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Chapter 22

RAM AIR TURBINE SCOOP SIGNALLING UNIT, ULTRA, TYPE A740/1

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LEADING PARTICULARS

Ram air turbine scoop signalling unit, Ultra, Type A740/1	**Ref. No. 5UC/6585**
Output at datum r.p.m. (*to* 180 *ohm relay*)	35*mA*
Input voltage	115*V*, 400 *c/s single phase*
R.p.m. datum	5000 *r.p.m.*
R.p.m. datum trim variation (*using RV*101)	± 200 *r.p.m.*
Amplifier standing current	4*mA*
Overall dimensions	6·6 *in.* × 4·3 *in.* × 4·3 *in.*
Weight	3·5 lb

Introduction

1. The ram air turbines scoop signalling unit, Ultra, Type A740/1 (*fig.* 1), is a magnetic amplifier unit, used to control the extending mechanism of an aircraft's air scoops. When extended, the air scoops provide a supply of ram air for an electrical turbo-generator which maintains the primary electrical supply. In the event of the aircraft engine speed falling below a datum level (approximately 5000 r.p.m.) the scoops are extended, and the ram air turbine automatically provides a standby electrical supply for the flying control motors and other essential services.

2. The engine speed sensing element is a tacho-generator providing a frequency signal proportional to engine speed. The output from the scoop signalling unit is connected to an external relay which controls the extending mechanism. At engine speeds above the datum level the output is at a maximum, so that the relay is kept energized and the air scoops are retained in the stowed position. When engine speed falls below datum, amplifier output falls to a minimum, thereby releasing the control relay and causing the air scoops to extend. The principles and applications of magnetic amplifiers are described in A.P.4343, Vol. 1, Sect. 1, Chap. 3.

DESCRIPTION

3. The transductors and all associated components are fitted to a chassis on one side of a base-plate and are enclosed in a cylindrical metal casing. The chassis is screwed to the base-plate and consists of a rigid framework, to which the two transductors are mounted in tandem, and which also serves as a mounting

