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Permus

THYRISTOR DIMMERS

MAINTENANCE HANDBOOK

88-060-03
40/B149

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CONTENTS

APPENDICES

DRAWINGS

	Issue	
7A25810	1	24 x 10A Dimmer Rack, wiring diagram.
7A25811	1	12 x 20/25A Dimmer Rack, wiring diagram.
7B24842	1	12 x 10A Dimmer Rack, wiring diagram.
7B24841	1	6 x 20/25A Dimmer Rack, wiring diagram.
6B25916	9	Dual 2.5kW Dimmer Module, circuit diagram.
6B25974	9	5kW Dimmer Module, circuit diagram.
6C25219	3	RFI Suppression Board, circuit diagram.
7A25812	B	24 x 20/25A Dimmer Rack, wiring diagram.
7A28126	A	12 x 40/50A Dimmer Rack, wiring diagram.
6A28237	E	Permus Demultiplex Board, circuit diagram.

1 INTRODUCTION

This handbook covers the installation, commissioning, operation and maintenance of the Strand Lighting PERMUS range of stage and studio dimmers.

WARNING: High voltages are present inside Permus Dimmer Racks. Installation and commissioning should be performed only by a qualified electrician familiar with this type of equipment. Repair of faulty equipment beyond first-line maintenance must be entrusted to a Strand Lighting approved agent. Tampering by unqualified persons invalidates any warranty provisions and can be dangerous.

For assistance with service or maintenance, please contact the nearest branch, agent or associate company of Strand Lighting. Details of spare parts and fuse-links available for the equipment are enclosed and a current spares price list is available on application to any of the above.

This handbook has been carefully reviewed and is believed to be reliable; no responsibility will be accepted, however, for any inaccuracies. The handbook is subject to change without notice.

1.1 Using the Handbook

When using this handbook, the following conventions should be noted:

i) Integrated circuits are identified by their component number, prefixed with the letters IC (e.g. IC7). Where an integrated circuit contains more than one logic element, the output pin number of the element concerned is added as a suffix, e.g. IC13/4. In the case of elements with two or more outputs, e.g. bistables, one of the outputs is chosen for identification purposes, depending on the context.

ii) The term 'pin' is used to identify connections to integrated circuits. Connections to printed circuit boards are referred to as 'board terminal' or simply 'terminal'.

2 GENERAL INFORMATION

This handbook refers to the following types of Permus Dimmer Racks. Always use the seven digit Strand Lighting order code for reference.

	Reyrolle fused	Neozed fused
24 x 10A dimmers	0602011	0602109
12 x 20/25A dimmers	0605005	0605100
12 x 10A dimmers	0602003	0602117
6 x 20/25A dimmers	0605013	0605119

Permus dimmer racks are designed for use with the full range of Strand Lighting control desks and other control panels, to provide a lighting control installation for stage and studio use. This handbook details the information required for the installation, commissioning and maintenance of Permus dimmer racks.

2.1 Equipment

2.1.1 Racks

Four standard types of Permus dimmer rack are available: two full size 60kW configurations - with 24 channels of 10 Amp dimmers or 12 channels of 20/25 Amp dimmers, and two half size 30kW configurations - with 12 channels of 10A dimmers or 6 channels of 20/25A dimmers. All standard racks are wired in 'star' configuration.

The racks are of totally enclosed construction, designed for installation as free standing units. Mounting bolt holes are provided at the top of each rack. During transit, they are fitted with lifting eyes, but these may be replaced by the brackets provided to facilitate securing to a wall, or back to back with a similar rack. Cable entry to the Contracting area of the rack is through a removable top panel. Access to the Contracting and termination area and the dimmer module area is via removable upper and lower covers.

