# Chapter 4

## CONTROL AND PROTECTION UNIT, ROTAX, TYPE U3704

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### LEADING PARTICULARS

| | |
|---|---|
| **Control and protection unit, Type U3704/1** | *Ref. No.* 5UC/6587 |
| *Output voltage* | 208 *volts a.c.* ± 4 *per cent* |
| *Phase* | 3 |
| *Frequency* | 250 *to* 400 *c/s. overall* |
| *Load range* | 0–21 *kVA* |
| *Power factor* | *Unity to* 0·9 *lag.* |
| *Temperature range* | −40 *deg. C. to* +50 *deg. C.* |
| *Altitude* | 30 000 *ft.* |
| *Cooling* | *Natural* |
| *Overall dimensions* | |
| *Length* (*over handle*) | 11·750 *in.* |
| *Width* | 9·250 *in.* |
| *Height* | 8·500 *in.* |
| *Weight* | 21·5 *lb.* |

## Introduction

◀ **1.** The control and protection unit, Type U3704, is designed to control and protect the output of the 22 kVA a.c. generators, Types N0407 and N0408 which are used in aircraft de-icing systems. This chapter describes in detail the U3704/1; the U3704/2 incorporates radio suppression and some minor circuit alterations, and is covered in Appendix 1 to this chapter. ▶

## DESCRIPTION

**2.** The components are housed within an alloy box, the cover of which incorporates perforated panels to provide ventilation.

**3.** The components are mounted on two chassis, one fixed and the other hinged; by turning the hinged chassis about the hinge pin, access is gained to all components. Each component is identified by code symbols which are directly related to the circuit diagram (*fig.* 4).

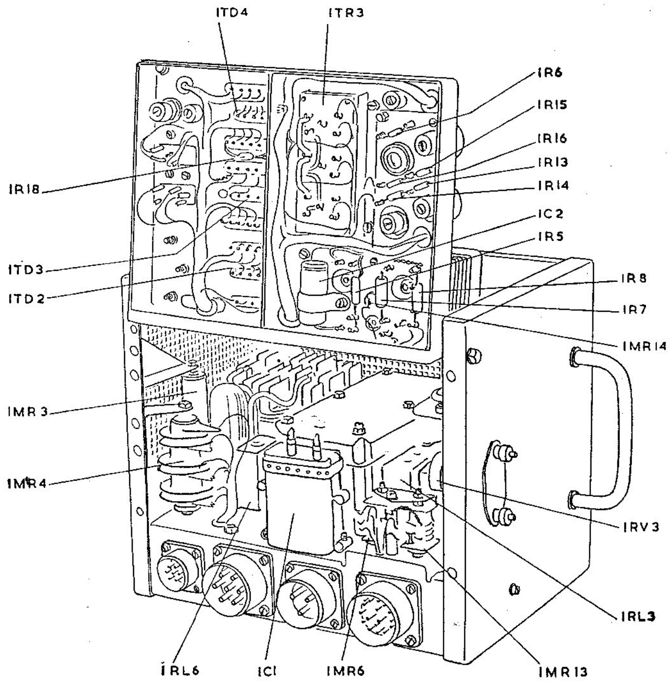


**Fig. 1. Layout of components (1)**

**4.** The equipment is suitable for operating at altitudes of up to 30 000 ft. within a temperature range of −40 deg. C. to +50 deg. C.

**5.** Fig. 1, 2 and 3 show the physical layout of the components in the unit.

## OPERATION

**6.** Operation of the U3704/1 is based on the use of magnetic amplifiers, by which means accurate control of the output voltage and effective protection arrangements are achieved. A theoretical diagram of the internal connections is given in fig. 4.

**7.** Minor adjustments of the controlled voltage level can be made with the voltage trimmer potentiometer (1RV3), which is located behind the swing cover plate on the front of the unit, above the data plate; adjustment can be made in approximately 1 V steps to ±9 V without the necessity of disturbing the unit cover.

**8.** Regulation of the busbar voltage is obtained by a system operation which is based entirely on the use of magnetic amplifiers. Control of the average of the three r.m.s. line voltages is maintained at 208 volts ± 4 per cent over a frequency range of 250–400 c/s and a load range of no-load to 22 kVA.

**9.** Protection is provided against overvoltage and feeder faults up to the busbars, and indication of under voltage and earth leakage faults is provided. Indication is also given in the event of the system becoming inoperative.

**10.** These protective functions are effected by employing magnetic amplifiers to control pilot relays which in turn control the main switchgear or indicators. Each magnetic amplifier is adjusted to develop an infinite gain characteristic thereby providing a 'trigger' action for the control of the pilot relay. This renders the protection arrangements insensitive to variations in temperature, frequency and voltage. In addition, an inverse time characteristic is introduced by incorporating short-circuited turns, which allows the switchgear and indication circuit to ignore load switching transients.

### Voltage control

**11.** Accurate regulation of the busbar voltage is obtained by closed loop control of the alternator excitation. Two factors are considered in effecting this control, i.e., the load current delivered by the alternator and the error between the desired line voltage and actual line voltage.

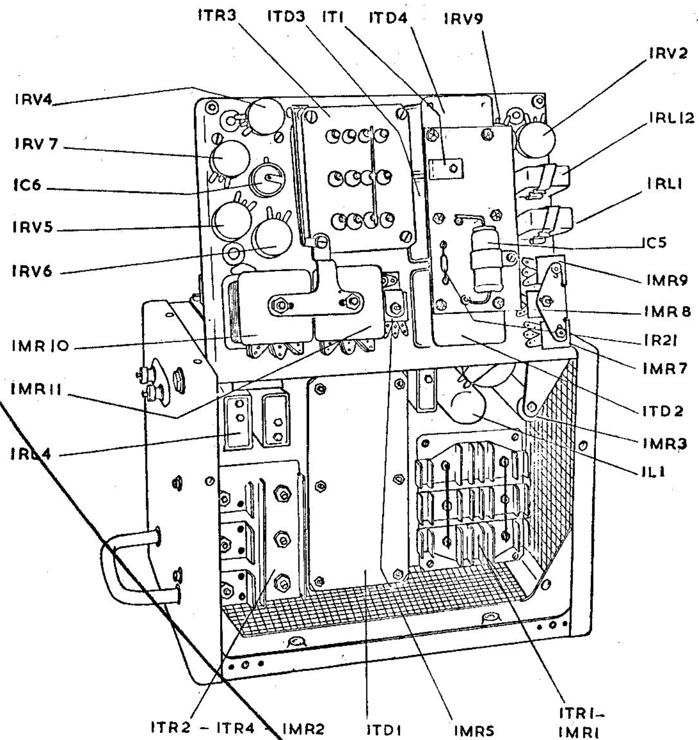


**Fig. 2. Layout of components (2)**

**12.** Excitation current proportional to load current is supplied to the alternator field via the current compounding transformer 1TR1 and silicon rectifier 1MR1. As this source of excitation is linear and the alternator characteristic is not, then the balance of excitation must be provided by the voltage regulator. Components of the voltage regulator include:—

(*a*) A voltage sensitive network, comprising two circuits, one containing resistors 1R5, 1R6, 1RV2 and 1RV3, the other the barretter 1L1 and resistor 1R20.

(*b*) An error magnetic amplifier, comprising transductor 1TD2 and rectifier 1MR7.

(*c*) A power magnetic amplifier comprising three-phase transductor 1TD1 and main auto-rectifier 1MR4.