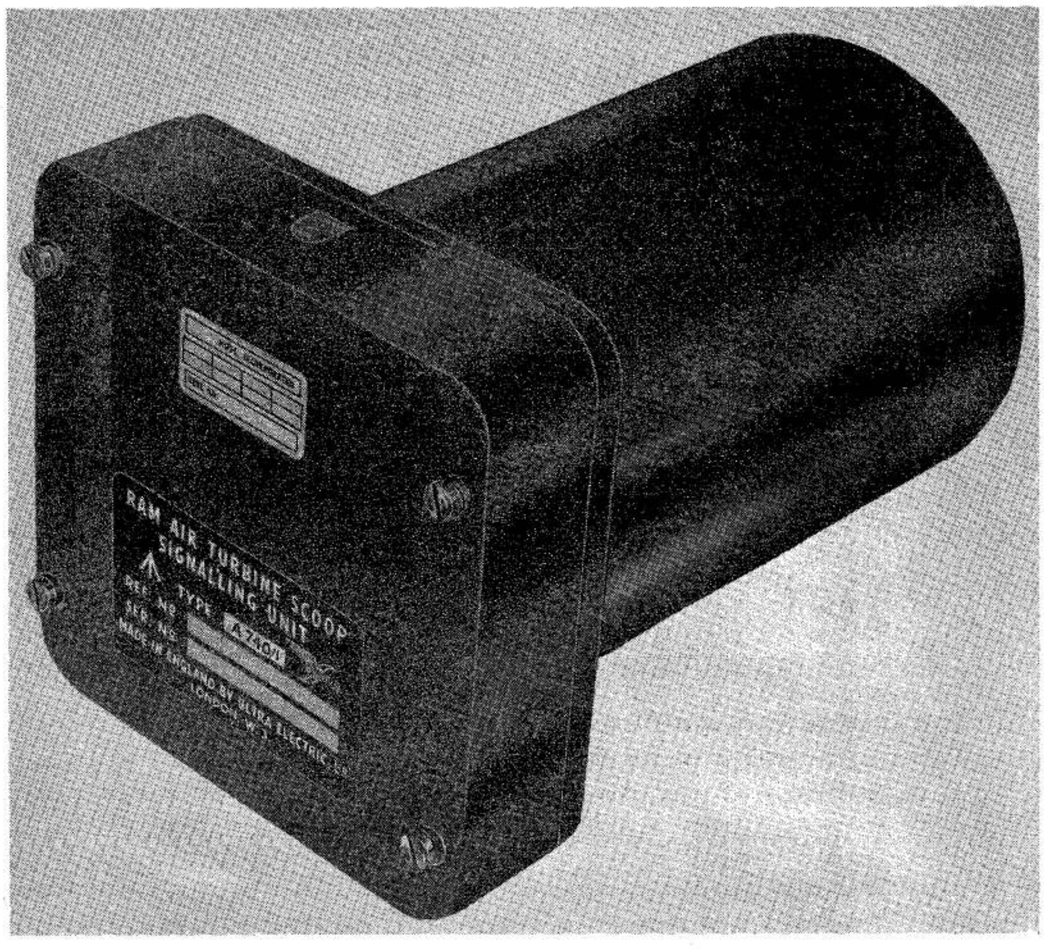

Fig. 1. Ram air turbine scoop signalling unit, Ultra, Type A740/1

for the terminal boards. The casing is sealed at its junction with the base-plate by means of a sealing gasket, thus forming an airtight, moisture-proof joint.

4. All the leads are brought through the base-plate via seven moisture-proof seals, and are taken to an eight-way terminal block illustrated in fig. 4. The side of the base-plate carrying the terminal block is enclosed by a removable protective cover. The unit is mounted by means of two mounting clamp assemblies which fit over the barrel of the casing. The assembly and wiring layout of the unit is shown in fig. 2.

(2) RV104—gain control. This controls the gain of the unit by positive voltage feedback over both stages of amplification (transductors 1 and 2).

(3) RV102—bias control. This controls the bias of both stages (transductors 1 and 2).

(4) RV103—balance control. This controls the balance of transductor 1 for no signal output when there is zero input from the discriminator.

7. A tacho-generator forms the sensing element, and feeds an a.c. frequency signal

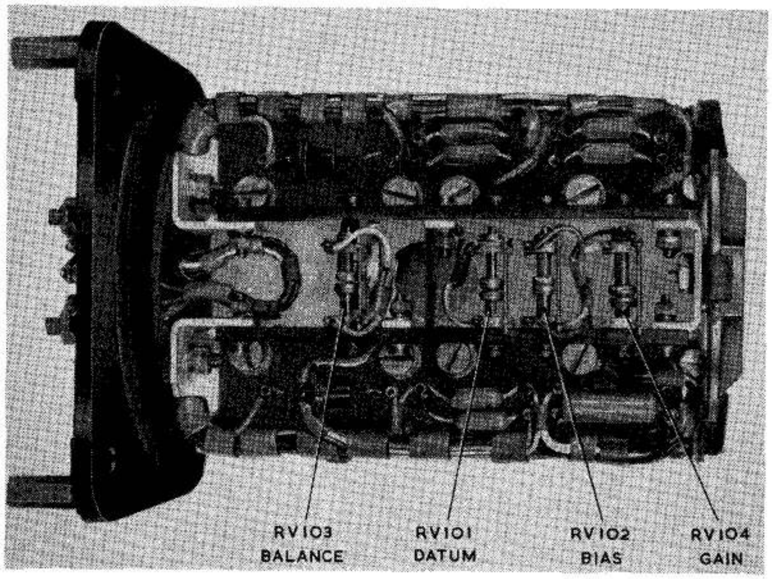

Fig. 2. Internal view, showing preset controls

proportional to engine r.p.m. into the frequency discriminator of the scoop signalling unit. The output from the discriminator provides the input signal to transductor 1.

8. Transductors 1 and 2 form two magnetic amplifier stages for the amplication of the discriminator output. The output from transductor 2 energizes the external relay which controls the selector for the hydraulic jacks. When engine speed is above the datum level the input signal from the discriminator causes the driver stage (transductor 1) to produce and amplified signal. This signal is sufficient to drive the output stage (transductor 2) into saturation thereby causing the

PRINCIPLES OF OPERATION

5. Fig. 3 is a block schematic diagram of the scoop signalling unit showing the input from the tacho-generator and the output to the control relay. Power input to the unit is derived from a 115V, 400 c/s single phase supply. A transformer unit provides the individual supplies for the magnetic amplifier stages.

6. The preset controls (*fig.* 2) which are provided within the scoop signalling unit are:

(1) RV101—r.p.m. datum trim. This controls the datum frequency of the discriminator.

scoop signalling unit to give maximum output. The control relay is thus kept normally energized. When the engine speed falls below datum, the output from the unit immediately falls to a minimum, and the relay is de-energized. This causes the hydraulic jacks to extend the air scoops, so that the ram air turbine will supply a standby electrical system.

