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Chapter 2

DATUM SELECTOR, ULTRA, TYPE D401/1

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LEADING PARTICULARS

Datum selector, Ultra, Type D401/1	Ref. No. 5CZ/5721
Overall dimensions (excluding leads)	14 $\frac{13}{32}$ in. $\times$ 5 $\frac{1}{8}$ in. $\times$ 3 $\frac{5}{8}$ in.
Length of external leads	40 in.
Weight (including leads)	9 $\frac{1}{2}$ lb.

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Introduction

1. Datum selector, Ultra, Type D401/1 (fig. 1) forms part of the Ultra Engine Control System, Type B.A.P.3, described in A.P.4343K, Vol. 1, Sect. 1 Chap. 1.

2. The unit is located on the flight deck pedestal and receives signals from the compressor driven tachogenerators. From each of these signals two outputs are derived. One output is a d.c. voltage which varies in a non-linear manner according to compressor speed, the second output is a d.c. voltage which is linearly proportional to compressor speed, and the level of which is dependent on the settings of preset potentiometers. The output voltages are fed to the input windings of the governor amplifier in the transmitter, Type T401/1. At datum, the two voltages are equal in magnitude.

3. Each of the four datum selector channels is capable of selecting HIGH datum, corresponding to climb conditions, or LOW datum, corresponding to cruise conditions. Each of these datums can be varied by ± 125 c.r.p.m. in steps of 12.5 c.r.p.m. The governor loop maintains the engine speed within ± 8 c.r.p.m. of the selected datum.

DESCRIPTION

4. The datum selector, Type D401/1 (fig. 2) is housed within a metal case which is secured to the rear end of the flight deck pedestal. Four cables, terminating in Plessey sockets, allow connection of the selector to the aircraft wiring. Each cable carries the signals to and from one engine channel.

5. The aluminium chassis contains four canisters, each housing the governor channel components for one engine channel. Also mounted on the chassis are four tacho signal filter units and the preset potentiometers controlling the HIGH and LOW datums of each channel. The front panel houses four switches, used to select c.r.p.m. governing of each channel independently, four potentiometers providing manual adjustment of the preset datums and a HIGH R.P.M./LOW R.P.M. selector switch controlling all four channels.

PRINCIPLES OF OPERATION

6. The principles of operation of the B.A.P. 3 system are described in A.P.4343K, Vol. 1 Sect. 1, Chap. 1.

7. The tachogenerator signal from each engine is fed to a filter unit and thence to two circuits, one resistive, the other capacitive. Since the output voltage of the tachogenerator varies linearly according to speed, the output of the resistive circuit will depend on the resistance. This resistance is varied by potentiometers and the resultant a.c. voltage is fed to a bridge rectifier. Variations in input signal frequency do not affect the d.c. output of the rectifier. The impedance of the capacitive circuit depends on the input frequency. The output of the capacitive circuit is applied to a further bridge rectifier to produce a second d.c. voltage which varies exponentially with tachogenerator frequency, and hence compressor speed. Fig. 3 illustrates the changes of output voltages with compressor speed.

