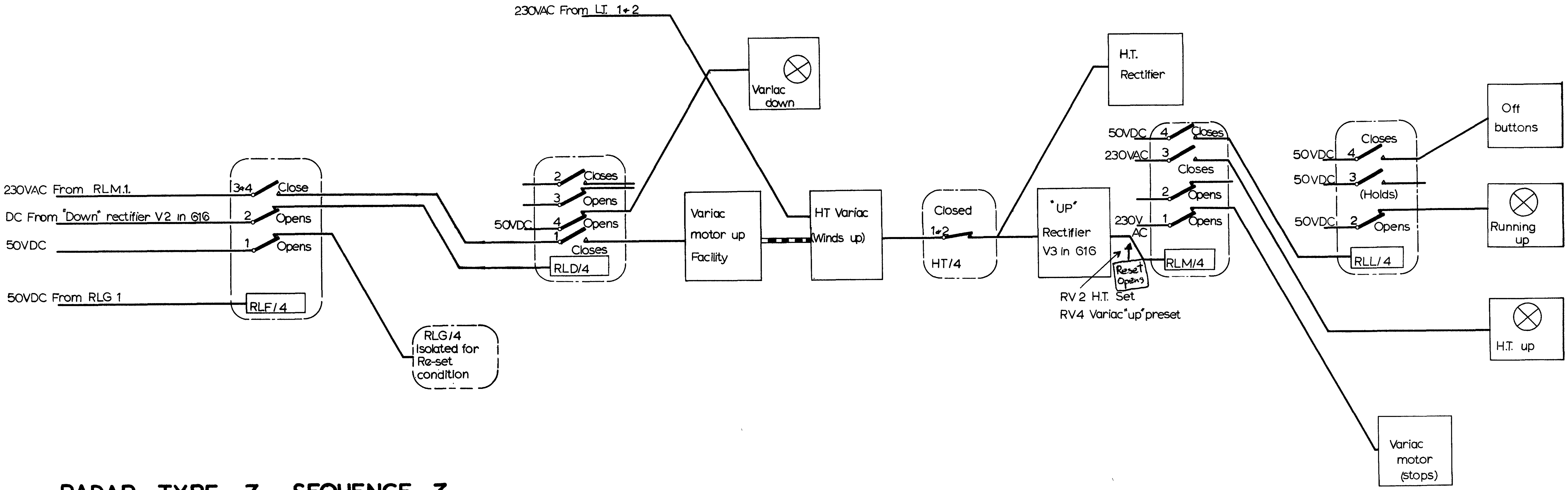
D.LOC850 461399 S.W. 3/65

D 722



RADAR TYPE 7 SEQUENCE 2

D.LOC850 461399 S.W. 3/65



RADAR TYPE 7 SEQUENCE 3

D 724

TRAINEE HANDOUT

TYPE 7
REMOVAL AND REPLACEMENT OF R.F. OSCILLATOR VALVE

1. Loosen l.t. connection, take connection to one side. Remove two nuts securing cathode lecher, take lecher off completely.

2. Screw valve out in normal manner, anticlockwise, remove valve.

3. Remove adapter from bottom of defective valve and screw it on to the bottom of replacement valve.

4. Replace valve, cathode lecher, securing nuts and l.t. connection in that order.

5. In actual practice both valves would have to be replaced as they are supplied in matched pairs.

TRAINEE HANDOUT

CR 3303/30

TYPE 7
SETTING UP TRANSMITTER TO DESIRED FREQUENCY (200 MC/S)

1. Connect pulse forming network output to oscillators.

2. Connect oscillator heaters.

3. Connect supply to dummy load (plug on top of Tx).

4. Remove shorting plug in SK2 at back of transmitter and connect Fan Assembly Type 26.

5. Set the perspex scale on front of right hand door to 4.5, using the Incremental frequency control.

6. From the Spot frequency table on the right hand door (inside) obtain settings of the various oscillator parts for the required frequency of 200 mc/s.

7. The cathode shorting bar is moved until the tip of the red pointer on it points to the required value on the vertical scale on the lecher.

8. The anode shorting bar is moved until the horizontal hairline on the perspex and its reflection in the lecher coincide with the required value on the vertical scale on the lecher.

9. The reading for the trombone is taken from the lower end of the upper part, the scale being on the lower part or inner trombone. The bolt is slackened off and the inner trombone slid along the bar until the bolt corresponds with the hole in the bar which gives the nearest value to the one required on the scale. The bolt is then tightened and final adjustment to the required frequency as checked by Wavemeter Type W1649 is carried out using the incremental frequency control on the front of the right hand door. This control is then clamped by the screw at the side.