CIRCUIT DESCRIPTION

9. The circuit diagram (*fig.* 5), shows the internal connections between components of the scoop signalling unit and the numbers which identify the terminals of the components.

Power supplies

11. Power supplies for the amplifier stages, and a d.c. supply (via rectifiers MR110 and MR111) are derived from a 115V, 400 c/s single phase transformer.

12. The power supplies are provided by transformer TR1 which has three secondary windings. One winding is connected to a full wave rectifier circuit which applies a bias signal to transductors 1 and 2. The 15V output from each half of the centre-tapped secondary is rectified by MR110 and MR111, the d.c. output being smoothed by C103 and R108, and stabilized by zener diode MR105. The other two windings of transformer TR1 provide the power supplies for each of the magnetic amplifier stages. One secondary is centre-tapped, each half supplying 5V to transductor 1, and the other secondary supplies 32V to transductor 2.

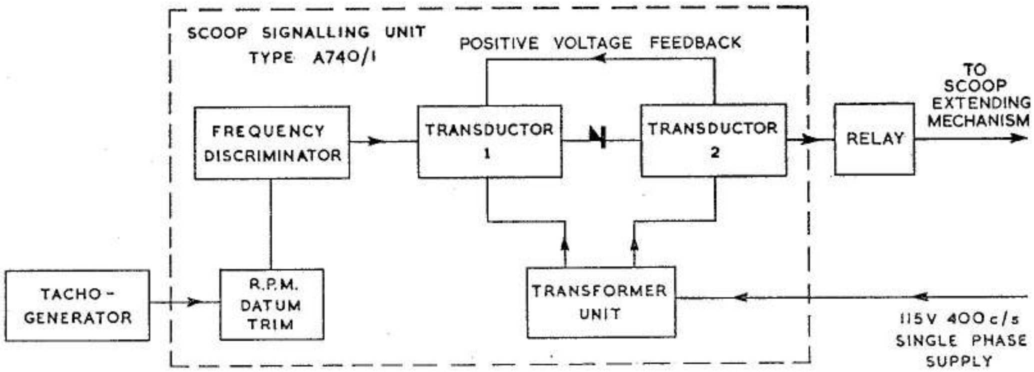

Fig. 3. Block schematic diagram

Terminal block connections

10. The terminal block connections (*fig.* 4) are as follows:

Tacho-generator input	Terminals 1 and 2
115V, 400 c/s supply	Terminals 7 and 8
Amplifier output	Terminals 5 and 6
Test connections	Terminals 3 and 4

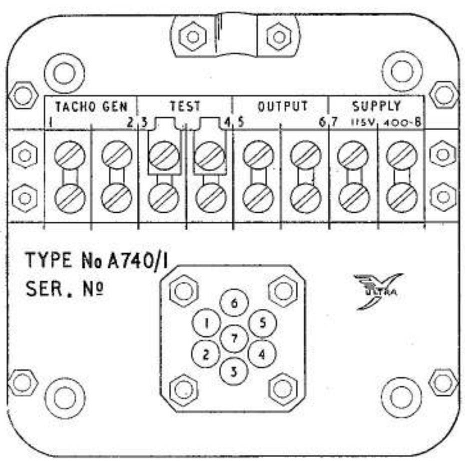

Fig. 4. Terminal identification diagram

Speed sensing

13. The sensing element is a tacho-generator, the output from which provides the input to the scoop signalling unit. The tacho-generator provides a 3-phase a.c. signal output, the frequency of which is directly proportional to engine speed. One phase of the tacho output is fed to terminals 1 and 2 of the scoop signalling unit.

14. The input to the unit is applied, via input terminals 1 and 2, to a frequency discriminating bridge circuit, consisting of the bridge rectifiers MR101–MR104, capacitor C101, and resistors R101–R104. The balance point of the discriminator is preset by means of the datum control potentiometer RV101.

Frequency discriminator

15. The single phase signal is filtered by the network R114 and C107, and then separated into resistive and capacitive components, via resistors R101, R102, RV101, capacitor C101, and a bridge network MR101–MR104. The frequency discriminator output signal is developed across R103 and R104, and is subsequently applied to the control windings of transductor 1.

16. The resistive and capacitive components are in opposition, and are equal at the selected r.p.m. datum. The following examples show the separation and the direction of the components in relation to the tacho-generator polarities:

(1) With the tacho-generator polarities —1 positive, 2 negative:

(a) Resistive signal current flows through R114, R103, MR102, R101, R102 and RV101 to terminal 2. The voltage developed across R103 is in direction YX in relation to the transductor 1 control windings.