**13.** Sensing of the error between the desired line voltage and the actual line voltage is dependent upon the comparison of two resistive circuits of the voltage sensitive network. One circuit, containing resistors 1R5, 1R6, 1RV2 and 1RV3, provides a linear voltage/current relationship, whilst the other circuit, containing barretter 1L1, gives an almost constant current. The two signal currents are then fed in opposing senses to the control windings of the error amplifier 1TD2. The resistor 1R20, connected in series with the barretter, is included to suppress surges which, in low temperature conditions, can cause false starting of the unit.

**14.** Current in the resistor circuit is adjusted such that at the required busbar voltage the signal currents in each circuit are nominally equal. In practice, a slight unbalance of currents at this desired voltage level obviates the use of a bias winding on transductor 1TD2. Any change in the average of the three r.m.s. line voltages above or below the nominal level will be detected by the voltage sensitive network. The error signal will then be fed into the error amplifier 1TD2, the output of which is, in turn, fed as a negative control into the power magnetic amplifier (1TD1 and 1MR4). The resultant output from the power magnetic amplifier is supplied to the alternator field as the modified excitation contribution of the regulator, thereby correcting the voltage error.

**15.** The purpose of the error magnetic amplifier (1TD2 and 1MR7) is to relieve the duty of the power magnetic amplifier. This improves stability with temperature variation and reduces the overall time constant of the regulator.

**16.** Bias and negative feedback loops are included to provide optimum operating conditions, e.g., a positive bias signal is applied to 1TD1 to compensate for the standing output of the error amplifier. Stabilization of the closed loop voltage regulating system is provided by transient negative feedback networks passed over each amplifier stage, e.g., a signal proportional to the output current of transductor 1TD2 is derived across the coupling potentiometer 1RV7 and is fed to the control winding of 1TD2 via the network 1C3 and 1R17. Similarly, in the output stage a three-phase voltage, proportional to the field voltage, is applied via rectifier 1MR3 to the control winding of 1TD1 via the capacitor 1C1.

**Operation at 200–250 c/s**

**17.** To maintain generation at low alternator speeds, i.e., in the frequency range of 200–250 c/s (for a load of 16 kVA), without exceeding the current rating of the regulator, necessitates limiting the maximum current delivered by the regulator to approximately 12 amp. d.c. Automatic current limiting is achieved by comparing a d.c. signal derived from current transformer 1TR4, via rectifier 1MR13, with the d.c. signal in the resistor arm (1R5, 1R6, 1RV2 and 1RV3) of the voltage sensitive network. The turns ratio of 1TR4 is such, that for regulator currents not greater than the nominal rating of excitation rectifier 1MR2, the output from 1MR13 is less than the current flow via 1R5, 1R6, 1RV2, 1RV3. Under normal operating conditions therefore, the output of 1MR13 has no effect in the controlled voltage level.

**18.** When the regulator current exceeds the nominal rating of 1MR2 the output of 1MR13 exceeds the current flowing in the resistors, so increasing the current flow in this resistor arm. The voltage regulator interprets this as a high voltage condition causing a reduction in excitation contribution and a progressive reduction in line voltage level with reduction in alternator speed. With further application of load the actual line voltage, under these conditions, will show a further reduction.

**Overvoltage protection**

**19.** Protection against an overvoltage condition is provided at a voltage level of 225 ± 5 volts. The circuit arrangement

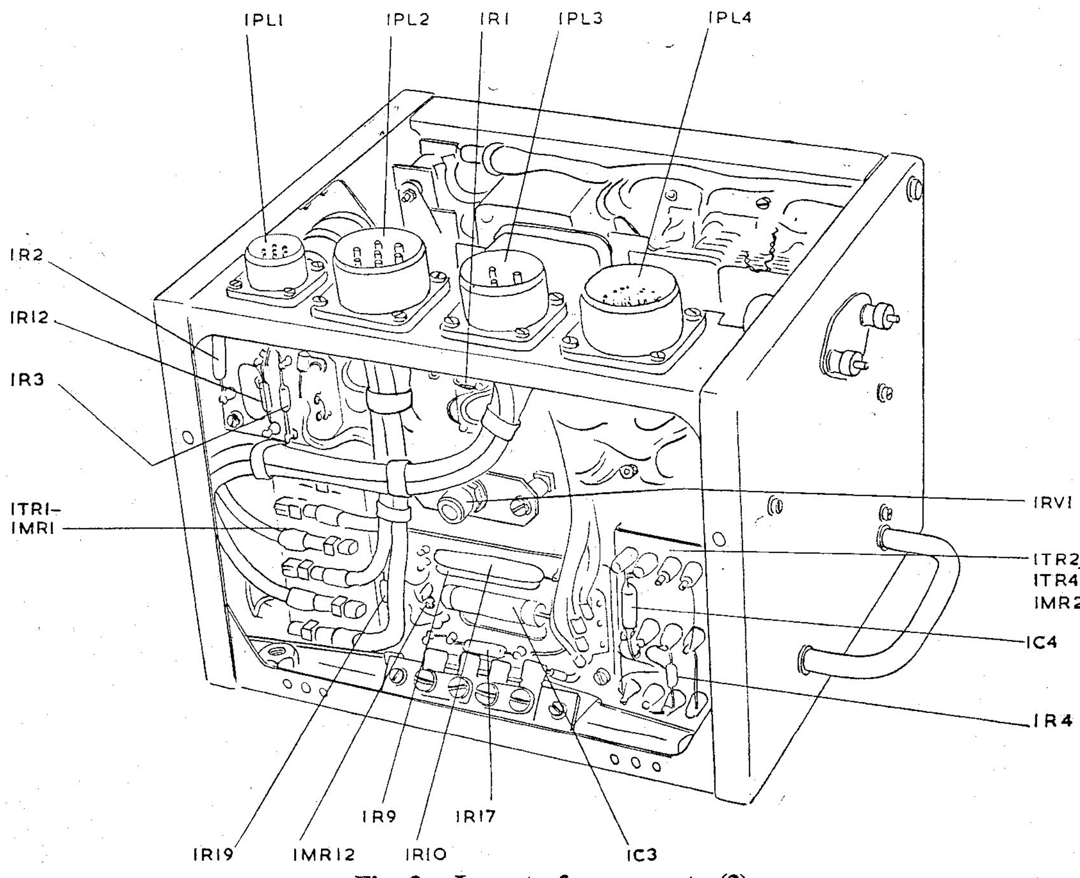


**Fig. 3. Layout of components (3)**

basically is formed by the combination of transductor 1TD3 and rectifier 1MR8, the output of which is applied to protection relay 1RL1. Positive feedback is applied to the transductor, thereby providing an infinite gain characteristic resulting in a trigger action for operation of the pilot relay 1RL1. Resistor 1R19 is inserted in the circuit to lock relay 1RL1. A voltage senstive network, similar to the one described for voltage control, is incorporated in this protection arrangement, i.e., the voltage sensing is dependent upon the comparison of two resistive circuits which supply respective control windings of 1TD3. One resistive circuit of the network comprising 1R8, 1R13, 1R14 and 1RV6 provides the linear voltage/current relationship whilst the other circuit, which incorporates the barretter 1L1 and resistor 1R20, provides the constant current signal. Both resistive circuits are fed from the output of rectifier 1MR11.

**20.** At the nominal supply voltage the circuit is adjusted so that relay 1RL1 is de-energized. With an increase of supply voltage, transductor 1TD3 saturates, thereby energizing relay 1RL1, and subsequently isolating the alternator output from the busbar.