10. Run up in the normal manner. When 1st delay light comes on, adjust set zero on output meter to zero, repeat every two minutes until fifth delay has come on.

11. It is now necessary to check and adjust the output frequency with the crystal controlled Wavemeter 1649. Two scales, the inner red scale is the one to be used.

   a. Plug main input plug into wall socket.

   b. Lift cover and take out flex leads and connect - and + terminals on top to - and + terminals in the front bottom. This connects 6V heater supply.

   c. Zero incremental dial.

   d. Internal aerial down.

   e. Switch on at wall, and on Wavemeter Power Unit Type 633 at bottom.

   f. Switch to ON position on wavemeter. Red light comes on.

   g. Leave for 20 minutes.

/h

h. Connect headphones into phone jack, switch from 'ON' position to 'Crystal' position, making sure that incremental dial is still at zero. Tune for 200 Mc/s dip. Lock scale making sure that scale is not moved.

j. Switch back to 'ON' raise aerial, with incremental frequency control on transmitter tune for dip in phone signals. <u>The tuning is extremely sharp</u>.

k. The transmitter is now correctly set up at the chosen frequency of 200 Mc/s.

TYPE 7 Tx

1. Security Check.

a. With earthing rod, earth the 5 e.h.t. points inside transmitter.

b. Check that all plugs and valve top caps are secure.

c. Connect pulse forming network output to dummy load.

d. Disconnect heaters to oscillator valves.

e. Remove supply to dummy load (on top of transmitter).

f. Trigger Unit Type 2, ensure that SW3 is switched to external, and that SW2, Monitor selector switch is on position 2.

g. H.T. setting on Control Unit 616 to zero.

h. All units fully in and locked.

j. Ensure that correct plugs in at PL1 and SK2 on back of transmitter, SK2 blank at this stage, Fan Assembly Type 26 which cools oscillator valves not required at this stage so is switched off.

k. Switch on wall switch.

2. Running Up Transmitter.

a. Meter switch to 50 V d.c.

b. Gate switch and power switch to on position.

c. Check DC On light comes on GREEN.

d. Check that 50 V reads, reading will depend upon which transmitter is in use.

e. Press on button, Fils On lamp lights.

f. 1st Delay light comes on.

g. Set Monitor to 2.5M ready for when waveforms come on.

h. Variac runs down and Variac Rundown lamp comes on.

j. After 2 minutes approximately 2nd Delay light (3rd Delay) comes on.

k. After another 3 minutes, 3rd Delay light (5th Delay) comes on. This lamp will stay on for about 1 minute, then h.t. contactor makes and equipment will run up.

l. Running Up and H.T. On lamp should light.

m. After run up to maximum position, with H.T. Set at minimum H.T. Up

n. Turn H.T. Set to position 10, press H.T. Reset (H.T. Up lamp goes out). Note the maximum e.h.t. it will rise to, this should be 7kV, when reached H.T. Up lamp comes back on. If the desired voltage is not reached adjustment will have to be made in C.U. 616.

3. Check Waveforms.

a. Position 2. — Trigger O/P: Taken from V7 cathode in trigger unit.

b. Position 3. No waveform unless receiver in circuit.

c. Position 4. — Main Thyratron Volts: taken from large thyratron grid.

d. Position 5. — Main Thyratron: taken from large thyratron cathode.

e. Position 6. — Line Change Volts: taken from capacity voltage divider across pulse forming network.

f. Position 7. — Voltage Output Pulse: taken from capacity voltage divider across large pulse transformer primary.

g. Position 8. — Secondary Sync Current: taken from secondary of large pulse transformer.

h. Position 9. — Primary Sync Current: taken from primary of large pulse transformer.

j. Position 10. Rx Blanking taken from V12 cathode on trigger unit.

k. Position 11. Can be used with wander lead using monitor as a scope.

4. Check Various Outputs. Using meter, switch and calibration on test meter unit (left hand door).

a. Supply volts.

b. Heater volts to oscillator section.

c. Trigger bias.

d. Minimum H.T. Current.

e. 50 V d.c.

f. General power unit output.

g. Monitor unit output.

h. I/P to discharger unit.

j. Trigger unit.