(b) Capacitive signal current flows through R114, R104, MR103 and C101 to terminal 2. The voltage developed across R104 is in direction XY in relation to the transductor 1 control windings, i.e., in opposition to the voltage developed across R103.

(2) With the tacho-generator polarities —1 negative, 2 positive:

(a) Resistive signal current flows through RV101, R102, R101, MR104, R104 and R114 to terminal 1. The voltage developed across R104 is in direction YX in relation to the transductor 1 control windings.

(b) Capacitive signal current flows through C101, MR101, R103, and R114 to terminal 1. The voltage developed across R103 is in direction XY in relation to the transductor 1 control windings, i.e., in opposition to the voltage developed across R104.

17. The resistive and capacitive voltages developed across R103 and R104 are always in opposition. When the voltages are equal the frequency discriminator output is zero; the output of transductor 1 is, therefore, also zero. The zero output condition occurs when the impedances of the resistive and capacitive networks are equal, i.e., at the r.p.m. datum. The impedances are matched at datum by RV101, which is preset. If the engine speed deviates from the datum level the resistive and capacitive voltages are unbalanced, thereby providing an error signal which is applied to transductor 1.

Amplifier stages

18. Transductor 1 is a shared-core, auto-self-excited, push-pull magnetic amplifier which provides the first stage of error signal amplification. The capacitor C102 provides smoothing of the error signal. There are two pairs of control windings, 2 and 3, all four windings being connected in series through each half of the shared core. In addition, a bias winding, 4, is connected in series with the bias winding of transductor 2. Capacitor C105, connected in parallel with the bias winding, has the effect of smoothing the bias signal and also, through magnetic coupling, the control signal.

19. The output of transductor 1 is fed, via blocking rectifier MR112, to the control windings of transductor 2. Capacitor C104 provides smoothing of the transductor 1 output signal. The potentiometer RV103 is preset to balance the first amplifying stage for zero output under conditions of zero signal input.

20. Since transductor 1 is a push-pull amplifier, error signals of either polarity, i.e., signals corresponding to the above or below datum conditions, are amplified. The blocking rectifier MR112 is included to eliminate signals corresponding to the below datum condition.

21. Transductor 2 forms the second stage of amplification, and consists of a single-ended magnetic amplifier which has two control windings, 3 and 4, connected in series. Capacitor C106 provdes smoothing of the transductor 2 control signal. The bias winding, 5, is connected in series with the bias winding of transductor 1. The output of transductor 2 is rectified by the bridge rectifiers MR115–MR118 and used to energize the external relay.

Feedback circuit

22. When an output current flows through terminals 5 and 6 to the external control relay, a voltage is developed across resistor R112. This produces positive feedback over both stages of amplification, and causes a current to flow through R113 and RV104. The voltage thereby developed across R113 assists the input to the control windings of transductor 1 when the aircraft engine speed exceeds the datum level. The amount of feedback, and thus the gain amplifier, is pre-set by adjustment of the gain control potentiometer RV104.

Bias circuit

23. The bias signal is fed through the series connected bias windings of transductors 1 and 2. Potentiometer RV102 controls the bias, and is preset during manufacture.