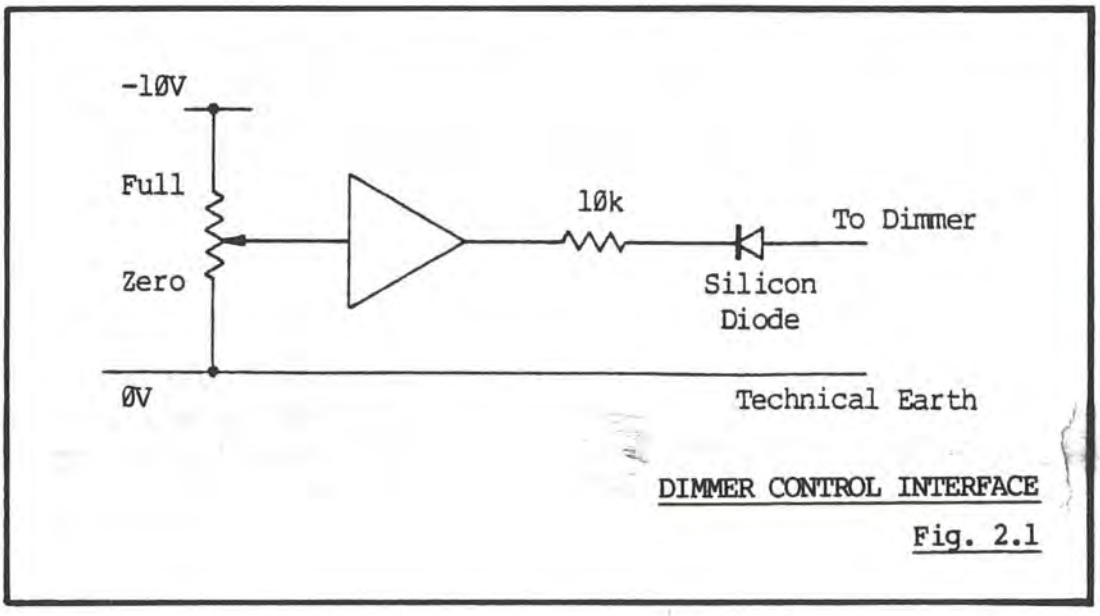
Permus 60kW Dimmer Racks
Supply Voltage Requirements - 220-250 V three phase or single phase
Power Requirements - 60kW
Weight - 90kg Dimensions - 1475mm (H) x 190mm (D) x 790mm (W)

Permus 30kW Dimmer Racks
Supply Voltage Requirements - 220-250 V three phase or single phase
Power Requirements - 30kW
Weight - 65kg Dimensions - 1475mm (H) x 190mm (D) x 496mm (W)

2.1.2 Dimmer Modules

The Permus dimmer modules are mounted in the lower part of the rack. Connection to each module is made by push-fit connectors to allow for easy replacement in the unlikely event of failure. Two module types are available; the Ref. 1809 single-channel 20/25A module (Order Code No. 0881214), and the Ref. 1808 dual-channel 10A module (Order Code No. 0881119). Note, however, that the standard Permus dimmer rack is configured for one type of dimmer only.

The dimmers require a control voltage input of 0 to -10V, -10V corresponding to full output and 0V to zero output. The signal should be fed via a 10k resistor and a silicon diode as shown in Fig. 2.1; this is the standard control interface used on Strand Lighting control desks.



DIMMER CONTROL INTERFACE

Fig. 2.1

2.1.3 Fuses

Each 10A dimmer is fused by a 10A Reyrolle HRC cartridge fuse or Neozed fuse as applicable. Each 20/25A dimmer is fused by a 20A Reyrolle HRC fuse or a 25A Neozed fuse as applicable. Control circuits are protected by 100mA Delay 20mm fuses. Access to all fuses is from the front of the rack, and does not require removal of any front panels.

CORRECTLY RATED FUSES MUST BE USED.

WARNING: Reyrolle MD10 AND MD20 Fuses

The fuses currently supplied by Strand Lighting and their agents feature an improved surge capability over those available from other suppliers. This reduces the likelihood of fuse failure when a cold lamp load is

connected and greatly increases the reliability of the dimmer system.

It is therefore recommended that only fuses obtained from Strand Lighting or their agents be used. These may be distinguished by the white ink used to print the rating on the fuse body. Fuses printed with blue ink do not have the improved characteristics and may prove unreliable.