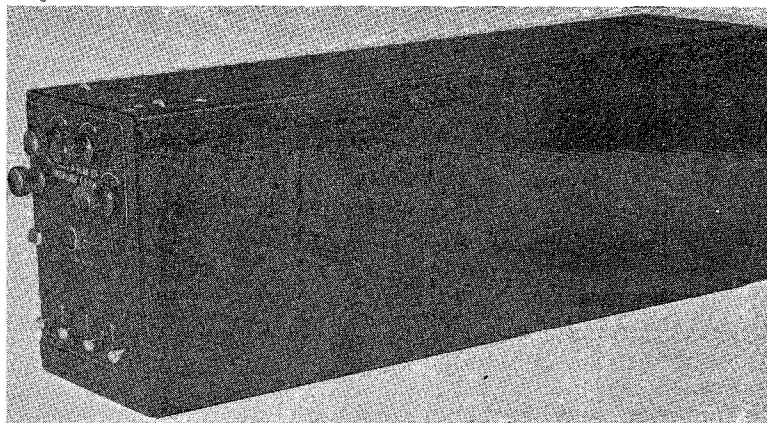


Fig. 1. Datum selector, ultra, type D401/1

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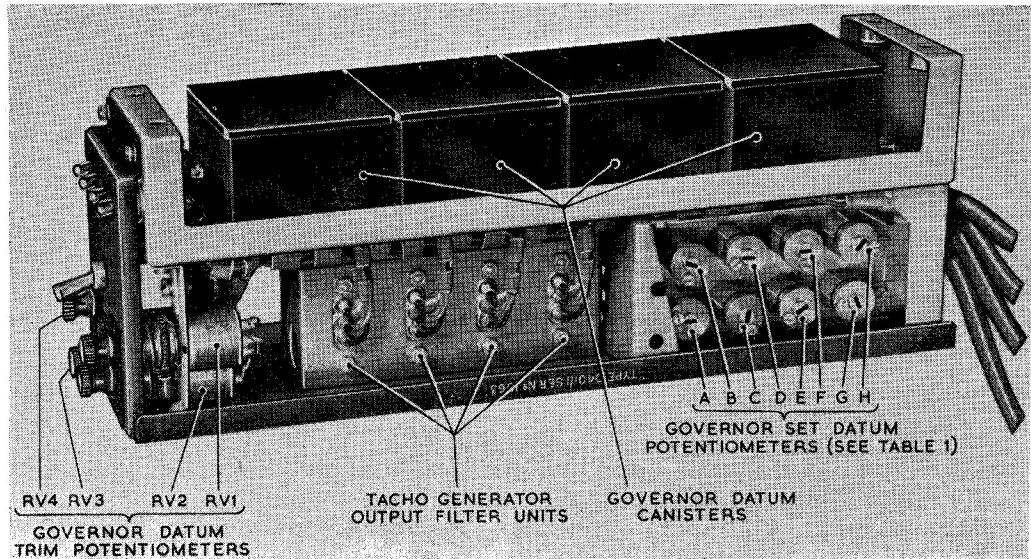


Fig. 2. Datum selector with cover removed

8. The two d.c. output voltages are fed to the input windings of the governor channel amplifier in the transmitter Type T401/1. The output of this amplifier is fed to a motor which drives the slider of a potentiometer via a reduction gearbox. The voltage picked off by the slider is the governor trim signal and is passed to the positioner discriminator transformer in amplifier Type A401/3 and to the pilot's trim indicator. A more complete description of the governor channel will be found in A.P.4343K, Vol. 1, Sect. 5, Chap. 1.

9. In operation, the pilot adjusts his throttle lever to obtain an engine speed, as indicated on the c.r.p.m. indicator, some 100 c.r.p.m. higher than the selected datum. When the governor system is switched on, the compressor speed is trimmed down to the datum selected. The pilot then readjusts his throttle lever so as to obtain a deflection of approximately one third of full scale on the trim indicator.

CIRCUIT DESCRIPTION

10. A circuit diagram of the datum selector, Type D401/1, is illustrated in fig. 4. External connections to the unit are made via four cables, terminating in 9-pole, Plessey sockets. The sockets are identical except

for the blanking pin arrangement. The blanking pin code is as follows:—

Engine Channel	Blanking pins
1	7 and 8
2	7
3	8
4	9

As each engine channel is identical, only channel 1 will be described.

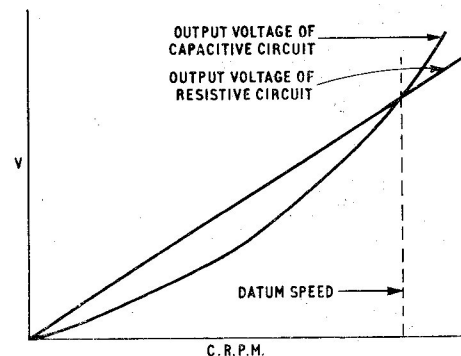


Fig. 3. Output voltage

11. The output from the compressor driven tachogenerator is fed into the unit at poles 1 and 2 of SKT1. The signal is fed to the filter circuit comprising L1/1 and C1/1.

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The purpose of this filter is to make the system independent of the tachogenerator output waveform, thus ensuring interchangeability of tachogenerators. From the filter circuit, the signal is fed to two separate circuits, one resistive, and the other capacitive.