SERVICING

24. Information on servicing will be published as soon as it becomes available.

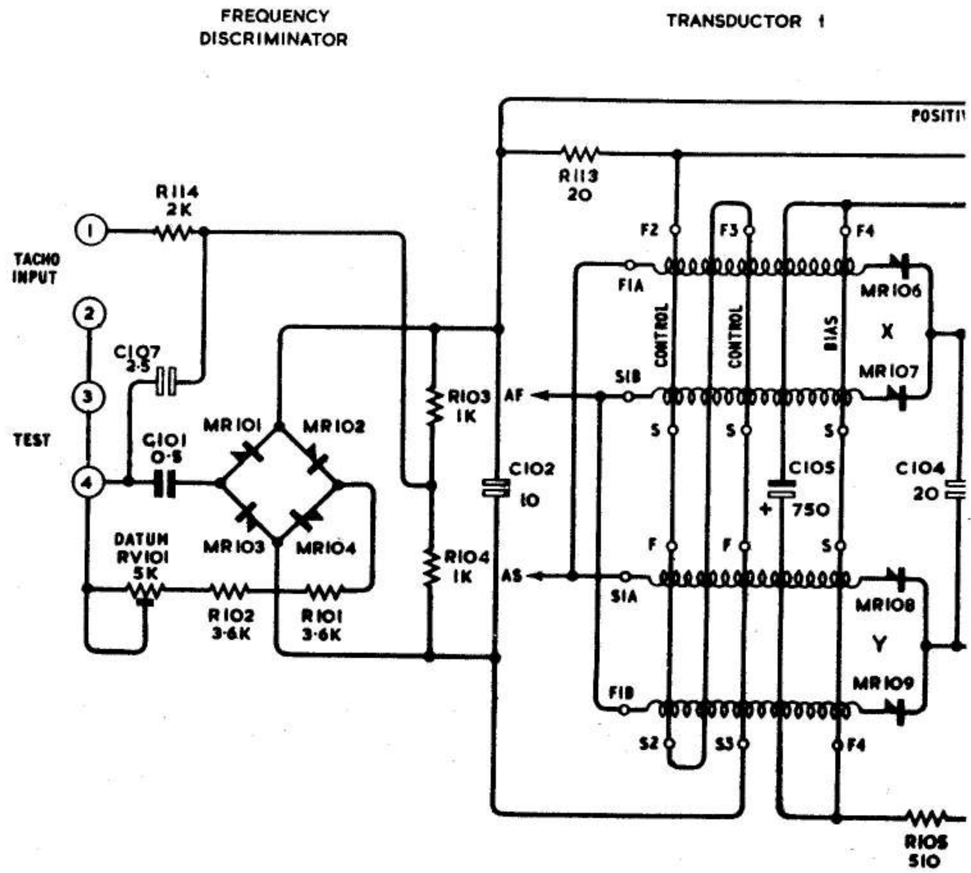

Fig. 5 Circuit diagram of Scoop

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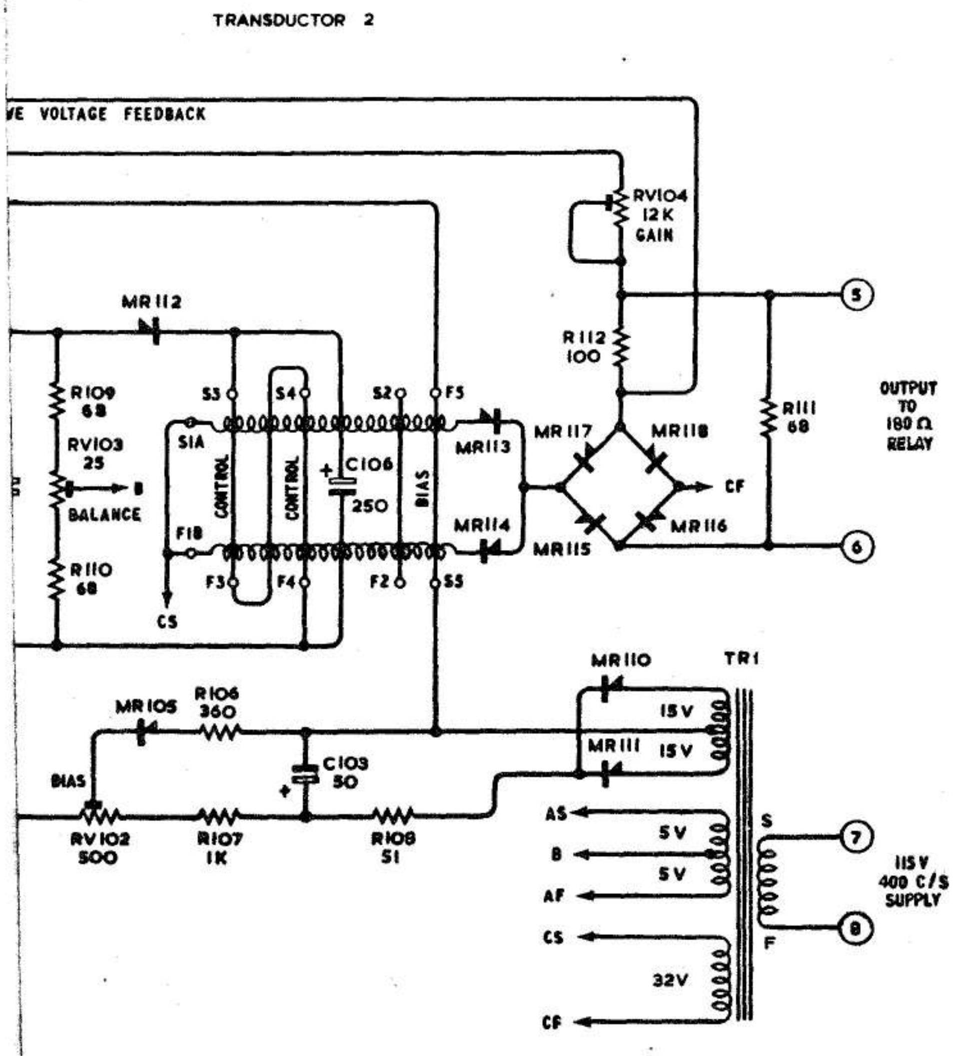