When ordering please state the following reference codes:

MD10 fuse	Order code 0831814
MD20 fuse	Order code 0832018

2.1.4 R.F.I. Suppression

Each rack is fitted with Radio Frequency Interference suppression, by way of capacitors fitted between each phase and neutral, earth and neutral, and each load and neutral. These capacitors are mounted on Ref. 1294 printed circuit boards in the Contracting Area of the dimmer rack.

2.1.5 Connections

Load and control connections are made via terminal blocks in the Contracting area of the rack. The channel identification numbering is the key for all connections to associated lamp loads, desks, etc. The incoming supply busbars and connectors may also be found in the Contracting area.

2.2 INSTALLATION SITE

To minimise expensive cable runs to the lamp loads, the rack should be sited as near to the loads as practicable, in a dry, free ventilating area with easy access for fuse changing. Where possible, group two or more racks together at one location. Avoid any acoustically live position in the acting or audience area, since the racks are not totally silent in operation.

In choosing the location for individual or grouped racks, ensure that free flow of air through each rack (air inlet at the base of the front panel, air outlet at the top of the front panel) is not impeded in any way. The natural convection in each rack is adequate to disperse the heat dissipated in the rack, so long as the inlet air temperature does not exceed $35^{o}C$ ($95^{o}F$). Air conditioning equipment may be necessary in some installations to maintain the ambient air temperature below $35^{o}C$.

Where two or more racks are grouped, it will be found convenient to arrange them in channel number sequence.

2.2.1 Associated Sound Installations

Waveform switching, such as is provided by Permus dimmers, can reveal, in the form of spurious interference, previously undetected earth loops in associated sound installations. Careful inspection of sound system earthing and screening may be necessary to remedy any earth loops.

High impedance microphone lines are also susceptible to pick-up of switching 'noise' from lamp circuits; low impedance balanced lines such as those used for moving coil microphones are most suitable, especially if long audio cable runs are necessary.

3 INSTALLATION

The rack should be located in the required position and fixed firmly to a wall or other vertical surface using the angled brackets provided. Alternatively, racks may be mounted back to back using the flat straps. The two lifting eyes at the top of the rack should be removed and replaced with the appropriate brackets and bolts.

Removing the cover from the lower part of the rack will reveal a cardboard protector. This is intended to prevent any debris, which may fall from the top of the rack when the wiring installation is carried out, falling into the dimmers where it may cause short-circuits when the equipment is switched on. Do not remove the protector until all the wiring is complete.

In the base of the rack behind the cardboard cover will be found a plastic bag containing the power fuses. For safety, all the rack covers and panels must be replaced before inserting these fuses and switching on.

3.1 Supply Connections

Note: Do not use high-voltage insulation testers on this equipment.

The top panel and upper door should be removed to gain access to the Contracting area of the rack. The top panel may be cut to allow for necessary cable and trunking entry. All cables must be routed through the top panel.

A label showing the layout of the rack will be found inside the rack (see Figs. 3.1 to 3.4). 60kW racks are provided with busbars for the incoming supplies. If the installation is to be a single phase system, the coupling plate provided should be connected across the three phase busbars using the available screws on the busbars.