Resistive circuit

12. Three resistive elements R1/1, RV1 and R2/1 are connected, in series, to the moving pole of switch S5. R1/1 is shorted when the ON/OFF switch, S1, is set to ON. RV1 is a potentiometer the resistance of which is varied by a front panel knob, via a 20-step indexing mechanism. The signal passes through RV5 or RV6 depending on the setting of S5 (HIGH/LOW. RV5 and RV6 are preset potentiometers used to set up the LOW and HIGH datums. The resulting a.c. signal is applied to the bridge rectifier MR1/1, the d.c. output of which is smoothed by C3/1. The d.c. signal is fed out of the unit on poles 5 and 6 of SKT1. R1/1 is embodied in the datum selector unit to ensure that there is always an input to the governor amplifier from the resistive arm. Predominant signals from the resistive arm will always turn the trim motor in such a direction that trim will be wound off the trim potentiometer. R1/1, therefore, ensures that when the datum selector is switched off, any remaining trim will be removed.

Capacitive circuit

13. Capacitor C2/1 is fed from the filter circuit, via S1. The frequency of the signal from the tachogenerator varies according to compressor speed. The impedance of C2/1 will, therefore, decrease as the compressor speed increases and the amplitude of the a.c. voltage applied to the bridge rectifier, MR2/1, will bear a non-linear relationship to compressor speed. The d.c. output of the bridge rectifier is smoothed by C4/1 and is fed out of the unit on poles 3 and 4 of SKT1.

Governor amplifier

14. Although the governor amplifier is a part of the transmitter, Type T401/1 mention is made here in order to clarify the description of the datum selector circuit.

15. Fig. 3 shows how the d.c. voltages from the resistive and capacitive circuits

vary as the compressor speed changes. The point where the two outputs are equal is the datum point, the datum being adjusted by varying the resistance of the resistive circuit and hence changing the slope of the line. The two outputs are applied to the input windings of the governor amplifier. These windings are wound in opposition so, when the two voltages are equal, the resultant input to the governor amplifier is zero.

16. Assuming that the compressor speed increases from datum, then there is a resultant input voltage to the governor amplifier, which is proportional to the difference between the outputs from the capacitive and resistive circuits in the datum selector. The corresponding output from the governor amplifier is fed to a motor which drives the governor trim potentiometer, sending a trim signal to the positioner amplifier. The throttle motor is thus driven in a closing direction so as to reduce the fuel flow to the engine. A decrease in compressor speed results and, as the speed decreases, the difference between the two governor amplifier input voltages decreases until equal input voltage conditions are reached, the resultant input to the governor amplifier gain being zero. A decrease from engine datum speed results in a reversal of the conditions described above.

Datum setting potentiometers

17. The following table indicates the datum setting potentiometers for each engine channel and should be read in conjunction with fig. 2 and 4.

TABLE 1

Datum setting potentiometers

Potentiometers		Engine channel	Datum
Fig. 2	Fig. 4		
A	RV6	1	High
B	RV5	1	Low
C	RV8	2	High
D	RV7	2	Low
E	RV10	3	High
F	RV9	3	Low
G	RV12	4	High
H	RV11	4	Low