Signalling Unit A740/1
CTED

Fig.5

Appendix A

STANDARD SERVICEABILITY TEST FOR SCOOP SIGNALLING UNIT, ULTRA, TYPE A740/1

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Introduction

1. The tests detailed in this Appendix may be applied to the unit before it is put into service, or at any time to determine its serviceability.

TEST EQUIPMENT

2. The following test equipment is required:—

(1) Test set Ultra, Type Q2A8, (5G/3694) comprising:—control unit Type QC2A80 and motor unit, Type QM-2A80.

Note . . .

Care should be taken to ensure that the tachogenerator fitted in the motor unit is of the same type as that used in the aircraft in which the scoop signalling unit is to be fitted. The tachogenerator used will be either:—

(a) *Kelvin & Hughes, Type KGA*0801

or

(b) *Elliott Type* 30575 *Mk. II.*

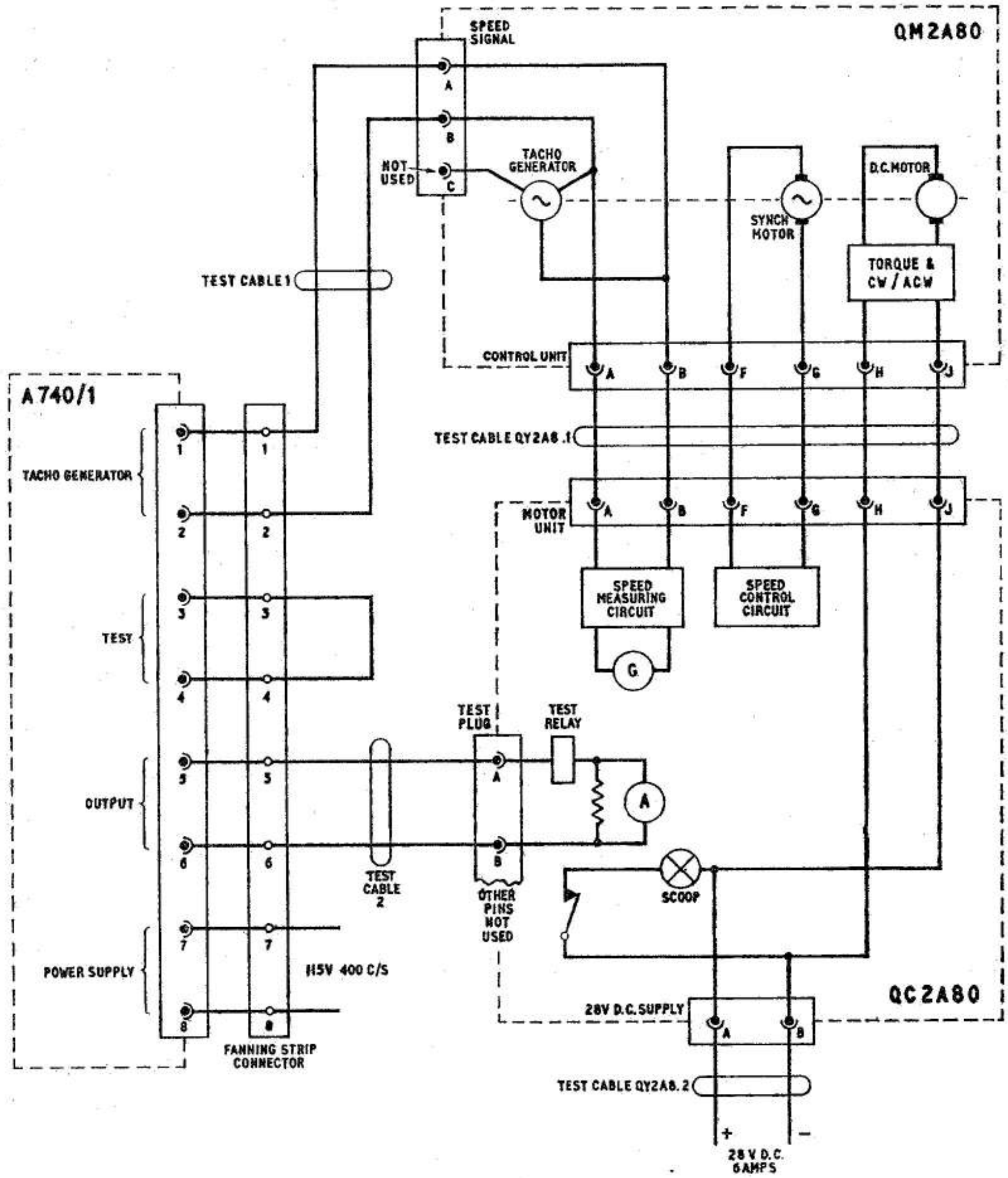
(2) Test cable, Ultra, Type QY2A8.1.

