## Group 3.A

# INTEGRATED FLIGHT INSTRUMENT SYSTEM (FULL)

# WITH TACAN AND STANDBY INSTRUMENTS

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## LIST OF ILLUSTRATIONS



## TABLE

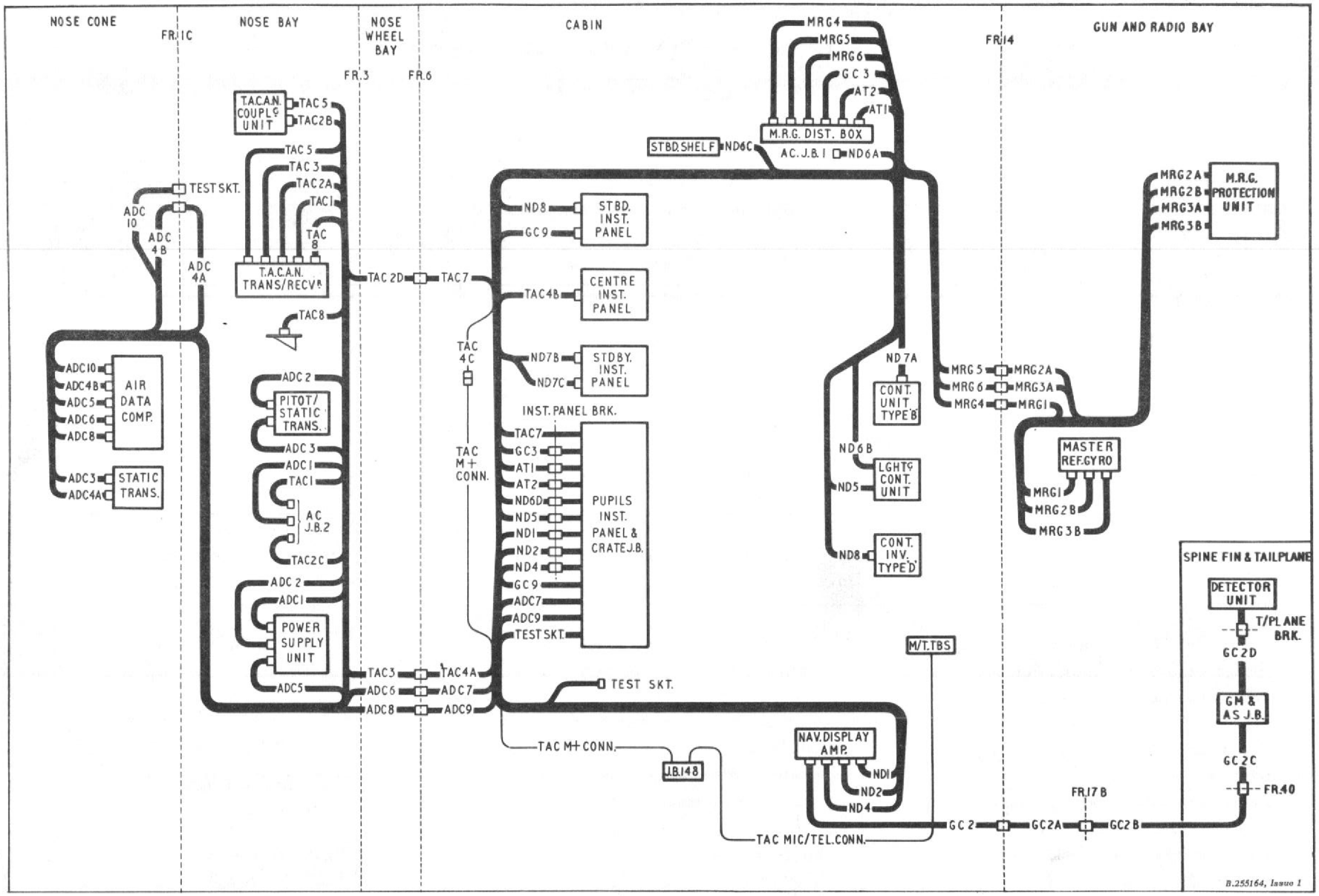


**Fig.1 I.F.I.S. cable layout (schematic)**

**Introduction**

1. This Group contains a description of the aircraft's fully integrated flight instrument system with Tacan and standby instruments, together with circuit diagrams and information on the servicing required to maintain the equipment in an efficient condition. For a general description of the aircraft instrument installation, reference should be made to Groups 1.A, 1.B and 1.C Detailed information on the standard items of equipment used will be found in the Air Publications listed in Table 1, but for full details of the complete system, reference should be made to A.P.4685E, Vol.1.

## TABLE 1

**Equipment used and Air Publication reference**

| Equipment Type | Air Publication |
|---|---|
| Master reference gyro, Mk.1, Type E | A.P.4685, Vol.1, Part 2, Sect.1 |
| M.R.G. distribution box | A.P.4685, Vol.1, Part 5, Sect.1 |
| M.R.G. protection unit | A.P.- |
| Compass detector unit, Type A<br>Navigation display amplifier, Type A<br>Offset computor, Type B | A.P.4685, Vol.1, Part 2, Sect.2 |
| ◀ Navigation display unit, Type C<br>Attitude indicator, Type F.4B or F.4D *(Mod.1329)* ▶ | A.P.4685, Vol.1, Part 2, Sect.5 |
| Compass repeater, Mk.2 | A.P.1275B, Vol.1, Sect.11 |
| ◀ Fast erection switches, Type C5162Y | A.P.113D–1108–1 ▶ |
| Air data computor, Type B<br>Static transducer, Type B<br>Pitot-Static Transducer, Type B<br>Power supply unit, Type C | A.P.4685, Vol.1, Part 2, Sect.3 |
| Long speed display unit, Type A<br>Height and vertical speed display unit, Type C | A.P.4685, Vol.1, Part 2, Sect.5 |
| Artificial horizon, Mk.6.C<br>Direction indicator, Type A<br>Control unit, Type B | A.P.1275A, Vol.1, Sect.13 |
| Integral lighting control box | A.P.4343E, Book 4, Sect.22 |

## DESCRIPTION

**General**

2. The integrated flight instrument system *(I.F.I.S.)* in this aircraft is subdivided into two main systems, the dynamic reference system and the aerodynamic system. The dynamic reference system has at its centre the master reference gyro; this provides elevation and bank information to tne attitude indicator, and heading data to the navigation display in conjunction with the compass detector unit, and Tacan when selected. At the heart of the aerodynamic system is the air data computor; this in conjunction with its associated transducers supplies the necessary data to the height, vertical speed and long speed displays.

**System details**

*Dynamic reference system*

3. The dynamic reference system derives its data, in the form of electrical signals, from the compass detector unit and the master reference gyro. Bank and elevation data is provided by the mercury sensing switches on the M.R.G. platform, which by means of servo links, cause the vertical gyro to motor into the stable position. This difference in position is then communicated to the attitude indicator, which shows the position of the aircraft relative to the horizon.

4. Heading information is obtained indirectly from the azimuth gyro of the M.R.G. *(para.10)* this being long term monitored by