**Feeder protection**

**21.** Protection against line to line and line to neutral faults is provided by a modified Merz-Price system. Two three-phase, delta connected transformers are employed, one being connected adjacent to the alternator star point circulating current (in alternator terminal block) (2TR1) and the other close to the busbars (3TR1).

**22.** Under normal operating conditions a state of potential balance exists between the two transformers. Any feeder fault up to the busbar will increase the output of transformer 2TR1 above that of 3TR1. A potential will then be applied to rectifier 1MR6, the output of which is fed into control windings of protection transductor 1TD3 and is interpreted as an overvoltage condition. Relay 1RL1 is therefore energized and 1RL3 subsequently de-energized (via IRL4 and 1R12) thereby short-circuiting the alternator field to switch off the alternator.

**Undervoltage indication**

**23.** Indication of an undervoltage condition is provided at a voltage level of 174 $\pm$ 5 volts. Transductor 1TD4, rectifier 1MR9 and a voltage sensitive network provides the basis of the undervoltage indicator arrangement. The voltage sensitive network incorporates two resistive circuits, one comprising resistors 1R7, 1R15, 1R16, and 1RV5, and the other barretter 1L1 and resistor 1R20. The function of the network is exactly as described for the voltage control and overvoltage protection sensing arrangements.

**24.** An infinite gain characteristic is exhibited by 1TD4 and is thereby similar to the overvoltage protection transductor 1TD3. A difference exists between the two transductor arrangements such that the control windings of 1TD4 are reversed compared with the windings of 1TD3. Hence in the event of an undervoltage condition occurring in the system 1TD4 saturates, energizing 1RL2 and subsequently causing lamp 3L1 to give the appropriate undervoltage indication.

**Pulsed d.c. tickle supply**

**25.** The pulsed d.c. tickle circuit enables the supply to the panel to be controlled when, in starting, the voltage drops to too low a level for the panel to be self-exciting. Under this condition the starting resistors 1R9 and 1R10 carry approximately 200 W each and the pulsed d.c. tickle circuit prevents this overload from continuing for longer than approximately 5 sec.

**26.** With a 28 V d.c. supply at 3SW1 and with the switch in the RUN position, the following conditions occur:—

(1) The lamp 3L2 (alternator failure warning) is energized via the normally closed contacts on the aircraft relay, supplied by 1PL4, pin D.

(2) A 28 V d.c. supply appears at the normally open contacts of 1RL5 via the normally closed contacts of 1RL6, supplied by 1PL4, pin A.

(3) A 28 V d.c. supply is applied to 1RL3 via 1PL4 pin B, the normally closed contacts of relays 1RL4 and 1RL1, and rectifier 1MR12.

(4) A 28 V d.c. supply is applied to 1RL5 via 1PL4 pin B, the normally closed contacts of relays 1RL4 and 1RL6, and transistor 1T1.

**27.** With relays 1RL3 and 1RL5 energized and with the alternator being driven, the machine field is separately excited. At the point when the alternator becomes self-excited, 1RL6 is energized, breaking the circuit at 1RL6, pins 21 and 22, and interrupting the supply to 1RL5 at pins 1 and 2 of 1RL6. With supply appearing at 1PL4 pin D, 3L2 is extinguished.

**28.** With the alternator at a standstill or being unable to attain a speed at which self-excitation can occur, 1RL5 is de-energized after a period (determined by 1C6, the resistance of the coil of 1RL5 and the current gain of 1T1) thus breaking the separate excitation circuit at pins 3 and 4 of 1RL5.

**29.** Reset action is achieved by moving switch 3SW1 to the KILL position, energizing relay 1RL4 via 1PL4 pin C. The supply is removed from 1PL4 pin B and thus 1RL3 and transistor 1T1. The voltage at 1C6 is removed by the resistance 1R21.

### Earth leakage indication

**30.** An indication of earth leakage is provided, via lamp 3L1, when the earth leakage current exceeds 10 mA. In the event of a line being short-circuited to earth the appropriate indication will be given; the maximum fault current is effected by the inclusion of 1R4.

**31.** Should a fault occur the earth leakage current is rectified by 1MR5 and applied to transductor 1TD4, and is thereby interpreted as an undervoltage condition. Consequently lamp 3L1 lights to provide the required indication.

### System inoperative

**32.** An indicator lamp 3L2 is fed from the 28 V d.c. busbar via the RUN/KILL switch and normally closed contacts on the auxiliary relay fitted to the aircraft. With the system functioning normally the contacts of the aircraft auxiliary relay are open (energized via 1PL4, pin D), and the lamp is extinguished. If the system becomes inoperative for any reason, with the RUN/KILL switch in the RUN position the auxiliary relay is de-energized and appropriate indication is given via lamp 3L1.

## INSTALLATION

**33.** The unit must be mounted base downwards and secured by four 0·250 in. UNF stiff anchor nuts located in the base of the unit. Electrical connections are made via four plugs mounted on the top of the unit.

## SERVICING

### Insulation resistance tests

**34.** Check the insulation resistance of the unit, as indicated in para. 35 to 42.

**35.** Common together pins A, B, C, D, E, F, and G on the socket for 1PL1, pins B, C, D, and P on the socket for 1PL4, pins D and E on the socket for PL2 and with flying leads and crocodile clips, the terminals A7, B7, C7, B9 and B10 on transformer 1TR3. Bring out the connection as a common lead. Also common together pins A, B and C on the socket for PL2 and bring out the connection as a common lead.

**36.** Common together pins K and L on the socket for PL4 and with flying leads and crocodile clips, terminals A5, B5 and C5 on transformer TR2 and terminals A3, B3, C3, C9, C10 of transformer 1TR2. Bring out the connection as a common lead.

**37.** Common together pins A and F on the socket for 1PL4 and bring out the connection as a common lead.

**38.** Common together pins J and H on the socket for 1PL4 and bring out the connection as a common lead. Also common together pins G and I on this socket and bring out the connection as a common lead.

**39.** Connect a separate lead to pin E on the above socket.

**40.** With flying leads and crocodile clips, common together terminals A9 and A10 on transformer TR3 and bring out the connection as a common lead.

**41.** Connect all but the first commoning lead to a suitable point on the chassis (e.g. shell of the connecting plug) and with a 500-volt insulation resistance tester check the insulation resistance; the reading should not be less than 5 megohms.

**42.** Repeat the insulation resistance test on each commoning lead in turn with the other seven remaining connected to the chassis. With a 500-volt insulation resistance tester the reading obtained should not be less than 5 megohms.