(3) Test cable, Ultra, Type QY2A8.2.

(4) Test circuit as illustrated in fig. 1.

POWER SUPPLIES

3. The following power supplies are required:—



TEST CABLE 1 MAKE FROM PLESSEY PLUG TYPE 2CZ/83296, USING 19/·006 P.T.F.E. WIRE TO M.O.S. SPEC. E.L.1930
TEST CABLE 2 MAKE FROM PLESSEY PLUG TYPE 2CZ/83302, USING 19/·006 P T F E WIRE TO M.O.S. SPEC. E.L.1930

Fig. 1. Bench test circuit

(1) 115V, 400 c/s, single phase, capable of supplying a current of up to 150mA.

(2) 28V d.c. capable of supplying a current of up to 6A.

TEST PROCEDURE

Note . . .

Unless otherwise stated, the controls, switches and indicators referred to in the following paragraphs are located on the control unit, Type QC2A80.

Connections

4. Connect the scoop signalling unit, test equipment and power supplies as shown in fig. 1. It will be necessary to construct two test cables according to the instructions given in fig. 1. Ensure that the link between terminals 3 and 4 on the scoop signalling unit is in place.

Preparation

5. (1) Set the TORQUE switch (QM-2A80, to HIGH.

(2) Set the ROTATION switch (QM-2A80) to C.W.

(3) Set the A/C TESTS switch (QM-2A80) to STATIC.

(4) Set the DATUM SELECTOR switch to HIGH.

(5) Set the TACHO GENERATOR LOAD switch to INDICATOR.

Note . . .

If no tacho-indicator is fitted to the control unit, this switch should be set to IND. & RESIST.

(6) Set speed scale to 100%.

(7) Set TEST POSITION switch to BENCH.

(8) Set the SELECT SPEED MEASUREMENT RANGE switch to position 1.

(9) Set the select METER TEST switch to BATTERY and check that METER 1 indicates on the GREEN range.

(10) Set the SPEED SIGNAL, COARSE control fully counterclockwise and set the FINE control to its control position.

(11) Set the 28V D.C. SUPPLY switch to ON and check that the SUPPLY lamp is lit.

Note . . .

If the lamp does not light, check the polarity of the d.c. supply (pole A of the SUPPLY plug should be +ve).

(12) Set the SELECT METER TEST switch to ∅ 1 and check that METER 1 indicates an output voltage from the tachogenerator.

(13) Rotate the SPEED SIGNAL, COARSE control slowly clockwise until the a.c. motor in the motor unit reaches synchronous speed. This is indicated by a slowly increasing reading on METER 1.

Caution . . .

Do not allow the motor to run at non-synchronous speeds for long periods.

(14) Continue to rotate the SPEED SIGNAL COARSE control slowly clockwise until METER 1 indicates 20V.

(15) Unclamp the galvanometer and zero the needle.

(16) Momentarily depress the GALVO key to SEARCH and observe the deflection of the galvanometer needle.

(17) Adjust the SPEED SIGNAL, FINE control so as to reduce the galvanometer deflection to zero, depressing the GALVO key at frequent intervals to observe the effect on the galvanometer.

Note . . .

For a galvanometer deflection to the left of zero, rotate the SPEED SIGNAL, FINE control clockwise and for a galvanometer deflection to the right of zero, rotate the control counterclockwise.

(18) When the galvanometer deflection is within 5 scale divisions of zero, set the GALVO key to READ.

(19) Make final adjustments to the SPEED SIGNAL, FINE control to obtain a null on the galvanometer.

(20) According to the type of tachogenerator fitted in the motor unit, the reading on METER 1 should be:—

(a) For Kelvin & Hughes tachogenerator, 26V ± 2V

(b) For Elliott tachogenerator, 21V ± 2V.