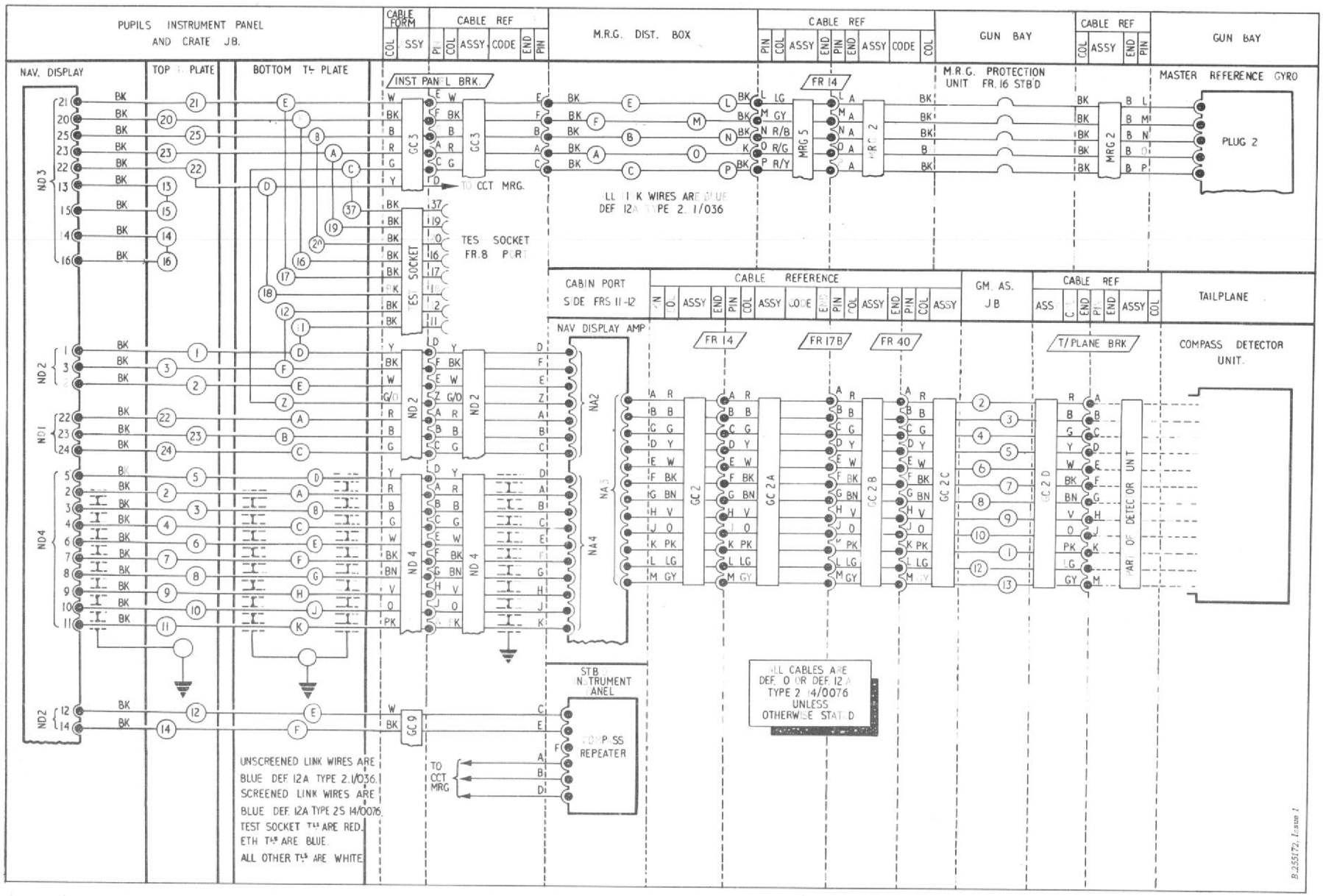


**Fig.2 Dynamic reference system, compass and monitoring system (routeing)**

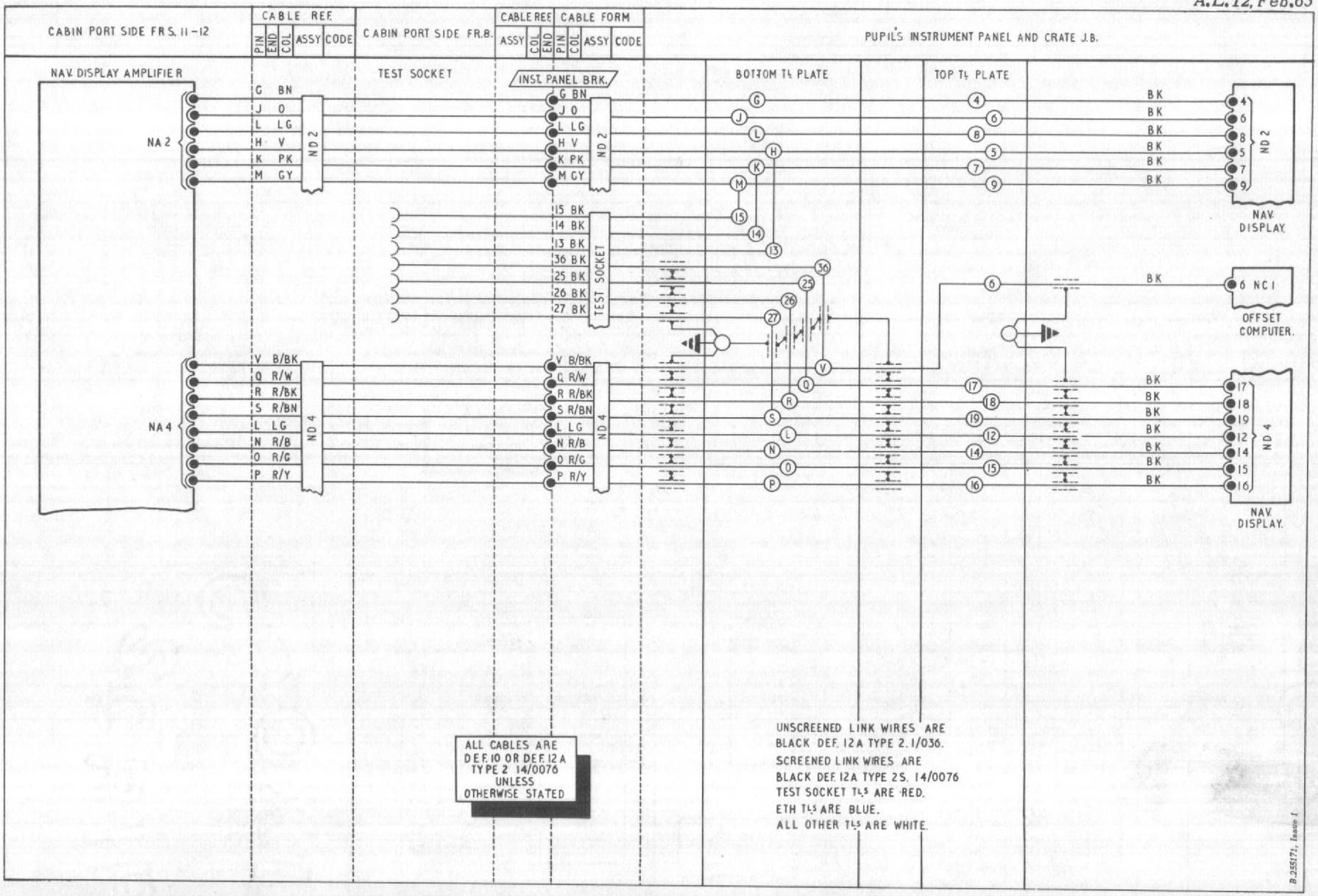


**Fig.3 Dynamic reference system, navigation display amplifier calibration outputs (routeing)**

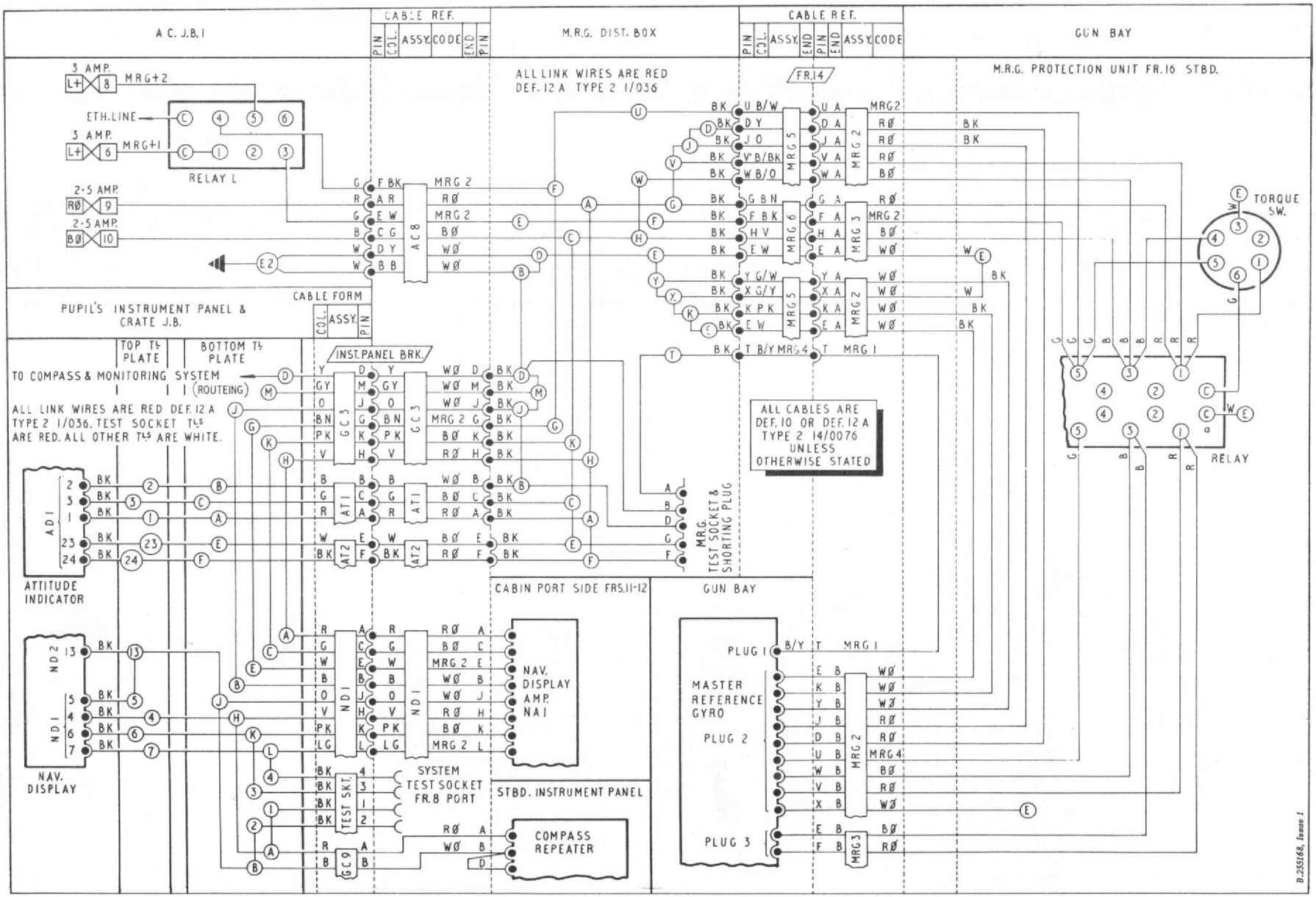


**Fig.4 Dynamic reference system, power supplies (routeing sheet 1)**

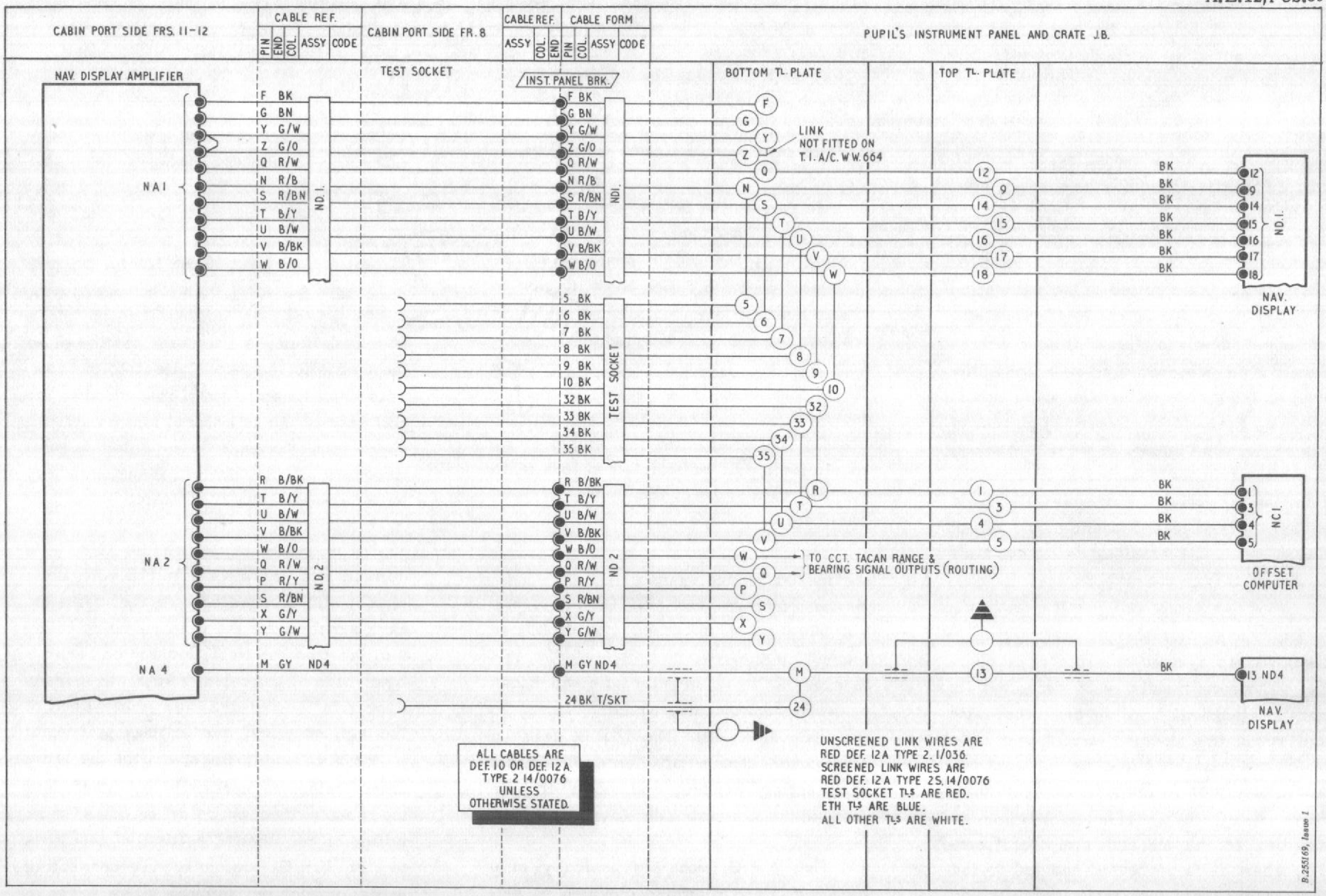


**Fig.5 Dynamic reference system, power supplies (routeing sheet 2)**

the compass detector unit *(para.16)* in the tail plane. Any error signals arising from a difference between the output of the detector unit and the position of the compass card in the navigation display *(para. 21)* are used to precess the azimuth gyro, which then returns a signal to shift the compass card until a position is reached where nullification of the error occurs.

**5.** In conjunction with the heading information given, Tacan signals *(Sect.16, Chap.2)* may also be fed to the navigation display. These signals can represent direct or offset bearings *(para.25)* and ranges from Tacan beacons; via servo links, the data is fed to the roller blind mechanism, range counter and Tacan bearing pointer of the navigation display. In the offset mode, a computor is incorporated to resolve the information derived from manually made settings of range and bearing, and direct Tacan data, the resultant being read off by the pilot from the display.

*Aerodynamic system*

**6.** The aerodynamic system acquires its data in electrical form, via the pitot-static and static transducers *(para.34 and 35)*, which are connected into the pressure and static pipelines of the pitot head installation *(Group 3.C)*. This information is supplied to the air data computor *(para-37)*, where it is processed and fed to the instruments of the integrated display *(paras.41 to 46)* associated with height, vertical speed, speed and Mach number.

*Standby flight instrument system (S.F.I.S.)*

**7.** The standby flight instrument system derives its heading information from a directional gyro *(para.59)* mounted on the control unit, and attitude data from a gyro within the artificial horizon *(para.52)*. Both gyros are automatically controlled and run up by the control unit.

**8.** In the event of failure of the aircraft's a.c. system and hence supplies to the control unit, the single phase power requirement of the S.F.I.S. is maintained by the inverter in the control unit which is fed from the normal d.c. supply.

**9.** If the normal d.c. supply fails, current will be fed to the inverter, from the standby batteries, and the single phase requirement will be maintained in a similar way to that described in the previous paragraph.

**Dynamic reference system**

*Master reference gyro. (M.R.G.)*

**10.** The master reference gyro *(fig.2)* is located on the rear face of frame 14, and is mounted on a hinged cradle which can be swung downwards, enabling access to the main inverters. The M.R.G. feeds a continuous stream of electrical signals representing heading and flight attitude data, to the integrated displays.

**11.** The M.R.G. consists basically of a gyro stabilized platform, operated by servomotors, and carries the vertical *(earth)* and azimuth gyros. The vertical gyro serves only to maintain the platform relative to the vertical; this condition is monitored by gravity-seeking mercury switches mounted at right angles to each other on the plane of the platform. If the platform topples, the associated mercury switch closes and operates a servo, thereby motoring the platform back to the stable condition. Attached to the inner and outer platforms are synchros, resolvers, and linear potentiometers which transmit elevation and bank data to the attitude indicator *(para.27)*. The azimuth gyro, which has its axis horizontal to the plane of the platform, is long term monitored by the magnetic fluxgate element of the compass detector unit *(para.16)*, carried in the port side of the tail plane, and provides a short term reference from which angular movement of the aircraft in azimuth may be measured.

**12.** The power supplying the M.R.G. is derived from the aircraft's 115 volt, three phase, 400 c/s and 28 volt d.c. systems. Both supplies are fed via four fuses in the a.c. junction box No.1, located on the starboard side of the cabin. Two of these fuses appear in the red and blue phase lines of the a.c. supplies, and another pair exist in the d.c. supply lines; one of the latter fuses being automatically switched into the supply feed by relay L *(fig.4)* upon failure of the other. Electrical connections to the M.R.G. are made via connecting leads brought out through glass seals in the sealed case of the unit, which terminate in a plug and socket.

*M.R.G. distribution box*