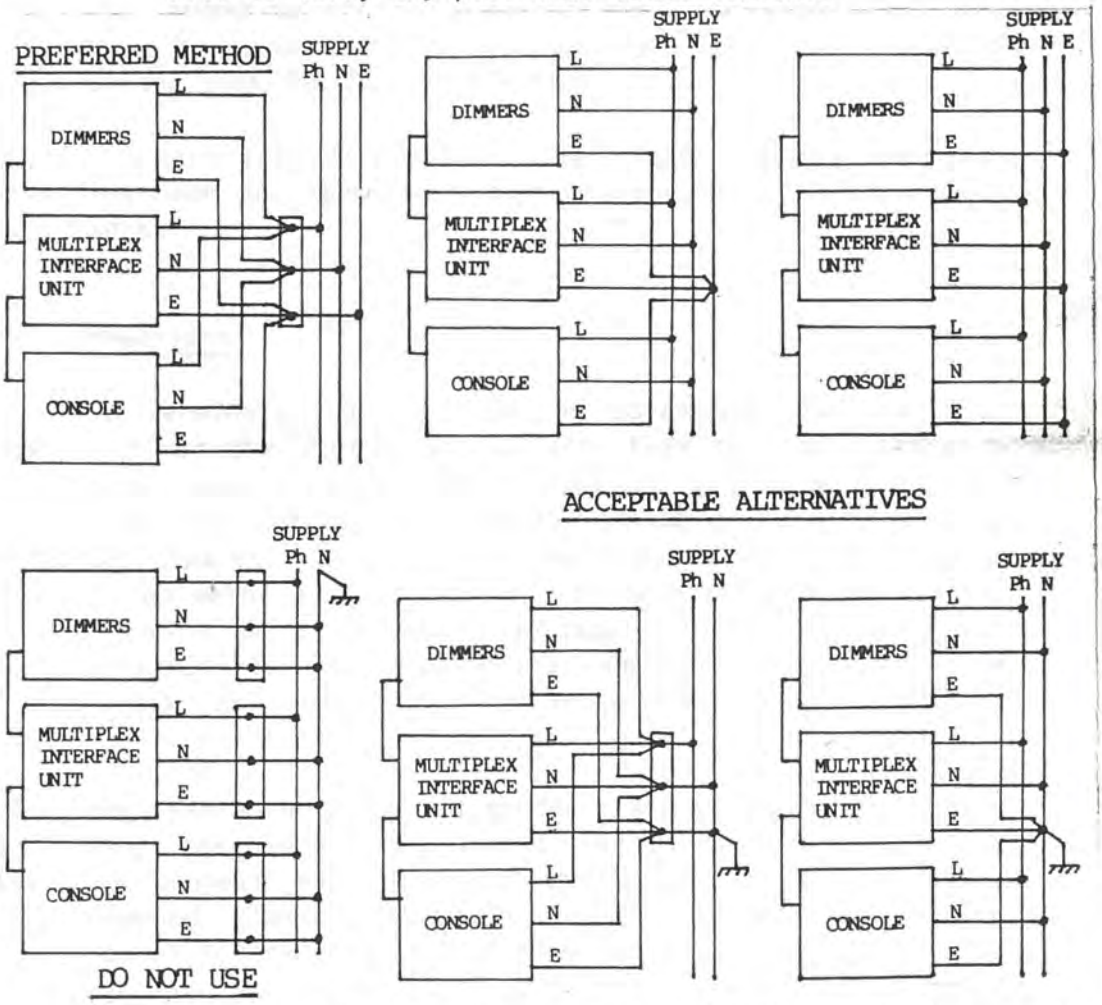
The busbars and their main cable clamps are designed and adequately rated for the appropriate cable sizes to be used. Note that the cable clamps are designed to allow cables to be clamped either vertically straight down onto the busbars, or radiused horizontally onto them, depending on the installation.

30kW racks are provided with rail mounted terminals for the incoming supply. For single phase installations, the three phase terminals should be connected together with suitably rated cable.

It is imperative that an adequately rated safety conductor be provided, connected to the earth busbar or terminal as appropriate. Do not rely on earthing via conduit or trunking.

WARNING: Where the control console produces a multiplexed output (e.g. Tempus M24) and the dimmer racks are fitted with Demultiplex Boards (see Appendix B), the equipment must be properly earthed if it is to function correctly. IT IS ESSENTIAL THAT EARTH BE AT THE SAME POTENTIAL AT ALL POINTS IN THE SYSTEM. If this is not the case, circulating currents may be generated in the signal earth connections, leading to fluctuating light levels and, in extreme cases, severe damage to the equipment.

In cases where the earth is provided via the supply neutral, all units in the system should ideally be powered from the same source via adequately rated three core (L. N. E.) cable. If this is not possible, a single earth point must be chosen and all the units earthed ONLY AT THIS POINT (see diagram). The conductors used must be able to carry any potential fault current.



If damage is caused as a result of failure to observe the above recommendations, any warranty will be invalidated. If in doubt, your local Strand Lighting agent will be pleased to advise.