5. To Run Down.

a. Press and keep pressed H.T. Reset button. Reduce H.T. SET to minimum.

b. When e.h.t. down to minimum, press H.T. OFF button without delay or else starts running up again.

c. Power on/off switch to OFF.

d. Gate Switch to OFF.

e. Open doors.

f. With earthing rod, earth, I/P to pulse transformer, main smoothing condenser, charging diode cathode, and O/P of main rectifiers.

g. Remember that other power units have condenses in them which will hold a charge, so leave power units for 1 minute before handling.

CR 3303/43

TRAINEE HANDOUT

NOISE CHECK

1. Connect output of Noise Generator Type 1 to input of receiver. Switch on both receiver, transmitter and noise generator. Allow 5 minutes to warm up.

2. Test Set 4341 switched to zero, noise generator range switch to off and output level to minimum.

3. Switch to 2nd detector current with built in test meter switch on transmitter.

4. With gain control on Trigger Unit Type 2 (on transmitter) adjust for any convenient level, say 200, Note Reading obtained.

5. Set Test Set 4341 to 3 db position.

6. Note that test meter reading falls.

7. Switch noise generator to o/5 position and with output level control of noise generator increase level of reading of built in test meter to original level. This may necessitate moving from o/5 to 0/10 position depending upon whether original level can be reached.

8. Take note of noise figure presented on noise factor meter. This figure should be greater than 6 and not less than 4.

LOC/TLS/93/43/65

RX TUNING

1. CT53, Function Switch to C.W. Frequency range to 6 set spot frequency to 200 Mc/s (Transmitter range 190/210 Mc/s). Use graph making sure that correct one is used (check numbers of chart and CT53).

2. Switch on CT53 and receiver.

3. Set carrier to 60 micro amps, this value should be maintained throughout this test.

4. On receiver power unit select position 5 on meter switch and if necessary use H.T.SET. Control to adjust reading to 210V.

5. Disconnect sockets 3 and 4 (right hand side of RX) and terminate SK3 with a terminating unit Type 34. Connect Test Set Type 4341. Switched to DET on SK4 of receiver.

6. Connect Multimeter Type 1 (AVO) on 300/50 micro amps range across Test Set 4341 output terminals.

7. Starting at 1 MV range on CT53 attenuator and multiplier at 1. Adjust attenuator controls to give 2/3 full scale deflection on 300 micro amps range. Change to 50 micro amps range and repeat.

8. Unlock tuning capacitors and tune in the order C4, C3, C2, C1 for maximum reading on AVO. Keeping check that CT53 output remains at 60 micro amps. It will be necessary to alter attenuation on CT53 as receiver is brought into tune.

9. Repeat 8 for final tuning.

10. Tighten locking nuts on tuning capacitors, taking care not to alter settings.

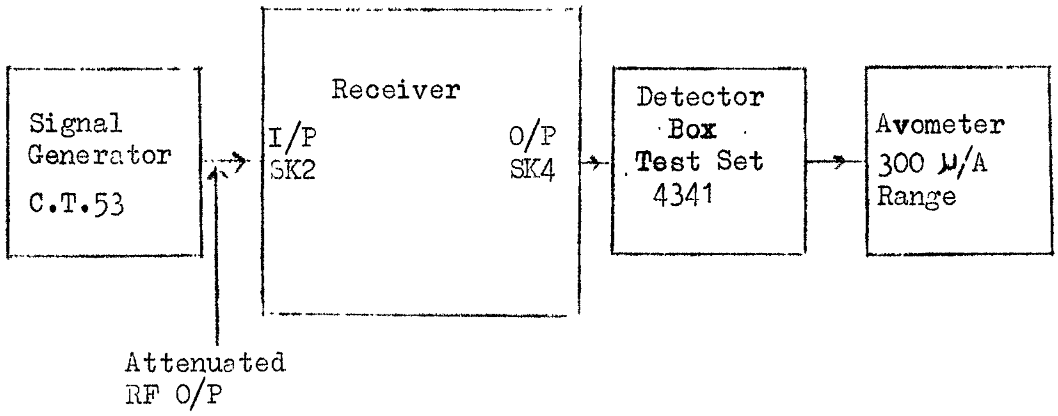
11. Switch off h.t. to V1. Reduce attenuation on CT53 until a large reading is obtained.

12. Adjust neutralizing coil for minimum reading on AVO. This may entail readjustment of attenuator in CT53.

13. Switch h.t. back on to V1.

TRAINEE HANDOUT

RECEIVER TUNING



RECEIVER NOISE CHECK