| Cct. Ref. | Description | Value | Part 1 |
|---|---|---|---|
| 1R1 | Bias resistor | 620 Ω 3 W | |
| 1R2 | Feed back load resistor | 10 K 4½ W | |
| 1R3 | Feed back series resistor | 390 Ω 1½ W | |
| 1R4 | Leak limiter | 6·8 K 1½ W | |
| 1R5 | Signal resistor | 100 Ω 3 W | |
| 1R6 | Signal trim resistor | 33 Ω 1½ W | |
| 1R7 | Undervoltage resistor | 120 Ω 3 W | |
| 1R8 | Overvoltage resistor | 150 Ω 3 W | |
| 1R9 | Starting resistor | 4·7 Ω 6 W | |
| 1R10 | Starting resistor | 4·7 Ω 6 W | |
| 1R12 | Field short ballast | 1·2 K 3 W | |
| 1R13 | Overvoltage trim resistor | 22 Ω 1½ W | |
| 1R14 | Overvoltage trim resistor | 22 Ω 1½ W | |
| 1R15 | Undervoltage trim resistor | 22 Ω 1½ W | |
| 1R16 | Undervoltage trim resistor | 22 Ω 1½ W | |
| 1R17 | Current feedback resistor | 1·5 K 3 W | |
| 1R19 | Relay hold resistor | 680 Ω 1½ W | |
| 1R20 | Barretter ballast resistor | 22 Ω 1½ W | |
| 1R21 | Pulsed tickle resistor | 1 K 1½ W | |
| 1RV1 | Output bias control | 350 Ω ½ W | |
| 1RV2 | Signal control coarse | 25 Ω ½ W | |
| 1RV3 | Signal control fine | 25 Ω ½ W | |
| 1RV4 | Merz-Price trim | 100 Ω ½ W | |
| 1RV5 | Undervoltage trim | 25 Ω ½ W | |
| 1RV6 | Overvoltage trim | 25 Ω ½ W | |
| 1RV7 | Coupling control | 450 Ω ½ W | |
| 1RV9 | Earth leakage trim | 750 Ω ½ W | |
| 1RV10 | Relay operate control | 680 Ω | |
| 1C1 | Feedback capacitor | 15 μF 150 V d.c. | |
| 1C2 | Isolating capacitor | 1 μF 150 V d.c. | |
| 1C3 | Current feedback capacitor | 40 μF 12 V d.c. | |
| 1C4 | Output transductor control winding capacitor | 10 μF 6 V d.c. | |
| 1C5 | Earth leakage capacitor | 1 μF 150 V d.c. | |
| 1C6 | Pulsed tickle delay capacitor | 140 μF | |
| 1MR1 | Compounding rectifier | | |
| 1MR2 | Excitation rectifier | | |
| 1MR3 | Feedback rectifier | | |
| 1MR4 | Main auto rectifier | | |
| 1MR5 | Earth leakage rectifier | | |

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**Table 1**
**Circuit component details**

| *Number* | *Cct. Ref.* | *Description* | *Value* | *Part Number* |
|---|---|---|---|---|
| | 1MR6 | Merz-Price rectifier | | |
| | 1MR7 | Pre-amp. rectifier | | |
| | 1MR8 | Protection rectifier | | |
| | 1MR9 | Indication rectifier | | |
| | 1MR10 | Contactor supply rectifier | | |
| | 1MR11 | Signal rectifier | | |
| | 1MR12 | Blocking rectifier | | |
| | 1MR13 | Current limiting rectifier | | |
| | 1MR14 | Blocking rectifier | | |
| | 1RL1 | Protection relay | 1 c/o 1 BK | |
| | 1RL2 | Undervoltage indication relay | 1 c/o 1 BK | |
| | 1RL3 | Field shorting relay | 2 M 2 B (H.D.) | |
| | 1RL4 | Lock out relay | 4 B (H.D.) | |
| | 1RL5 | Pulsed tickle relay | 2 M 2 B (H.D.) | |
| | 1RL6 | Separate excitation relay | 2 M 2 B (H.D.) | |
| | 1TR1 | Compounding transformer | | P7302 |
| | 1TR2 | Excitation transformer | | P7402 |
| | 1TR3 | Supply and reference transformer | | P7501 |
| | 1TR4 | Current limiting transformer | | |
| | 1TD1 | Excitation transductor | | P7102 |
| | 1TD2 | Pre-amp. transductor | | P7201 |
| | 1TD3 | Overvoltage protection transductor | | P7002 |
| | 1TD4 | Undervoltage indication transductor | | P7003 |
| | 1PL1 | A.C. protection lines | 7 × 22A | |
| | 1PL2 | A.C. feed in and field | 7 × 73A | |
| | 1PL3 | A.C. feed out | 3 × 73A | |
| | 1PL4 | D.C. control lines | { 2 × 41A<br>14 × 22A | |
| | 1T1 | Pulsed tickle transistor | | |
| | 1L1 | Barretter | | |
| | 2 ALT 1 | Alternator | | NO407<br>NO408 |
| | 2TR1 | Merz-Price transformer | | Part of<br>Alternator |
| | 3TR1 | Merz-Price transformer | | P6601 |
| | 3L1 | Undervoltage warning lamp | | |
| | 3L2 | General failure indicator lamp | | |