(21) Set the SELECT METER TEST switch to positions ∅2 and ∅3 in turn and repeat the procedure detailed in sub-para. (15) to (19) above at each setting of the switch.

(22) In each instance the reading on METER 1 should be within ± 1V of the reading obtained in sub-para (20). Failure to achieve these figures indicates a fault in the tachogenerator or the associated wiring.

(23) Set the GALVO key to its central position.

(24) Switch the 115V, 400 c/s supply on and allow a 5 minute warm-up period.

Datum, gain and standing current (see fig. 2)

6. (1) Set the SPEED DATUM scale to 51%.

(2) Set the SELECT METER TEST switch to SCOOP and ensure that the reading on METER 1 is not less than 35 mA.

(3) Rotate the SPEED SIGNAL, COARSE control slowly counterclockwise until the reading on METER 1 starts to decrease.

(4) Rotate the FINE control counterclockwise until the scoop indicating lamp lights and ensure that the reading on METER 1 does not exceed 4 mA.

(5) Momentarily depress the GALVO key to SEARCH and observe the deflection of the galvanometer needle.

(6) Adjust the SPEED DATUM scale setting so as to reduce the galvanometer deflection to zero, depressing the GALVO key at frequent intervals to observe the effect on the galvanometer.

Note . . .

For a galvanometer deflection to the left of zero, the SPEED DATUM scale must be turned clockwise and for a deflection to the right of zero, the scale must be turned counterclockwise.

(7) When the galvanometer reading is within 5 scale divisions of zero,set the GALVO key to READ.

(8) Make final adjustments to the setting of the SPEED DATUM scale to obtain a null on the galvanometer.

(9) The SPEED DATUM scale reading should be 51% ±1%. (Note this reading for future reference).

(10) Rotate the SPEED SIGNAL, FINE control slowly clockwise until the SCOOP indicating lamp becomes extinguished.

(11) Check that the reading on METER 1 is not less than 35 mA.

(12) Repeat sub-para. 5 to 9 but in sub para. 9 the SPEED DATUM scale reading should be 0·5 to 1·5% higher than the reading previously noted.

Disconnecting supplies

7. (1) Turn COARSE and FINE controls fully counterclockwise.

(2) Switch off SELECT SPEED MEASUREMENT RANGE switch.

(3) Switch off 28V d·c. supply.

(4) Disconnect all cables.

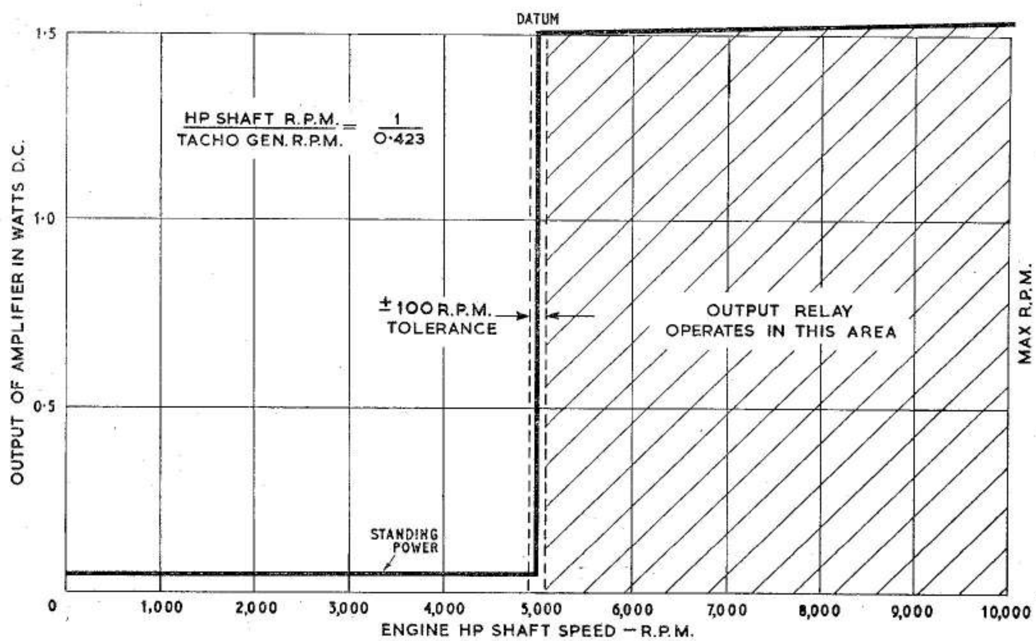


Fig. 2. Amplifier characteristic

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