**13.** The M.R.G. distribution box *(fig.2)*, situated above the a.c. junction box No.1 provides interconnection between the M.R.G. and other equipments and connects the manually controlled fast-erection switches to the M.R.G. In addition, it houses a test socket *(para.32)* for connection to the system during first line servicing, the socket being shorted out by provision of a suitable plug, when not in use.

**14.** Within the interior of the distribution box the connections from the plugs and sockets and internal links are made at a terminal platform divided into sections, one for each plug and socket. The terminal links are coloured in order that the service to which they belong may be identified.

*M.R.G. protection unit*

**15.** The M.R.G. protection unit is housed in a metal case which is located on the forward face of frame 15 and provides protection of the M.R.G. from damage following a partial failure of the power supplies. The protection unit consists of a power failure unit, a power failure relay and a terminal board. The a.c. and d.c. supplies are fed to contacts on the relay and power failure unit *(torque switch)* and the sequence in which these components operate ensures that no d.c. is supplied to the M.R.G. before the a.c. supply voltage level and phase sequencing is correct.

*Compass detector unit*

**16.** The compass detector unit *(fig.2)* is located in the tail plane and is mounted in an upright position relative to the fore and aft axis of the aircraft. The unit is basically composed of two pairs of magnetically sensitive elements arranged at right angles to each other, one pair parallel with the fore and aft axis of the aircraft and the other pair parallel with the athwartships axis, which together measure the horizontal component of the earths magnetic field.

**17.** The output signals from the detector unit are fed to the navigation display *(para.21)* where a comparison is made with the position of the compass card, the resultant signal corresponding in phase and amplitude with the degree of card misalignment. This signal is then amplified in the navigation display amplifier *(para.19)* and fed to the M.R.G. *(para.10)* where it is used to precess the azimuth gyro. The azimuth gyro then returns a signal to shift the compass card until a position is reached where the misalignment signal is nullified.

**18.** During violent manoeuvres of the aircraft, the output from the detector unit is disconnected within the M.R.G. and the system functions as a directional gyro. By this means, errors are minimised but any that do occur are removed at the rate of 2 to 3 deg./min. when monitoring has been restored.

*Navigation display amplifier*

**19.** The navigation display amplifier *(fig.2)*, situated on the port side of the cabin between frames 11 and 12, contains the compass monitoring amplifier and servo-amplifiers associated with the navigation display system. The servo-amplifiers increase the error signal levels within each servo loop sufficiently to control the associated servo motors, which in turn drive the indicating devices to positions which nullify the error signals.

**20.** The purpose of the compass monitoring amplifier is to amplify and demodulate error signals obtained from the compass card in the navigation display *(para.21)* during periods of misalignment with the earths magnetic field, as determined by the detector unit, and use these signals to precess the azimuth gyro in such a direction as to rotate the compass card towards the synchronised heading. Electrical connections to the instrument are made by way of plugs and sockets on the rear panel.

*Navigation display*

**21.** The navigation display *(fig.2)*, located on the pupil's flying instrument panel, is capable of presenting compass I.L.S., Tacan *(via the Tacan coupling unit Sect. 6, Chap.2 and the offset computor para.25)* and data link information dependent upon the mode selected by the pilot. In this aircraft, data link and I.L.S. are not available, but by selection of the data link position,