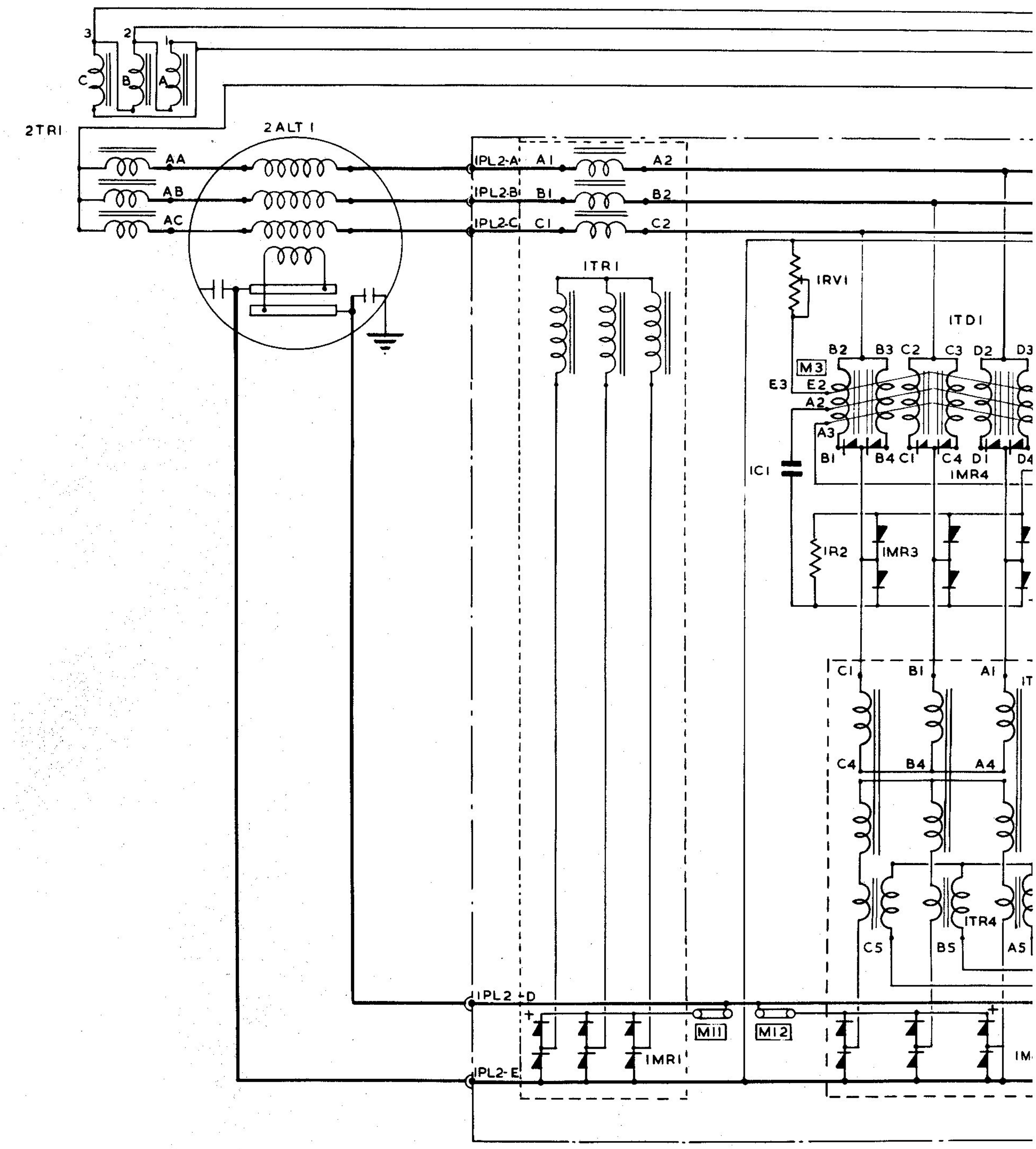


Fig.4

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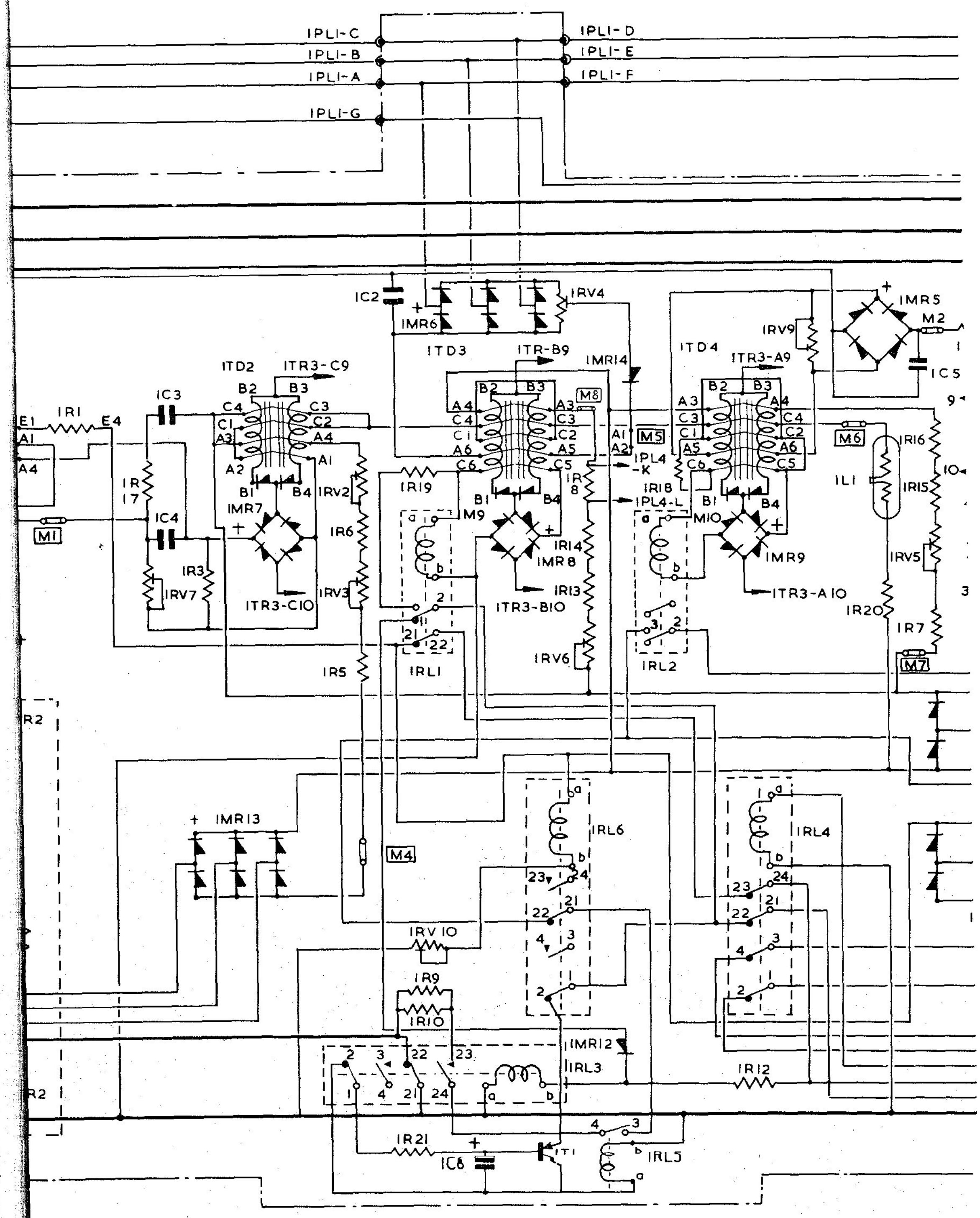
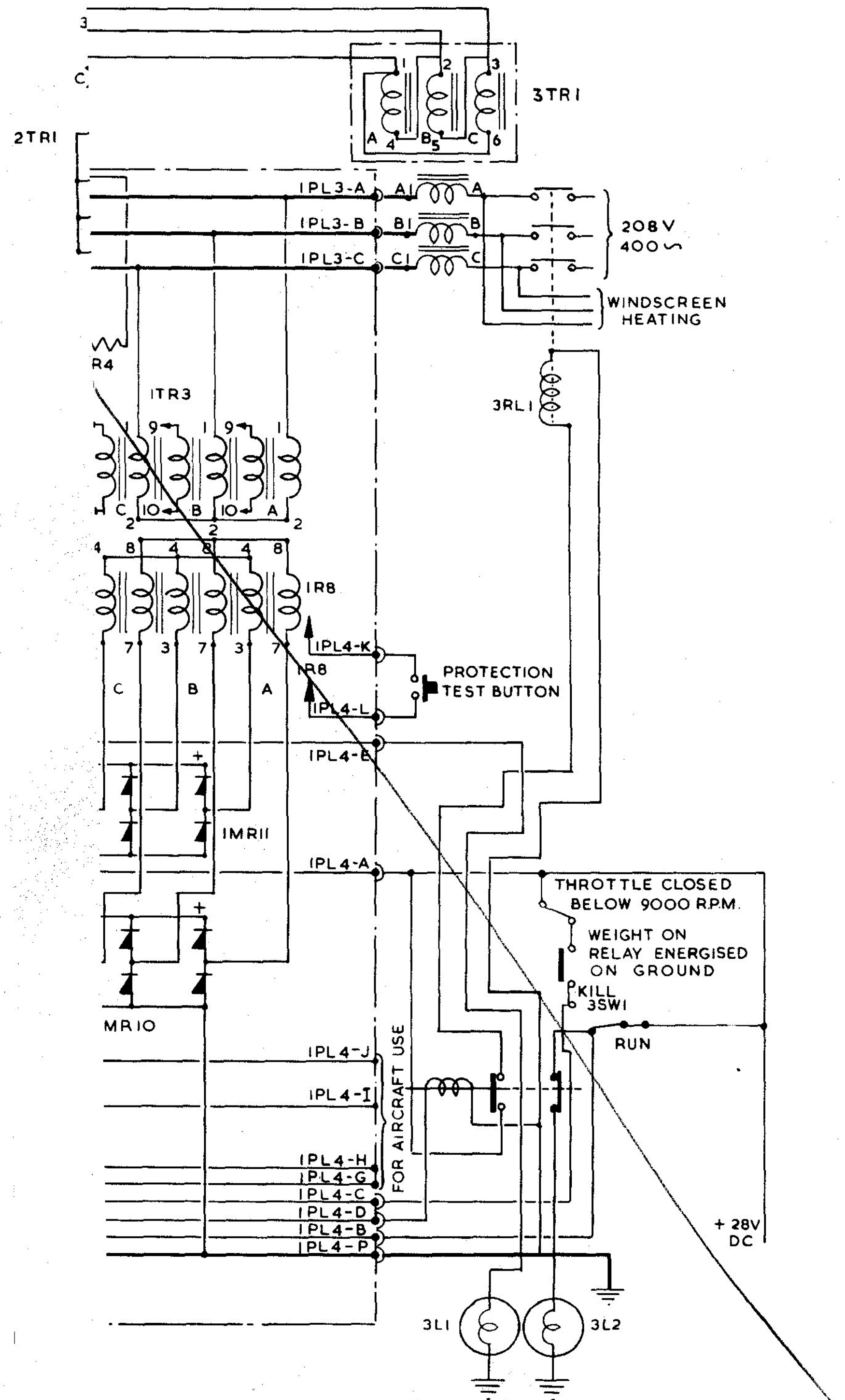