3.1.1 Phase Distribution

As can be seen from the label inside the rack (Figs. 3.1 to 3.4), each rack is supplied with dimmers evenly distributed between phases. In the 60kW rack, the dimmer modules are split into six equal groups labelled A - F. Each of the six groups is allocated to one of the three phases, P1 - P3. When the rack is supplied, groups A and B are allocated to P1, C and D to P2, and E and F to P3. Similarly, the dimmers in the 30kW rack are divided into 3 groups, each allocated to one of the three phases; A to P1, B to P2 and C to P3. In some three phase installations, redistribution of this group/phase allocation may be desirable.

In order to alter the phase allocation of any group, the relevant wire, which is labelled with its group letter, should be moved from the phase busbar or terminal to which it is connected, to the desired phase busbar or terminal, as applicable. This is all that is required. The group/phase allocation should be marked on the label inside the rack for future reference.

The group of each load termination, load fuse, control fuse and corresponding neon is labelled to make phase identification of each channel simple.

3.2 Control Connections

The control terminals are numbered to correspond to the load terminals. Since the wiring has to carry less than 30 volts at a few milliamps, any suitable multi-conductor cable can be used subject to local authority regulations. Suitable cable is detailed in section 6 - Spares. Ideally, this cable should not be run in the same conduit as mains or load cables. If necessity dictates this, ensure the cable is of adequate voltage rating. Connect each numbered terminal to the appropriate numbered terminal on the associated desk or panel. Connect the common return line to terminal TE (technical earth/ground).

In some cases, where the number of conductors used in the multi-core cable exceeds the number of dimmers in the rack, it will be necessary to connect the remaining conductors to another rack. Suitable terminal blocks, available from Strand Lighting, may be fitted in to the Contracting area of 60kW racks, to the left of the control terminals, to permit coupling of these remaining conductors to an outgoing multi-core cable to another rack.

It should be noted that technical earth is connected to mains earth within the rack. On many installations (e.g. those with Galaxy or Tempus M24 control desks) the connection is made elsewhere and it may be necessary to remove this link; the link is a single green/yellow insulated wire from the control terminal TE to the earth busbar.

3.3 Loads

Permus dimmers are designed to control tungsten lamp loads of the same voltage rating as the main supply. The maximum continuous current rating of the dimmer channels is 10 Amps for the 2.5kW version and 20 Amps for the 5kW version. Low loads, down to 5W, may be controlled. The dimmers will also control transformer fed loads, provided that the transformers are individually fused.

Do not connect to a dimmer or associated load circuits, any flash boxes or similar pyrotechnic devices, or any appliance liable to absorb excessive surges of power from the mains supply.

The dimmers can be used to control hot or cold cathode fluorescent lamps, but specially designed control gear must be used, the dimmer ratings must be halved, and resistive or tungsten lamp ballast is required. Great care is necessary in this type of installation, and the quality of control is inferior to that achieved with tungsten lamp loads. You are advised to contact the local Strand Lighting agent concerning such installations.

3.3.1 Load Connections

Since control of the output to the load involves waveform switching, the load and neutral return conductors to each channel load must be run as a pair of equal length, adjacent conductors; this will ensure that each conductor in the pair carries equal and opposite current components. If a patching panel or other form of load selection unit is used, divert the conductors as a pair to and from this unit. Lack of care in this respect may result in strong induced fields tending to vibrate the cable trunking or radiate interference.

Groups of load, neutral and earth terminals are provided for each channel in 30kW racks. For 60kW racks, load terminals are numbered to correspond to dimmer channels and the neutral conductors for each load should be made to the neutral busbar using the 'spider' clamps provided. Each of these can accommodate at least two neutral conductors.

If armoured or metallic conduited cables with adequate earthing of sheaths are not used, separate earth conductors are necessary and should be connected to the earth busbar or terminals as appropriate.

3.3.2 Load - Line Terminations

These should preferably be to socket outlets numbered to correspond with the channel identification numbers, and for the flexibility usually required of stage and studio lighting, a standard socket outlet should be adopted where possible.

In the United Kingdom, 15 Amp 3-pin BS546 outlets are often used in large installations. For high voltage loads requiring outlets of more than 15 Amp rating, suitably rated receptacles must be used. 32 Amp connectors to CEE 17 are suggested.

For applications in countries other than the UK, local practices or regulations must prevail.