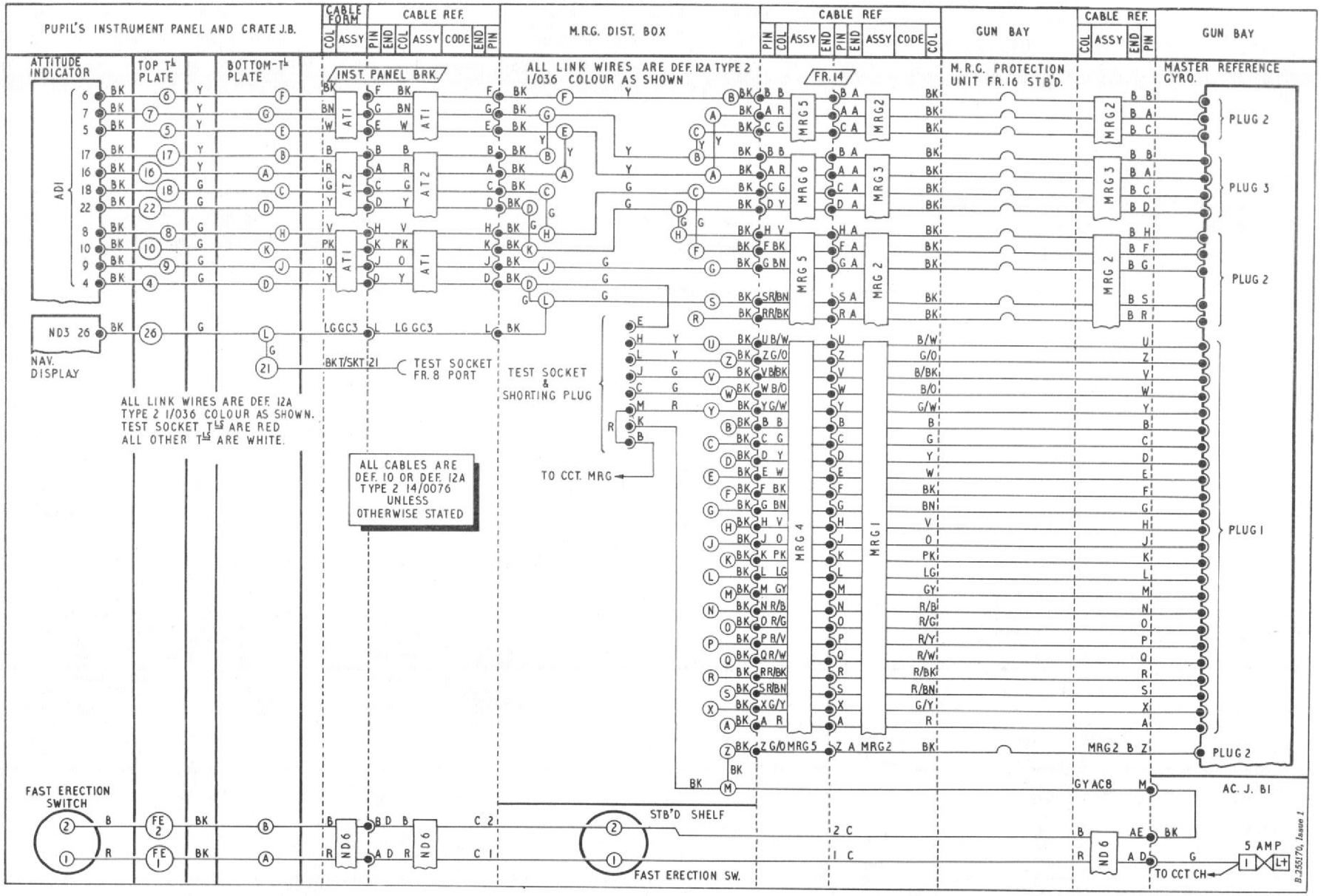


**Fig.6 Dynamic reference system, signal outputs, control and power failure warning (routeing)**

during a radio silence Tacan bearing information may be routed to the display.

**22.** Flight data on the display is presented on a 'roller blind' situated in a space surrounded by the compass card which is always operating and visible. All navigational information is therefore related to magnetic heading as resolved by the detector unit. Synchronisation of the compass card is achieved by way of a knob marked SYN at the bottom right hand corner of the display unit, and indicated by an annunciator flag which shows that this condition has been reached. Desired heading is selected by a control marked HDG situated at the bottom left hand corner of the instrument. A switch, bearing the letters D.G., is situated on the left hand side of the display for use when it is required to operate the M.R.G. as a directional gyro only. Upon operation of this switch, the path to the torque motor of the azimuth gyro will be open-circuited thus allowing the gyro to be used directionally. To indicate that this selection has been made, a flag bearing the letters D.G. will appear in a small window beneath the switch.

**23.** The entire presentation is illuminated by six lamps behind red filters, the lamps being fed by the 3 phase 400 c/s supply via the integral lighting control unit *(para.48)*. Three lamps are connected in parallel across opposite phases with a common line so that in the event of the loss of a single phase, three lamps would continue to function. No power failure warning device is provided in this display, but is shown on the power failure flag of the attitude indicator *(para.27)* which serves both instruments. Electrical connections to the display are provided by means of four multi-pole plugs at the rear, and the instrument, which is readily removable, is locked in its mountings by a securing stud.

*Compass repeater*

**24.** The compass repeater *(fig.2)* is situated on the starboard instrument panel between the altimeter and the turn and slip indicator. This instrument is slaved to the navigation display by means of a synchro link, and provides an additional display of heading information.

*Offset computor*

**25.** The offset computor *(fig.3)* is located above the navigation display on the pupil's flying instrument panel. The purpose of the computor is to convert the manually selected settings of offset range and bearing into electrical signals, and transmit them via a synchro resolver to the navigation display *(para.21)* where they are added to the direct Tacan signals from the Tacan couplings unit *(Sect.6, Chap.2)*. The position of the 'roller blind' and 'roller blind carriage' on the navigation display is thus determined by the resultant sum of these signals.

**26.** The computor dials are illuminated by two lamps located behind red filters and supplied via the "integral lighting control unit *(para.48)*. The lamps are wired in such a way that in the event of the loss of a single phase, one lamp would continue to function. A 16-pole plug protruding through the rear plate provides all the necessary connections for the operation of the computor, and a fixing lug is used to secure the instrument in position.

*Attitude indicator*

**27.** The attitude indicator *(fig.4)*, situated to the left of the navigation display on the pupil's flying instrument panel, provides an instantaneous display of the aircraft's attitude in elevation and bank, relative to the horizon. This is achieved by means of a 'roller blind' mounted on a rotatable carriage, the 'blind' being divided into two sections one pale grey and the other black, representing the sky and earth respectively. Controlled by synchro signals from the M.R.G. *(para.10)* which drive servomotors within the instrument, the display provides indications of bank and elevation angles through a 360 deg. range of roll and pitch to an accuracy of ± 1 deg., with a dead sector of 0.5 deg. In addition, aircraft slip conditions are shown by a ball-and-tube slip indicator situated just above the attitude display.

**28.** The presentation is illuminated by four lamps behind red filters, a lamp and filter being mounted in each corner of the instrument. The lamps are fed via the lighting control unit *(para.48)* and are

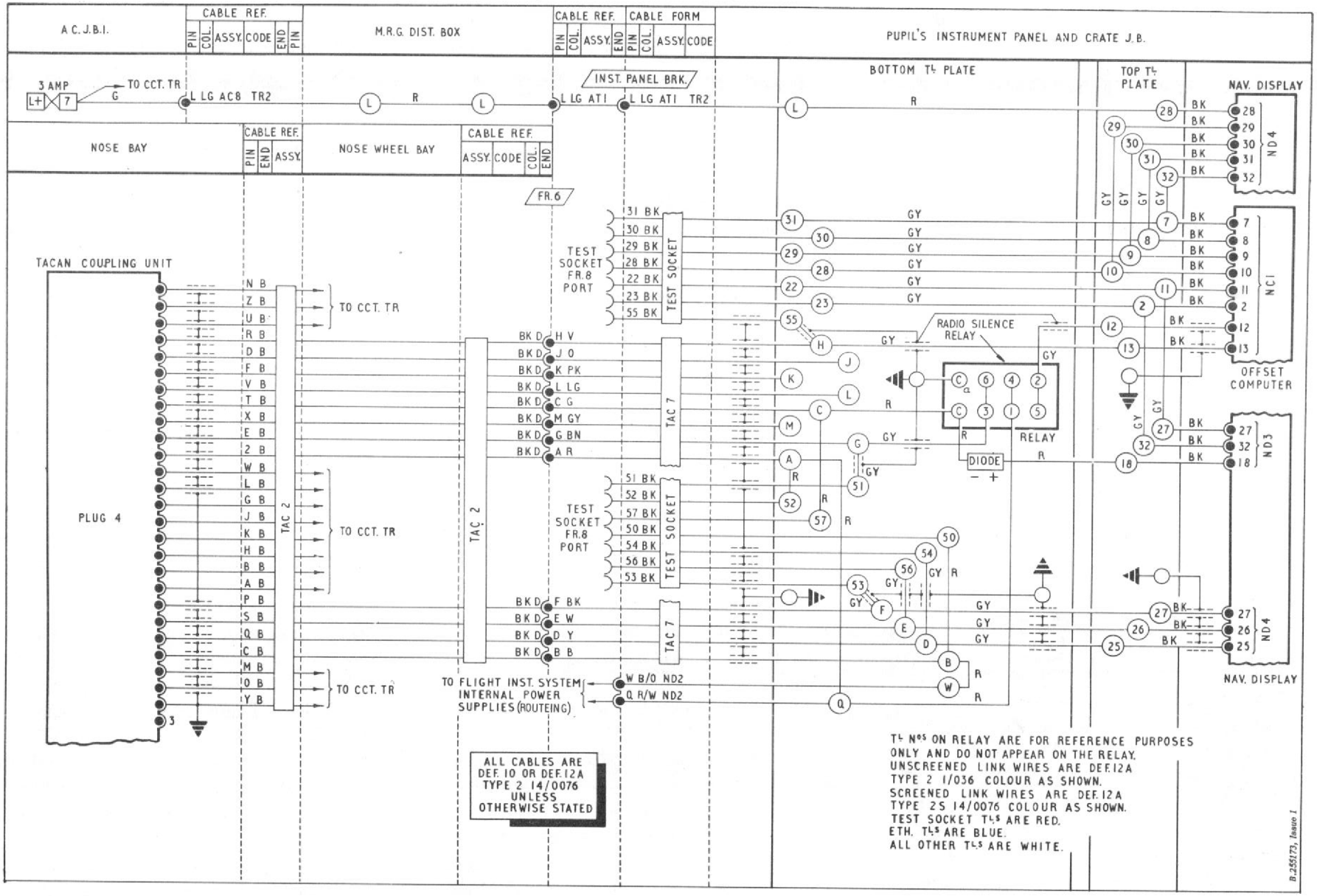


**Fig.7 Dynamic reference system, Tacan range and bearing outputs (routeing)**

wired so that with the loss of a single phase, two lamps would continue to function. The power failure warning device is located on the right hand side of the instrument and consists of a translucent orange disc bearing two white arrows. When the instrument is supplied with power the disc is obscured by a solenoid operated black flag, but should the supply fail, the flag will be released and the translucent orange disc, which is illuminated, will be exposed. This warning device also serves the navigation display *(para.21)* to which no separate warning indicator is provided. Electrical connections to the instrument are made via a special sliding type multipole plug, mounted on the rear panel, the fuses for the red and blue phases are also mounted on this panel and the instrument is secured in its mountings by a locking stud.

*Fast erection switches*

**29.** During periods of sustained acceleration and violent manoeuvres of the aircraft, sufficient errors may occur causing the M.R.G. platform to erect to a false vertical Normally these errors would be automatically removed at the natural gyro erection rate of 3 deg. per minute. In order that these errors may be removed more rapidly on resuming normal level flight, a manual fast erection push switch *(fig.6)* is provided on the pupil's instrument panel and another on the cabin starboard shelf.