Circuit diagram
RESTRICTED


3TR1
2TR1
1PL3-A
1PL3-B
1PL3-C
208V
400 ∿
WINDSCREEN
HEATING
R4
1TR3
3RL1
1R8
1PL4-K
PROTECTION
TEST BUTTON
1PL4-L
1PL4-E
1MR11
1PL4-A
THROTTLE CLOSED
BELOW 9000 R.P.M.
WEIGHT ON
RELAY ENERGISED
ON GROUND
KILL
3SW1
RUN
MR10
1PL4-J
1PL4-I
FOR AIRCRAFT USE
1PL4-H
1PL4-G
1PL4-C
1PL4-D
1PL4-B
1PL4-P
+ 28V
DC
3L1
3L2

Fig

Fig.4

# Appendix 1

## CONTROL AND PROTECTION UNIT
## ROTAX, TYPE U3704/2

### LEADING PARTICULARS

| | |
|---|---|
| **Control and protection unit, Type U3704/2** | *Ref. No.* 5UC/ |
| *Output voltage* | 208 *volts a.c.* ± 4 *per cent* |
| *Phase* | 3 |
| *Frequency* | 250 *to* 400 *c/s overall* |
| *Load range* | 0–21 *kVA* |
| *Power factor* | *Unity to* 0·9 *lag* |
| *Temperature range* | −40 *deg.C. to* +50 *deg.C.* |
| *Altitude* | 30 000 *ft.* |
| *Cooling* | *natural* |
| *Length* (*over handle*) | 11·750 *in.* |
| *Width* | 9·250 *in.* |
| *Height* | 8·500 *in.* |
| *Weight* | 21·5 *lb.* |

**1.** The U3704/2 is identical to the U3704/1 as described in the main chapter except that the U3704/2 has radio suppression fitted and is modified internally to include circuit alterations, designed to overcome spurious indication in tropical environments, and to compensate for excessive volt drop in the aircraft wiring.

**2.** Additions and alterations to the unit have been made as follows (*fig.* 1 and *Table*1A) :—

(1) Two triple capacitors (ZA6703) with four single capacitors have been added in the circuit to suppress radio interference.

(2) One leak limiter resistor 1R4 has been reduced in value to prevent spurious indication in tropical environments.

(3) One starting resistor 1R11 has been added and is connected in parallel with existing starting resistors 1R9 and 1R10; this has been introduced to compensate for excessive voltage drop in the aircraft wiring.

**3.** The circuit component details are as for Table 1 in the main chapter, except for the additions and alterations as follows:—

(Addendum to Chap. 4, Table 1)

**Circuit component details**

**Table 1A**

| Cct. Ref. | Description | Value | Part Number |
|---|---|---|---|
| 1R4 | Leak limiter resistor | 4·7K $1\frac{1}{2}$W | N.113590/65 |
| 1R11 | Starting resistor | 4·7Ω 6W | N.113593/109 |
| 1C7 | Capacitor | 2 μF | N.45574 |
| 1C8 | Capacitor | 2 μF | N.45574 |
| 1C9 | Capacitor | 2 μF | N.45574 |
| 1C10 | Capacitor | 2 μF | N.45574 |
| 1C11 | Three capacitors | 0·5 μF | ZA.6703 |
| 1C12 | Three capacitors | 0·5 μF | ZA.6703 |

## SERVICING

**4.** All soldered connections should be carefully inspected for dry and high resistance joints. Reference should be made to the theoretical circuit diagram (*fig.* 1) when applying tests detailed in para. 5 and 6 respectively.

### Continuity test

**5.** (1) Using a low voltage bridge (e.g. Wheatstone), connect leads to the shells of PL1 and PL2. The resistance measured between PL1 and PL2 should not exceed 0·05 ohm.

(2) Transfer the lead from the shell of PL2 to that of PL3. The resistance measured between PL1 and PL3 should not exceed 0·05 ohm.

(3) Transfer the lead from the shell of PL3 to that of PL4. The resistance measured between PL1 and PL4 should not exceed 0·05 ohm.

### Insulation resistance tests

**6.** (1) Common together pins A, B, C, D, E, F, G on a 7-pole socket (AN.3106A–16S–1S) for PL1, pins B, C, D, P on a 16-pole socket (AN.3106A–24–7S) for PL4, pins D, E on a 7-pole socket (AN.3106A–24–10S) for PL2, and bring out connection as a common lead. On the above socket for PL2, common together pins A, B, C and bring out connection as a common lead.

Similarly, on the above socket for PL4, common together pins K and L and bring out as a common lead. Common together J and H on Socket for PL4 and bring out connection as a common lead. Common together pins G and I on socket for PL4 and bring out connection as a common lead. Connect separate leads to both pins A and E on socket for PL4.

(2) Connect all but the first commoning lead to a suitable point on the chassis e.g. the shell of the connecting plug, and measure the insulation resistance with a 500 volt insulation resistance tester. It should not be less than 5 megohms.

(3) Repeat the insulation resistance test between the chassis and each of the remaining commoning leads in turn, with the other six commoning leads connected to the chassis. In each case, the insulation resistance should not be less than 5 megohms.