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SERVICING

18. The procedure for bench testing the datum selector is given in Appendix A.

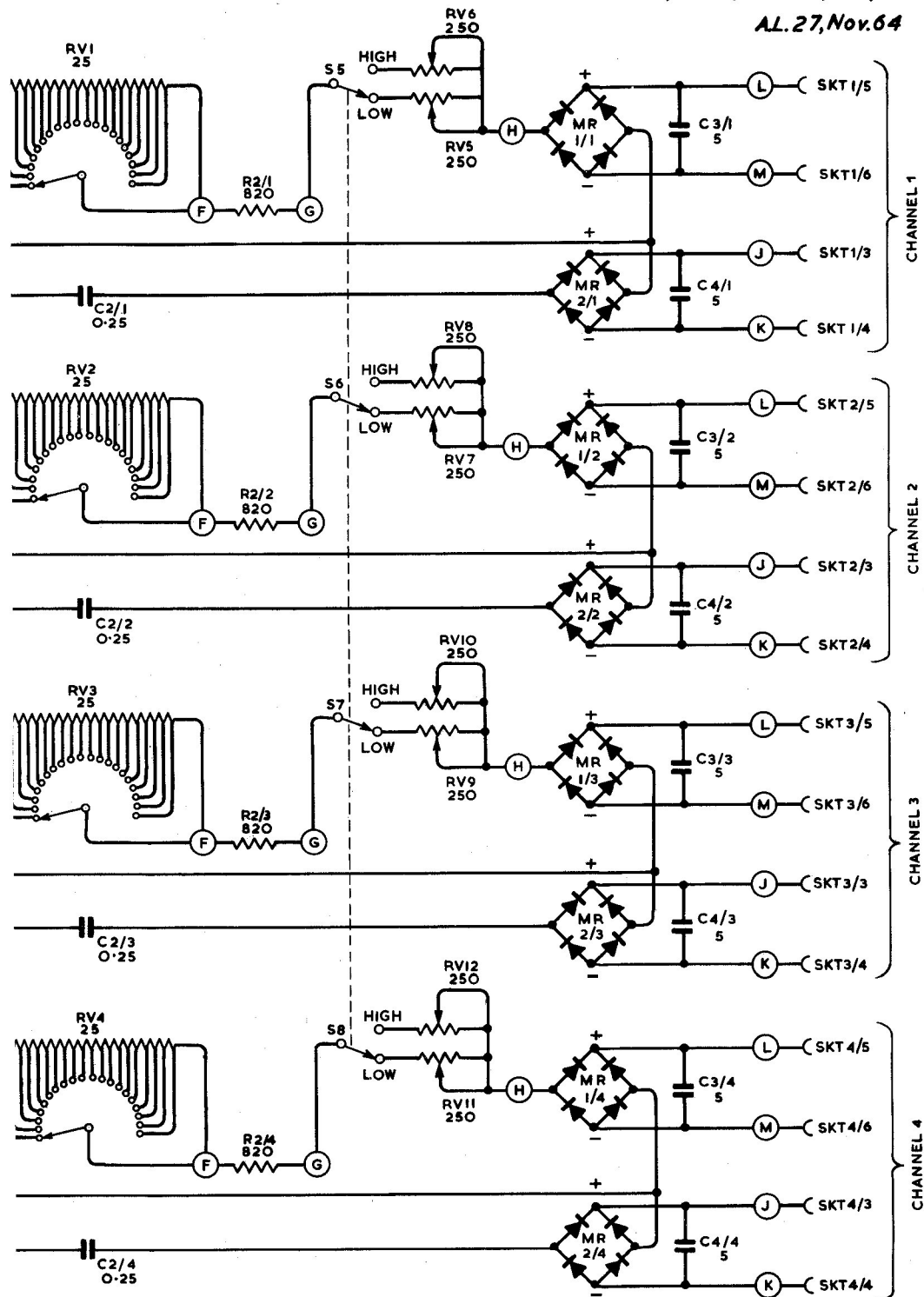
Aircraft tests

19. These tests are intended to prove the

serviceability of the datum selector when installed in an aircraft. The tests are performed with test equipment, Ultra, Type QE406. A description of the equipment, together with detailed test instructions, will be found in A.P.4343K, Vol. 1, Sect. 10, Chap. 3.

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or, Ultra, Type D4O1/1 – circuit
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Fig. 4