*Dynamic reference system power supply unit*

**30.** Certain units within the dynamic reference system require a specialised power source; this is provided by a power supply unit *(fig.5)* situated in the navigation display amplifier *(para.19)*. The unit is a self contained sub-assembly within the amplifier and supplies suitable voltages from the aircraft's a.c. supply for the servo-amplifier and motors, gain controlled pre-amplifier *(contained in the navigation display)*, detector unit, Tacan buffer amplifiers, and compass monitoring amplifier, also voltages for the Tacan range, and 'roller blind' potentiometers.

**31.** To enable the power supply unit to be removed during servicing operations, a handle is mounted on the top, and the wiring of the amplifier that contains the unit is so arranged that the electrical connections remain undisturbed during removal. The supply fuses are accessible from the top of the unit, and the three insulating boards, also mounted along the top, carry connecting pins which provide a convenient point at which voltage or resistance measurements may be made. The unit obtains its electrical supply from the aircraft's a.c. system *(Sect.5, Chap.1, Group E.1)*.

*Dynamic reference system test sockets*

**32.** The test sockets for the various equipments of the dynamic reference system are listed below, whilst information regarding test sets to be used in conjunction with these sockets is given in para.63.

(1) System - located on the port side of frame 8.

(2) M.R.G. - located in the M.R.G. distribution box.

(3) Navigation display - located on the navigation display amplifier.

**Aerodynamic system**

*Transducers*

**33.** The pitot-static and static transducers *(fig.9)* are located in the nose bay, on frames 3 and 1.C respectively. Delivered to the transducers via the pressure head installation are the pitot and static pressures which are then converted into electrical signals and routed to the air data computer. The transducers consist of capsule units and servo mechanisms.

*Static transducer*

**34.** Static pressure is fed to the static transducer where it is converted into three electrical outputs and transmitted to the computor *(para.37)*. The transducer provides a follow up servo system which delivers a synchro output corresponding to height, for transmission to the height section of the display unit *(para.41)*, together with further outputs in synchro and potentiometer modes for use as primary signals in the air data computor.

*Pitot-static transducer*

**35.** Pitot and static pressures are supplied to the pitot-static transducer which provides a conversion of the difference in

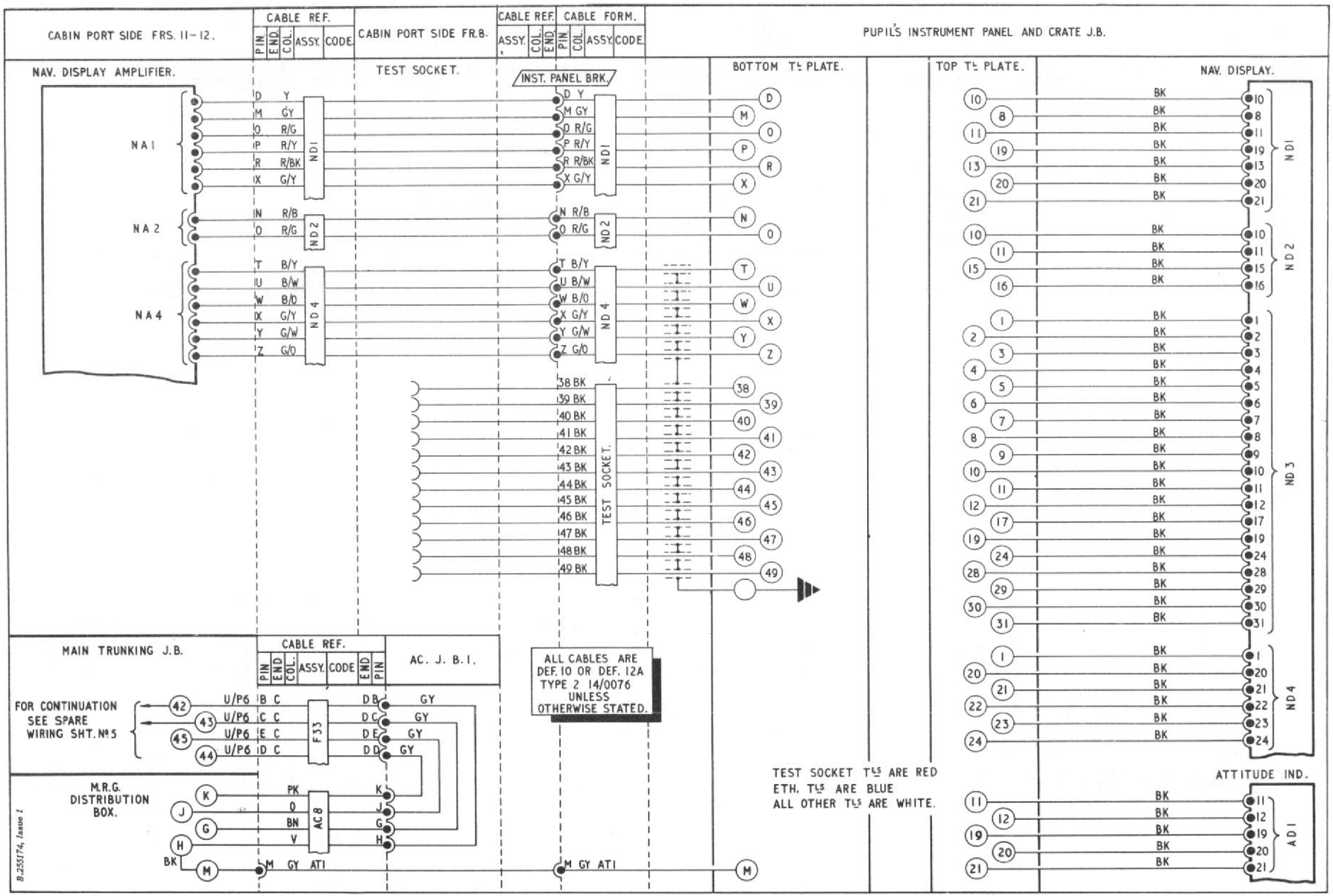


**Fig.8 Dynamic reference system, spare wiring and unused facilities (routeing)**

pressures into two electrical outputs. The transducer constitutes a follow-up servo system delivering an I.A.S. synchro output for transmission to the appropriate display, together with an output in the potentiometer mode for use as a primary signal associated with the air data computor.

**36.** Plugs and sockets on the front panels of the transducers provide the means of connection between them and the air data computor, and adapters which are also located on the front panels, serve as junctions between the transducers and the pitot and static pipelines. The power supplies to the transducers are all derived from the power unit of the air data system.

*Air data computor*

**37.** The air data computor *(fig.9)* is located on the forward face of frame 1.C above the static transducer. The computor *(which is driven by the transducers)*, consists of a number of servo units, each resolving a mathematical equation from the change in any variable in the equation from its initial value. The terms in the equation to be solved are provided in logarithmic form and the actual computation is achieved from the sum or difference of these functions.

**38.** The computors power supplies are derived from the aerodynamic system power supply unit, *(para.39)* and connections between the computor and its associated equipment are made by way of plugs and sockets mounted on the front panel.

*Aerodynamic system power supply unit*

**39.** The air data system power supply unit *(fig.9)* located on the port side of the forward face of frame 3, operates from the aircraft's 115 volt, 400 c/s 3-phase system and supplies all the a.c. and d.c. voltages required by the various units of the air data system, with the exception of the height and vertical speed display *(para. 41)* and long speed display *(para.44)*, each of which has an individual power supply unit.

**40.** No external controls to the supply unit are provided, but two potentiometer networks are accessible upon removal of the unit's cover; these controls are used in setting-up the various signal voltages for the computor. There is no provision for fusing within the unit, and so this requirement is met by two fuses in a.c. junction box No.1. Electrical connections to the unit are made by plugs and sockets mounted on the rear panel.

*Height and vertical speed display*

**41.** The height and vertical speed display *(fig.9)* is situated to the left of the attitude indicator on the pupil's flying instrument panel. The function of the unit is to present indications of altitude in feet, and vertical speed in feet per minute. Synchro outputs are linked to the display from a remotely situated pressure measuring unit *(para.33)* via the air data computor.

**42.** The display comprises two circular dials, one indicating vertical speed by a single pointer, and the other indicating height by a single pointer and a counter. The height presentation is provided with a knob to enable adjustments to be made for prevailing ground or sea level barometric conditions. When the knob is turned, the required millibar reading may be selected on the four digit counter, and the pointer will then move to the corresponding altitude.

**43.** Power supplies to the display are derived from a power pack within the unit; this being fed from the aircraft's 115 volt, 400 c/s 3-phase system. The presentation is illuminated by four miniature lamps with red filters; the lamps being linked to the lighting control unit *(para.48)* and connected in such a way that with the loss of a single phase, each presentation would continue to be illuminated. In the event of incorrect phasing, or failure of the main power supply, an illuminated amber coloured disc, set in an aperture on the altitude dial, will show to indicate a failure. Electrical connections to the display are made by way of a 32-pole plug which is mounted on the rear panel.