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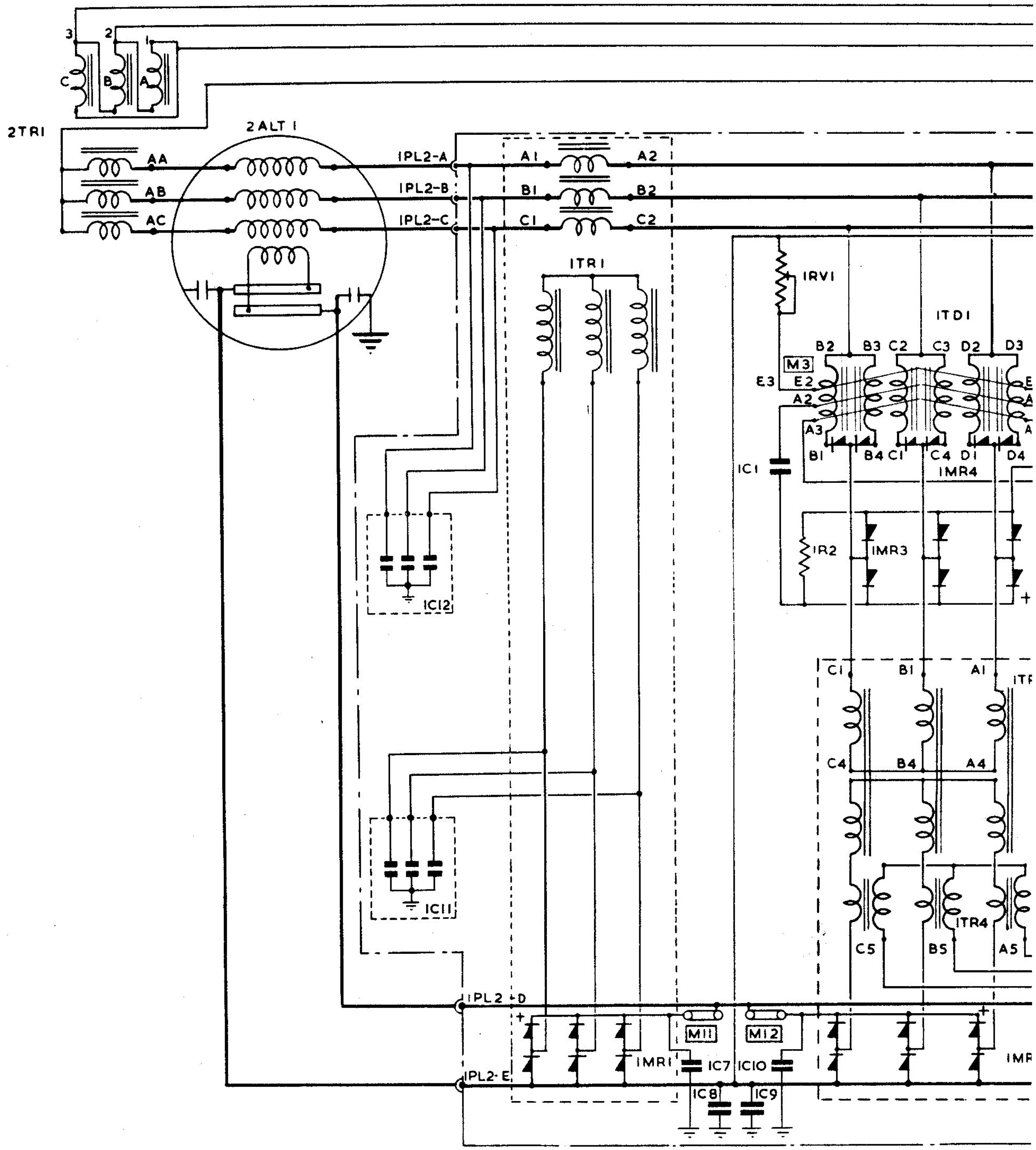
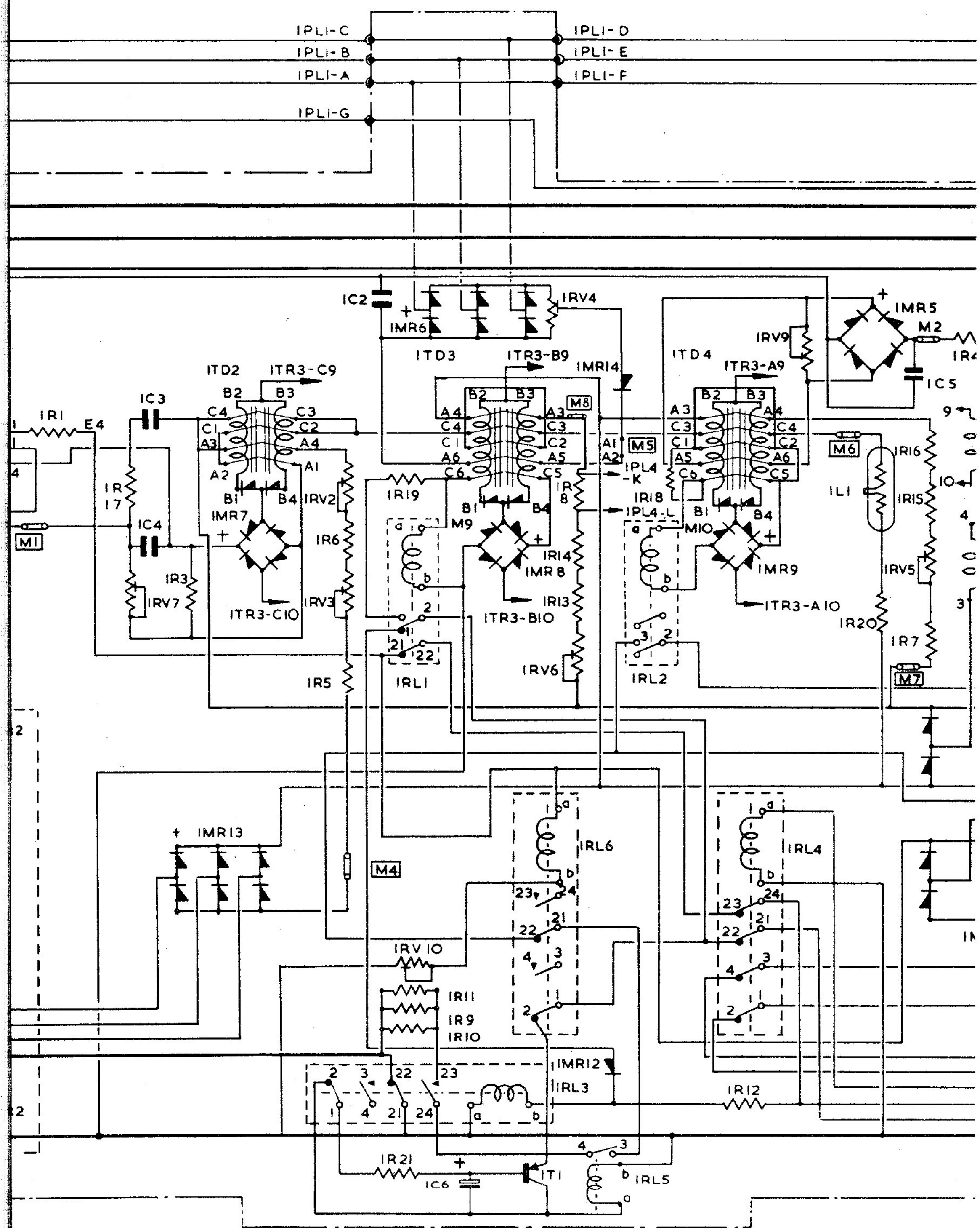



Fig.1

PP8913 147015/3340 8/61 2131 C&P Gp. 924 (4)