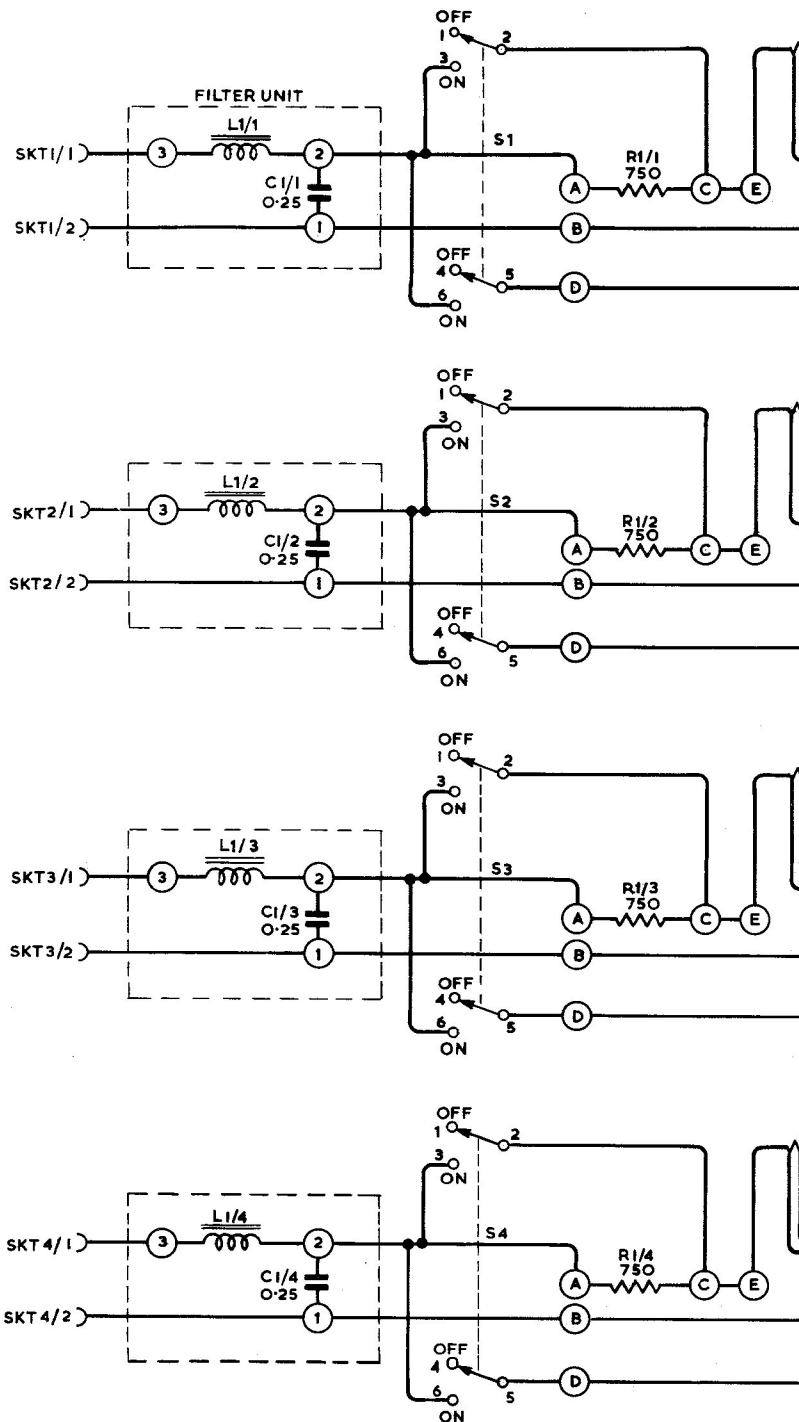


Fig. 4

Datum select
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Appendix A

STANDARD SERVICEABILITY TEST FOR DATUM SELECTOR, ULTRA, TYPE D401/1

Introduction

1. The test 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 QT4066 with test cableform.
- (2) Test equipment, Ultra, Type Q2A8 comprising control unit, Type QC2A80 and motor unit, Type QM2A80
- (3) Power amplifiers, Ultra, Type QT4063 (3-off)
- (4) Adapter box, Ultra, Type QY4022
- (5) Slave amplifier, Ultra, Type A401/3
- (6) Slave transmitter, Ultra Type T401/1
- (7) Multimeter, type 12889 (5QP/17447)
- (8) Engine speed indicator
- (9) 250V d.c. insulation resistance tester

POWER SUPPLIES

3. The following power supplies are required :—

- Either (1) 110V to 120V, 50 c/s, 1-ph
or (2) 200V to 250V, 50 c/s, 1-ph
and (3) 28V d.c.

TEST PROCEDURE

Test connections

4. (1) Connect the test equipment as shown in fig. 1, with the adapter box,

Type QY4022 connected to channel 1 of the datum selector.

(2) Check that the voltage selectors on the power amplifier, Type QT4063, are set for the mains supply to be used.

(3) Connect the power supplies as shown in fig. 1.

(4) Set the AMPLIFIER RACK switch to STANDBY and, after a period of two minutes, set the H.T. switch to ON.

(5) Adjust the voltage and frequency of the 115V supply to 115V, 400 c/s.

(6) Ensure that the reading on METER 5 does not exceed 0.85A.

Datum Check

5. (1) Connect the Multimeter, on the 10V a.c. range, between poles 1 and 2 of the slave transmitter test socket T/3.
(2) Switch on the test equipment, Type Q2A8, and set the QC2A80 controls as follows:—

(a) TACHO GENERATOR LOAD switch—NO LOAD

(b) SELECT METER TEST switch— $\bigcirc$ 1

(c) SPEED SIGNAL, COARSE control—45° from the fully clockwise position.

(d) SPEED SIGNAL, FINE control—fully counterclockwise

The settings of the remaining controls are immaterial.

(3) Set the QM2A80 controls as follows:—

(a) A/C TESTS switch to STATIC

(b) TORQUE switch to LOW

(4) Turn the SPEED SIGNAL, COARSE control slowly clockwise until the indication on the meter on QC2A80 begins to increase. Too rapid

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rotation of the COARSE control will result in loss of synchronism.