*Long speed display*

**44.** The long speed display *(fig.9)* is located on the pupil's flying instrument

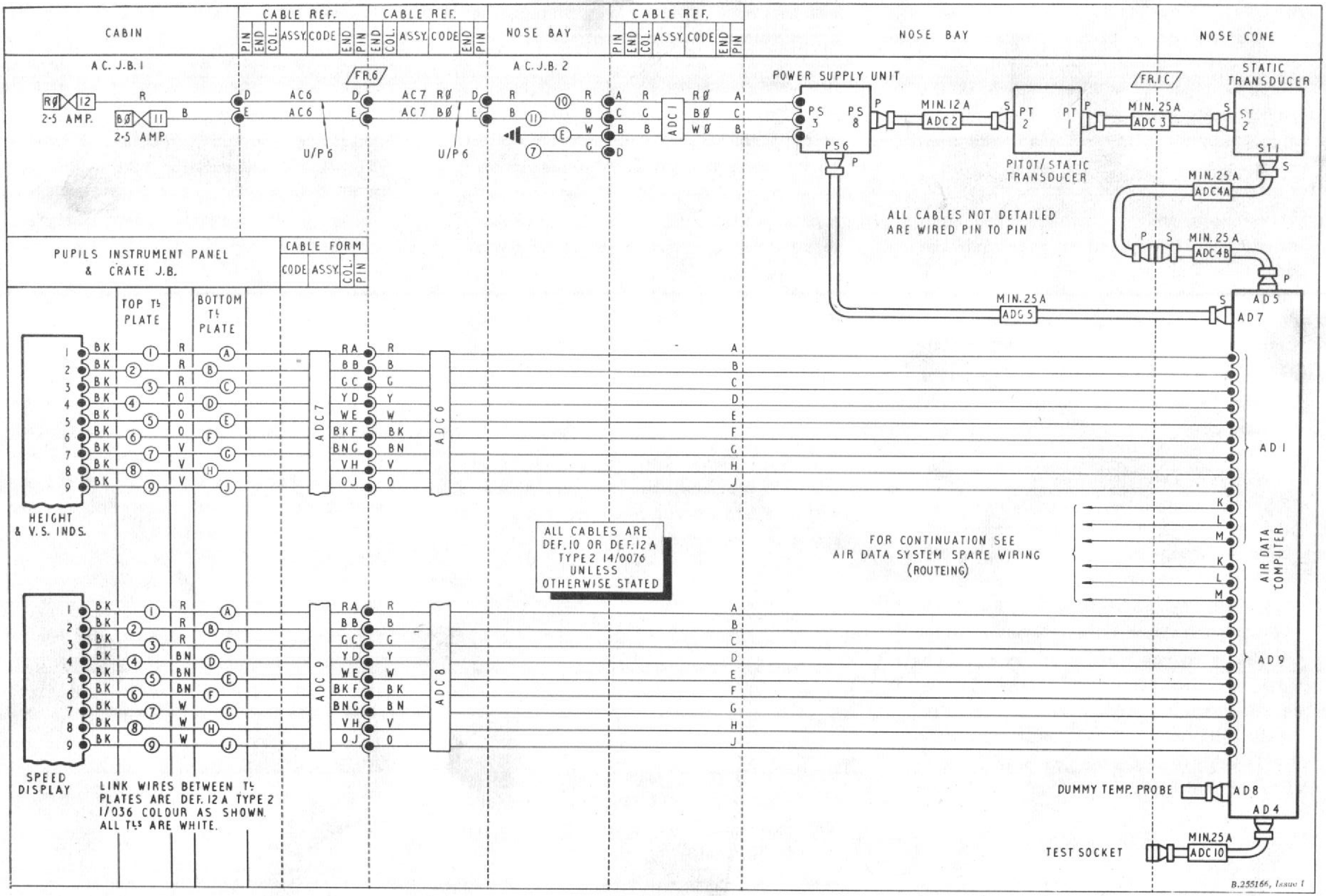


**Fig.9 Air data system (routeing)**

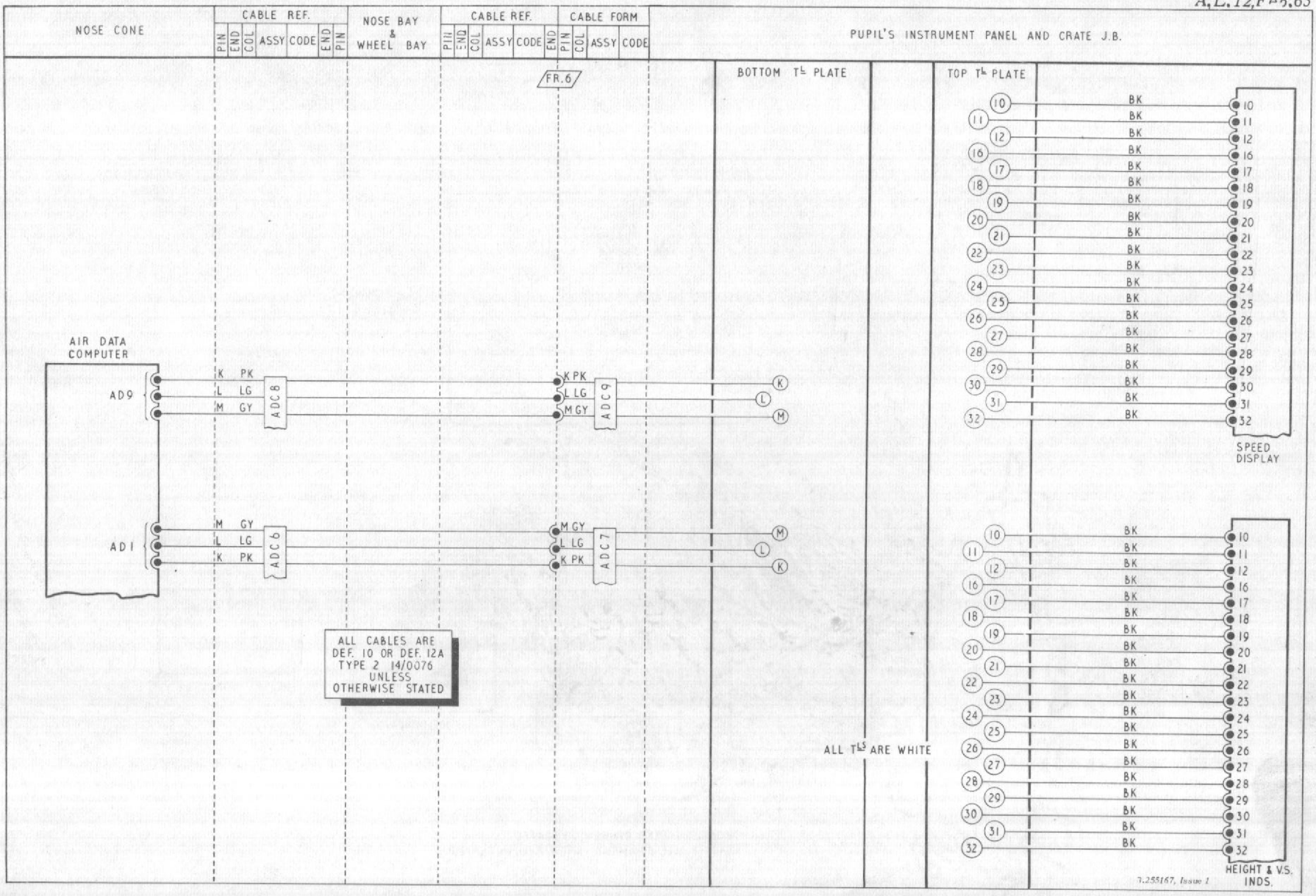


Fig.10 Air data system, spare wiring (routeing)

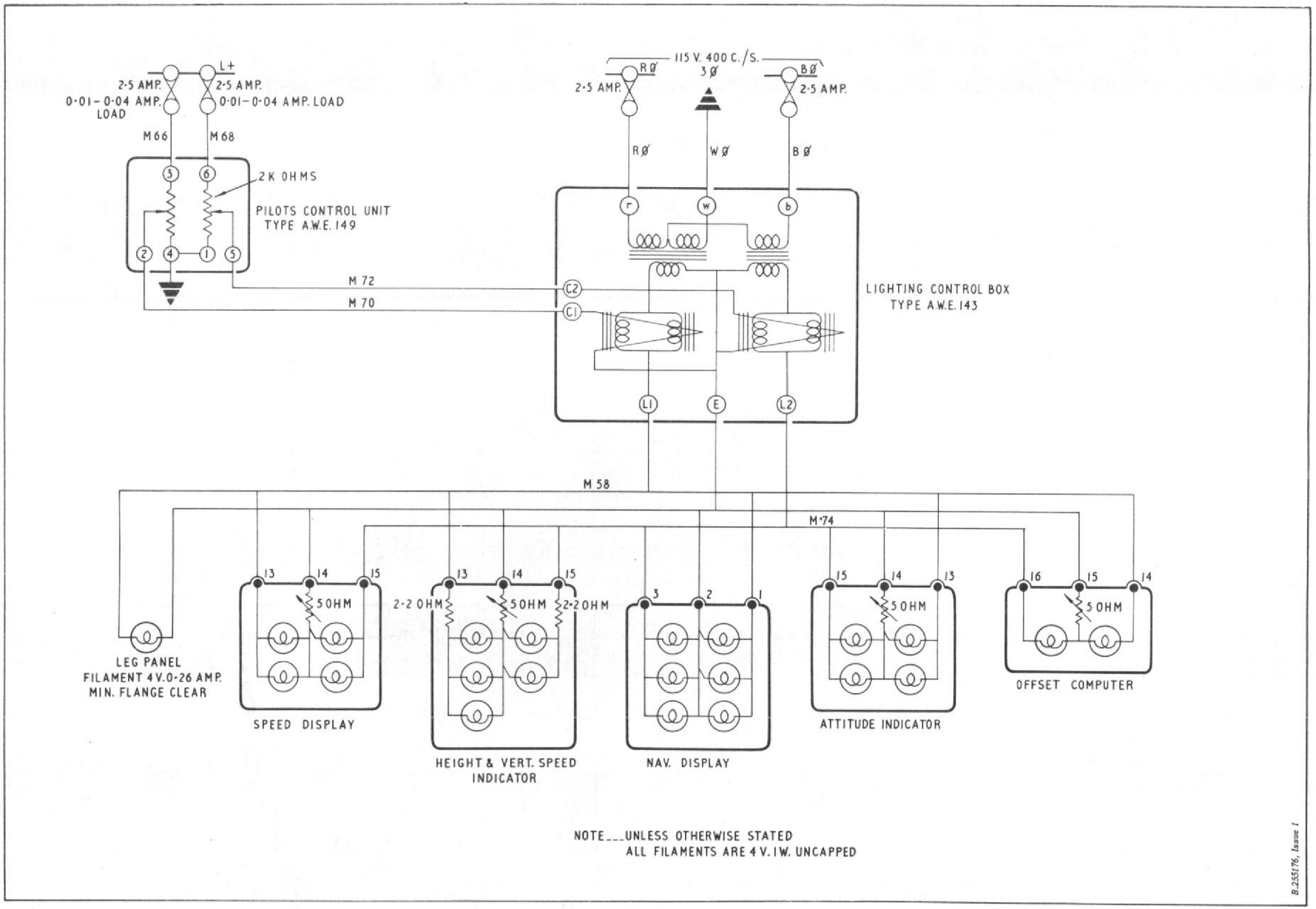


**Fig.11 I.F.I.S. integral lighting (theoretical)**

panel above the attitude indicator. The purpose of the display is to provide indications of Mach number and indicated air speed *(I.A.S.)*. The display is coupled to synchro outputs from a remotely situated pressure measuring unit *(para.33)* via the air data computor.