Circuit diagram
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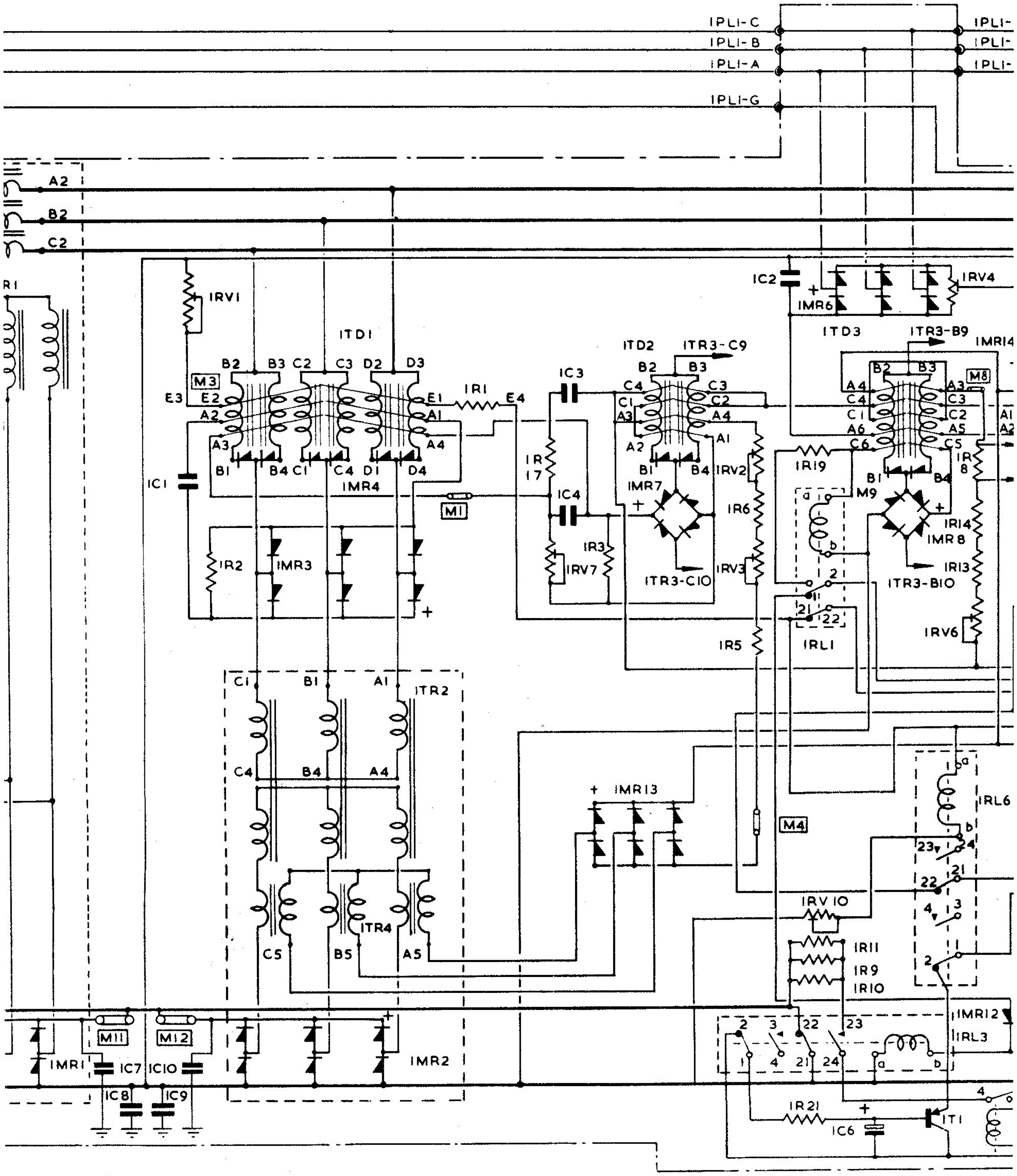


Circuit diagram
RESTRICTED

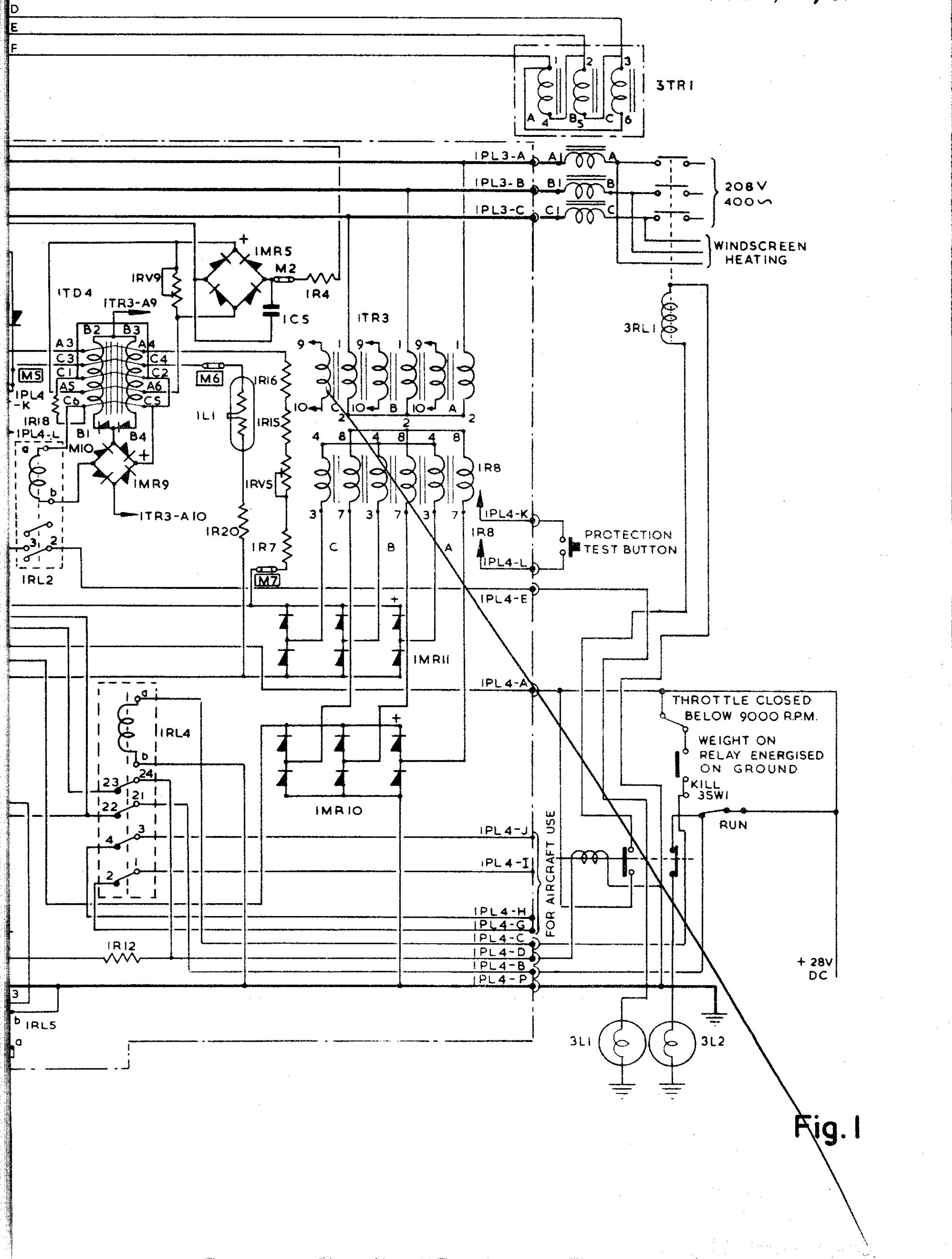
D
E
F
3TR1
1PL3-A
1PL3-B
1PL3-C
208V
400∿
WINDSCREEN HEATING
1MR5
M2
1R4
1RV9
1TD4
1TR3-A9
1C5
1TR3
3RL1
M5
1PL4-K
1R18
1PL4-L
M6
1R16
1L1
1R15
1RV5
1MR9
1TR3-A10
1R20
1R7
M7
1RL2
1R8
1PL4-K
1R8
1PL4-L
PROTECTION TEST BUTTON
1PL4-E
1MR11
1PL4-A
THROTTLE CLOSED BELOW 9000 R.P.M.
WEIGHT ON RELAY ENERGISED ON GROUND
KILL
3SW1
RUN
1RL4
1MR10
1PL4-J
1PL4-I
FOR AIRCRAFT USE
1PL4-H
1PL4-G
1PL4-C
1PL4-D
1PL4-B
1PL4-P
1R12
+28V DC
1RL5
3L1
3L2

Fig. 1