(5) Check that the engine speed indicator is functioning.

(6) Determine the speeds at which datum output is obtained from the datum selector unit. The point at which the datum is reached is indicated by a minimum reading on the Multimeter with the Multimeter range reduced to 2.5V a.c. The following table gives the datum speeds which should be obtained for various datum switch and datum trimmer positions.

Note . . .

The low and high datum speeds should be obtained from the engine manual.

(7) Repeat the tests indicated in sub-para. (6) with the adaptor box, Type QY4022, connected to channels 2, 3 and 4, in turn, of the datum selector. The results obtained should be as quoted for channel 1.

(8) Switch off the supplies and disconnect the test equipment.

Insulation resistance

6. (1) Using the Multimeter, on the $\Omega \times 100$ range, check that the insulation between each pole of the four sockets and the case of the unit is not less than 5 megohms.

(2) Repeat the test in sub-para. (1) above, using the 250V insulation resistance tester. The insulation resistance should be not less than 5 megohms.

(continued overleaf)

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TABLE 1
Datum Speeds

Datum switch position	Datum speeds for extreme datum trimmer positions	
	fully counterclockwise	fully clockwise
LOW	Low datum -100 to 150 c.r.p.m.	Low datum + 100 to 150 c.r.p.m.
HIGH	High datum -100 to 150 c.r.p.m.	High datum + 100 to 150 c.r.p.m.

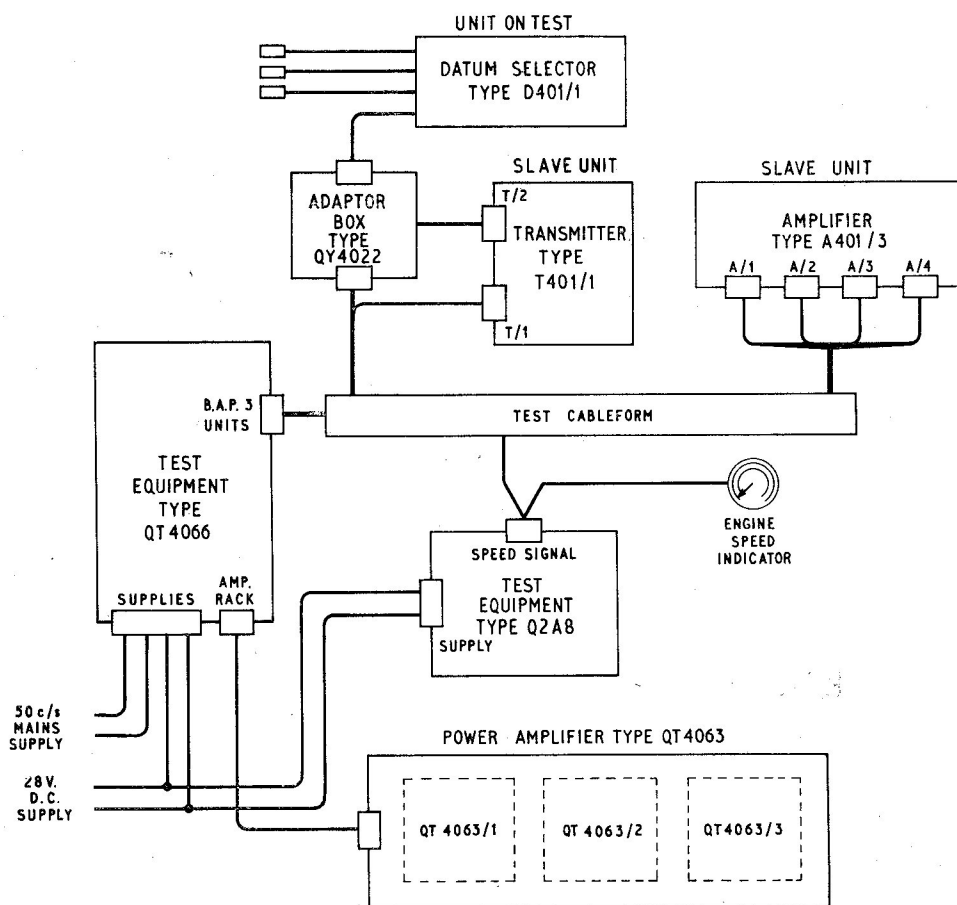


Fig. 1. Test connections

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