**45.** The display comprises two scales, one providing I.A.S. in knots and the other Mach number; one pointer only is used for both scales, the I.A.S. scale being fixed and the Mach number scale consisting of a moving tape. Due to this method of presentation the Mach number must be related to I.A.S., this being achieved by a differential in the gear train driving the Mach number tape.

**46.** Power supplies to the display are derived from a power pack contained within the unit and fed from the aircraft's a.c. system. The presentation is illuminated by four lamps supplied from the lighting control unit *(para.48)* which are wired in such a way that with the loss of one phase, two lamps would continue to function. Electrical connections to the display are made by means of a 32-way plug mounted on the rear panel.

*Aerodynamic system test socket*

**47.** The test socket for the various equipments of the aerodynamic system is located on the forward face of frame 1.C. Information regarding the test sets to be used in conjunction with this socket are given in para.63.

*Integral lighting control unit*

**48.** The integral lighting control unit *(fig.11)* which controls both systems lighting, is located on the port side of the floor at the rear of the cabin. The unit controls the supplies to the navigation display, the offset computor, the long speed display, the attitude indicator, and the height and vertical speed displays.

**49.** The control unit comprises two magnetic reactor units, each controlled by d.c. voltages derived from a potentiometer located below the integrated display. The reactors are wired in series with two lamp circuits, both being fed from the aircraft's a.c. supply system, via a pair of Scott connected transformers. The unit provides selection of illumination from zero lamp output to full brilliance, and is such that on a fault developing in one of its circuits, satisfactory operation may still be obtained.

**50.** Electrical connections to the unit are made via two 6-way terminal blocks which are located at one end, and the base is secured by four bolts passing through two straps, which are attached to the main body by screws.

**Standby flight instrument system (S.F.I.S.)**

*General*

**51.** The standby flight instrument system functions continuously to provide the pilot with essential flight data in the event of a supply failure occurring in the integrated flight instrument system. The instruments used in the standby system comprise an artificial horizon and a direction indicator, together with the air operated instruments *(Group 3.C)* and a ball-in-tube slip indicator incorporated in the attitude indicator of the I.F.I.S.

*Artificial horizon*

**52.** The artificial horizon *(fig.13)* located on the right of the navigation display on the pupil's flying instrument panel, is an electrically-operated gyroscopic unit which provides a continuous indication of the aircraft's attitude in bank and elevation, relative to the horizon.

**53.** Electrical supplies to the unit are derived either from the aircraft's a.c. system through a control unit *(para.57)* during normal functioning of the I.F.I.S., or supplied direct from the inverter of this control unit in the event of partial or complete failure of a.c. and d.c. systems.

*Direction indicator*

**54.** The direction indicator *(fig.13)*, situated below the artificial horizon on the pupil's flying instrument panel, is an electrically-operated gyroscopic unit, which provides the pilot with heading information.

**55.** Indications of heading are given by a circular disc graduated in degrees and connected directly to the shaft of a synchro torque receiver. In order to maintain synchronism between the heading disc and the magnetic compass, a knob exists on

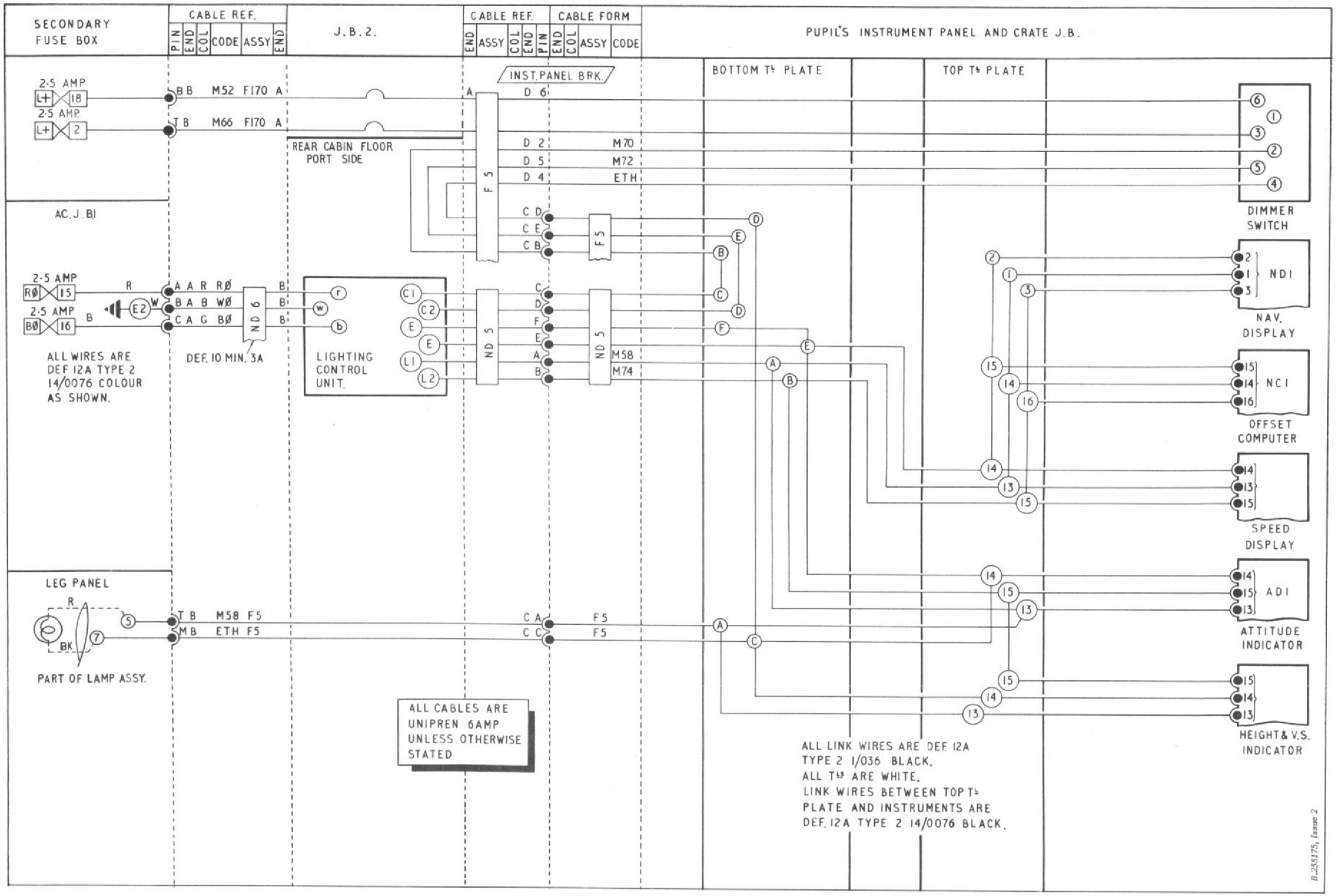


**Fig.12 I.F.I.S. integral lighting (routeing)**

the indicator which provides for manual correction of the synchro within the case of the instrument. The knob also serves as a push switch for fast-erection of the directional gyro, and a lamp is incorporated to provide a warning when the knob is pressed. Upon erection of the gimbal to within 15 deg. of the datum, fast erection will cease and the lamp will be extinguished.

**56.** Electrical supplies for the instrument are obtained via the control unit *(para.57)* during normal operation of the I.F.I.S., or supplied direct from the inverter of the control unit, following any failure within the aircraft's main a.c. or d.c. systems. Connections to the unit are provided by way of a socket at the rear of the instrument.

*Control unit*

**57.** The control unit *(fig.13)* which is mounted on the cabin floor behind the flying control casing, provides all the necessary power supplies to the standby instruments. The unit also supplies heading information by means of a directional gyro *(para.59)* and incorporates the control circuits for the artificial horizon *(para.52)* and directional gyro. The control unit operates on 3-phase power during erection/levelling. Following the start-up of No.3 inverter, but when No.2 inverter comes momentarily on line after engine start, relay 'N' switches the control unit to single phase operation, which causes it to switch to d.c. operation for the remainder of the flight.

**58.** The inverter portion of the unit which provides power supplies to the associated equipment in the event of main a.c. supply failure, consists basically of a transistorised oscillator fed by either the aircraft's d.c. generators or the standby batteries. At the onset of any partial or complete supply failure the inverter is automatically switched into the circuit to supply the unfed equipment. To prevent unnecessary drain on the standby batteries on the ground, the pitot head installation provides a feed to operate a speed switch *(fig.13)* to disconnect the batteries below 75 knots. If the pilot should require to override the operation of the speed switch, it may be accomplished by selection of the NORM/EMERGY switch *(fig.13)* which is retained in the NORM position by a strand of 28 S.W.G. copper wire and situated to the left of the percentage tachometer.

**59.** The directional gyro section of the control unit supplies heading data to the direction indicator and comprises a gyro which carries a synchro, mercury switches, and precession magnets. The output signals from the synchro are fed to the direction indicator where they are used to provide correction of heading indication.

**60.** Control of the directional gyro and artificial horizon is provided by thermal relays and a wander rate potentiometer circuit. On start-up, the gyro is automatically levelled by the action of one of the thermal relays in conjunction with an electronic switching circuit, and fifty seconds after starting, switched by another thermal relay into normal running. The wander rate circuit provides for automatic compensation for any minor mechanical out of balance conditions of the directional gyro during its life.

## SERVICING

### General

**61.** The servicing required to maintain the I.F.I.S. and S.F.I.S. in an efficient condition and the standard testing procedures are fully described in the relevant Air Publications *(quoted in Table 1)*. Before servicing or removing any components of these systems the aircraft must be rendered electrically safe as described in Sect.5, Chap.1, Group A.1.

### Bonding check

**62.** For the reliable and efficient operation of the aerodynamic system it is essential that the bonding resistance between the cases of any two components does not exceed 0.02 ohms. In order that these conditions are satisfied, check that all bonding leads are correctly assembled, and that the bonding of each unit to the other units and the airframe is established.

### Test sets

**63.** Functional checks of the installation may be carried out via the test sockets *(para.32 and 47)* and with the various test sets outlined below:-

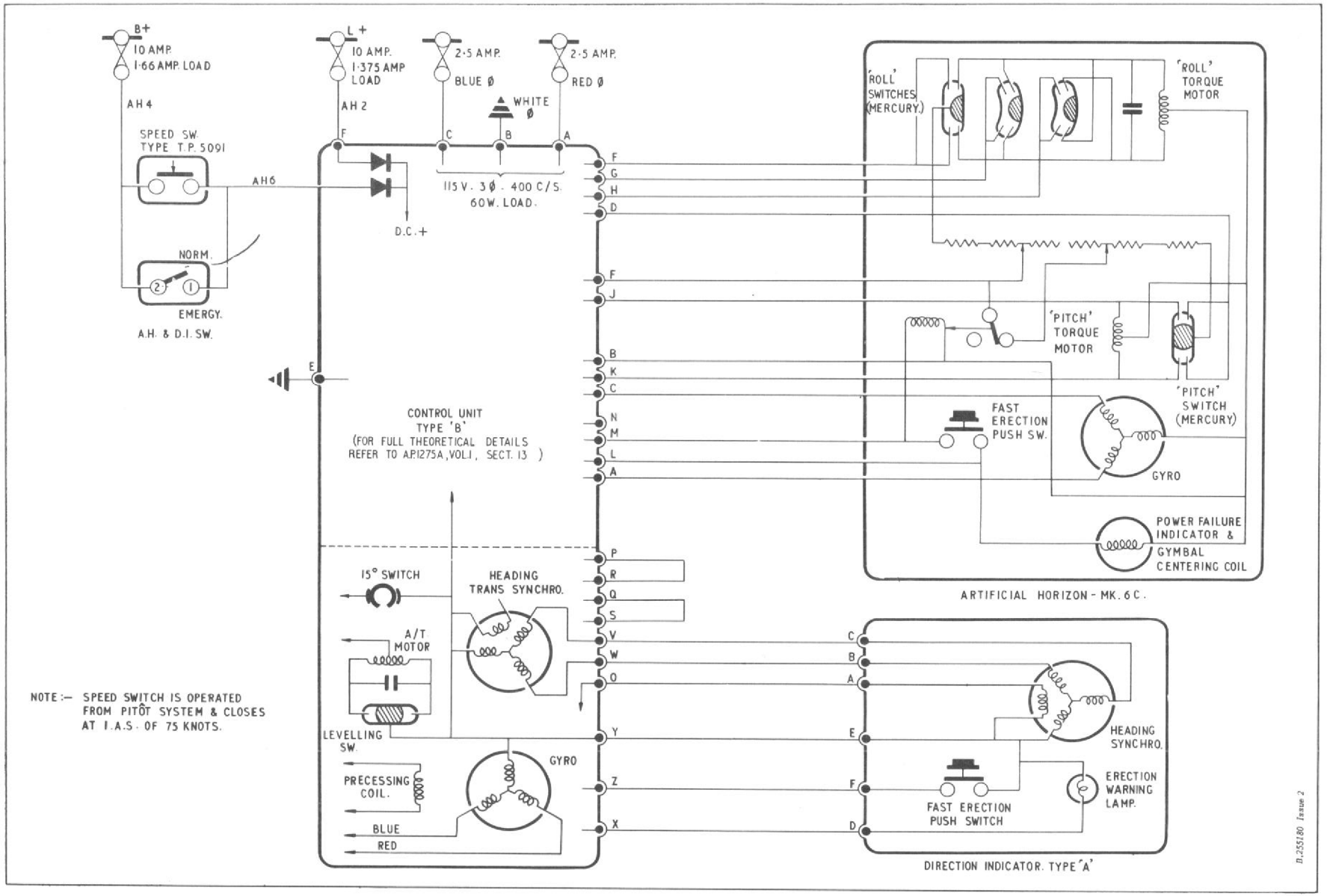


Fig. 13 S.F.I.S. (theoretical)

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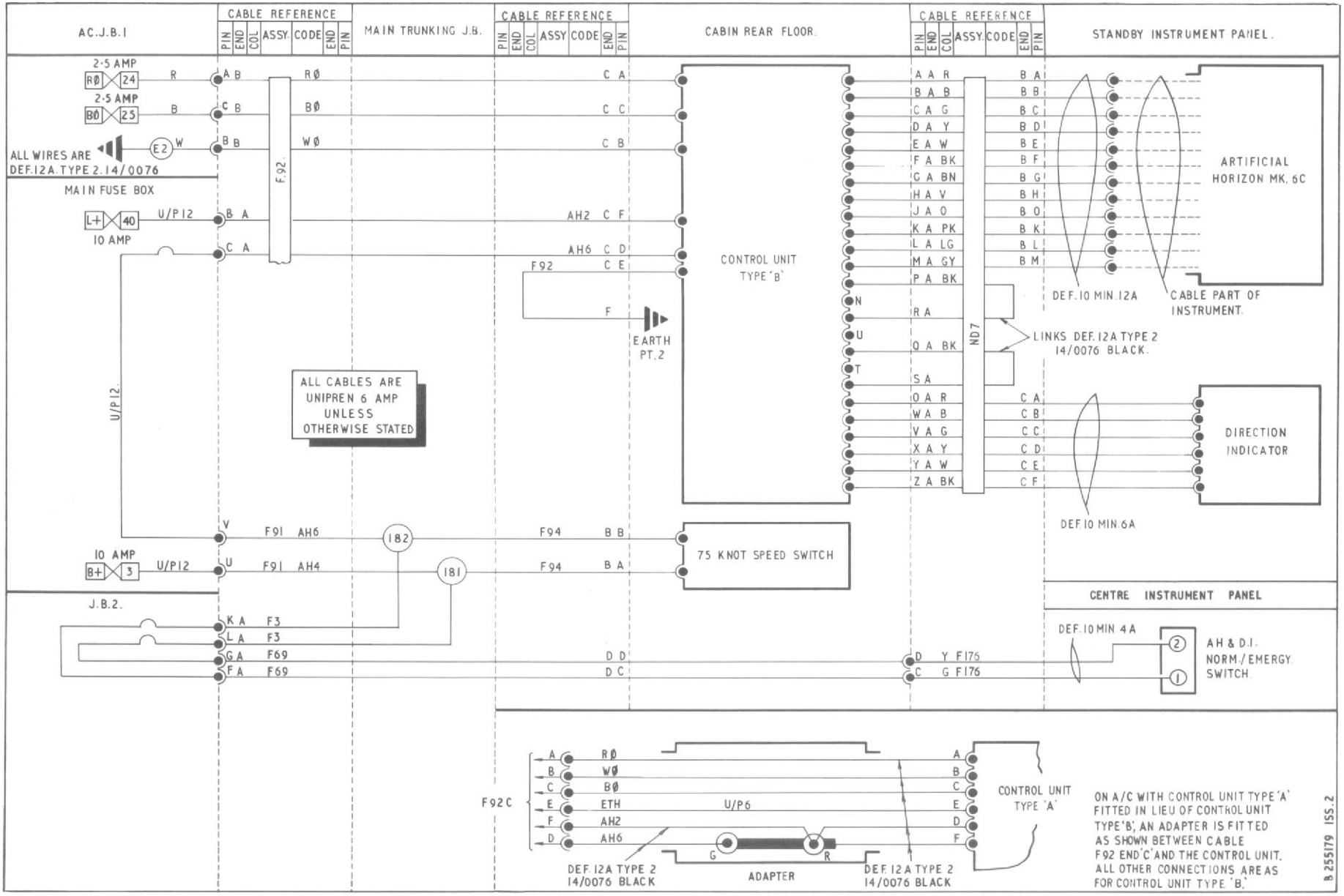


Fig. 14 S.F.I.S. (routeing)

◀ Mod. 1415 added ▶

(1) M.R.G. simulation may be carried out by substituting the M.R.G. with a Test set Type 1.A *(A.P.4685T)* to operate the attitude indicator should the M.R.G. be suspect. The additional outputs from this test set are not used in this aircraft.

(2) Bearing and range test signals for use with the navigation display, Tacan coupling unit and offset computor, may be derived from a Test set Type 7. *(A.P.4085T)*. This will provide actuation of the 'roller blind' and carriage of the navigation display.

(3) Tests for the air data computor may be carried out with the Test set Type 8.B. *(A.P.4685T)*.

(4) Ranging checks of the speed and height displays should be carried out from the pitot head using the appropriate adapter, from the Mk.2 Pitot/Static Test set. *(A.P.1275T)*.

(5) Calibration checks should be made with the Pitot/Static Test set Mk.3 *(A.P.1275T)* connected direct to the transducer pipe-lines. The Mk.2 Pitot/Static Test Set is not suitable for this purpose.

## WARNING

**The amplifiers in all units of this system contain transistors. DO NOT carry out insulation tests or remove equipment with the power 'ON'. It is essential that good heat shunts are used during soldering operations, and that small low voltage soldering irons are used. (A.P.4343). Test prods should on no account be used on the sockets in the instrument crate when the display units are removed, owing to the possible entry of swarf or strands of wire.**

## REMOVAL AND ASSEMBLY

### General

**64.** Once access has been gained, the removal of the units forming the integrated and standby flight instrument systems should present no difficulties. After re-assembly, however, the bonding resistance between the units of the aerodynamic system and the airframe must be checked.

### Removal of individual units

**65.** Each instrument may be removed by depressing a locking catch, and rotating a hexagon shaft, mounted adjacent to the catch, in a clockwise direction. This releases the locking mechanism, and by cam action forces the instrument clear of the crate in which it is mounted, by approximately 3/8 of an inch to allow removal by hand. A 2.B.A. socket spanner should be used to turn the shaft.

### Installation of individual units

**66.** When installing an instrument, it should be slid gently into the instrument mounting crate and pressed fully home. It is then only necessary, to rotate the hexagon bolt in order to secure the instrument; a spring loaded catch maintains the locking plate open until this operation has been completed. A 2.B.A. socket spanner should be utilised in turning the bolt.

### Removal of the instrument crate

**67.** The complete instrument crate with cables attached may be removed, should replacement of any electrical components become necessary. Removal is accomplished by first removing the display units and all cable clips, and uncoupling the Mk.4 plugs and couplers at the end of each cable. Two bolts in the base and two nuts at the top of the instrument crate should then be removed, and the crate pulled forward, complete with cables, plugs and couplers. Care should be exercised in retaining the resilient rubber washers.