3.4 Check and Test Procedure

When all the connections have been made to the rack, remove all cable ends and other debris from the rack. The lower door should be removed, revealing the cardboard protector covering the dimmer modules. This must be removed and disposed of, along with any debris inside the rack. The load fuse-links will be found packed in the lower half of the rack, and these should be located in the fuseholders. Check all connections carefully, especially to ensure that insulation is not trapped in the pressure pads of the load or control terminals. Replace and secure all the covers.

When the rack is fully installed, turn the a.c. supply to the rack on. Note that the neons on the control fuse panel indicate the presence of a.c. supply on the control circuits of each group of dimmer channels. All these neons should be on. Failure of a control fuse will cause its associated neon to extinguish.

Each dimmer channel should be successively raised to full and then taken to zero several times to check it functions properly. Complete failure of any one channel to light is usually caused by a blown fuse or lamp.

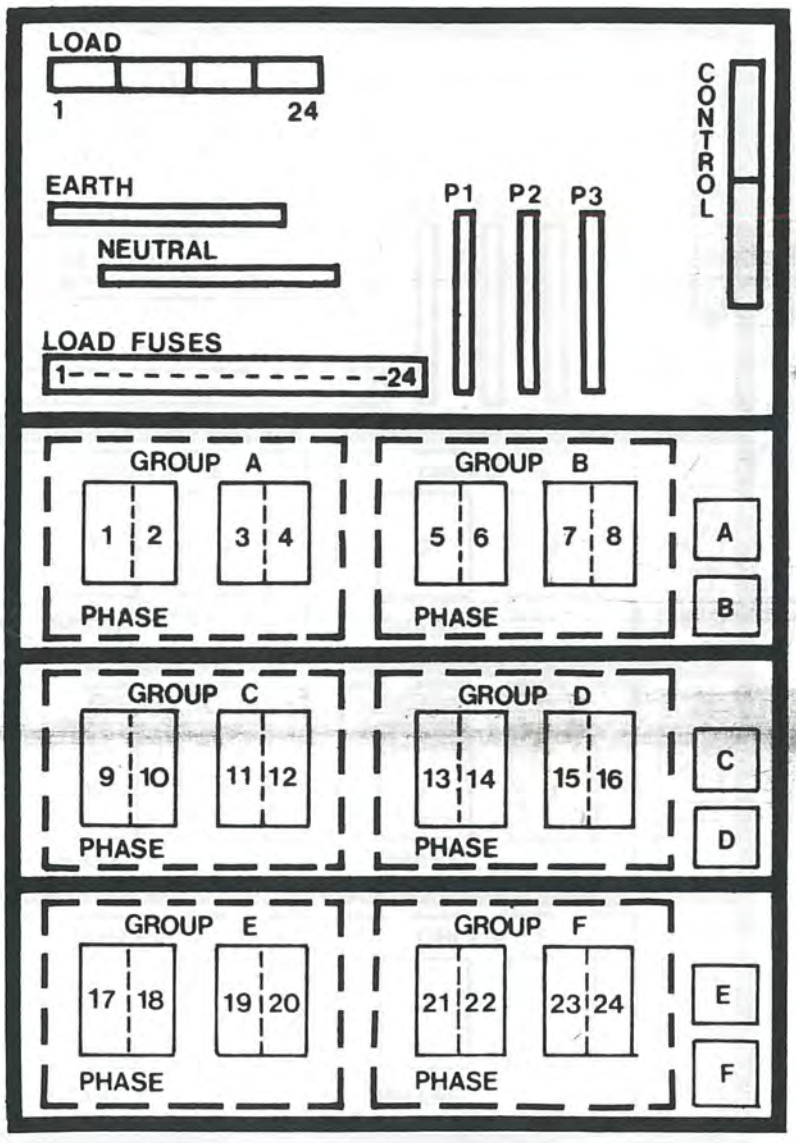
Reference to section 4, Maintenance, should be made in the event of any problems occurring with the functioning of the Permus dimmer rack.

3.5 Setting-up

A potentiometer (topset) is provided on the trigger card for each channel, which allows the full level to be adjusted for optimum dimmer performance. This level is set before despatch, but following repair, readjustment may be necessary.

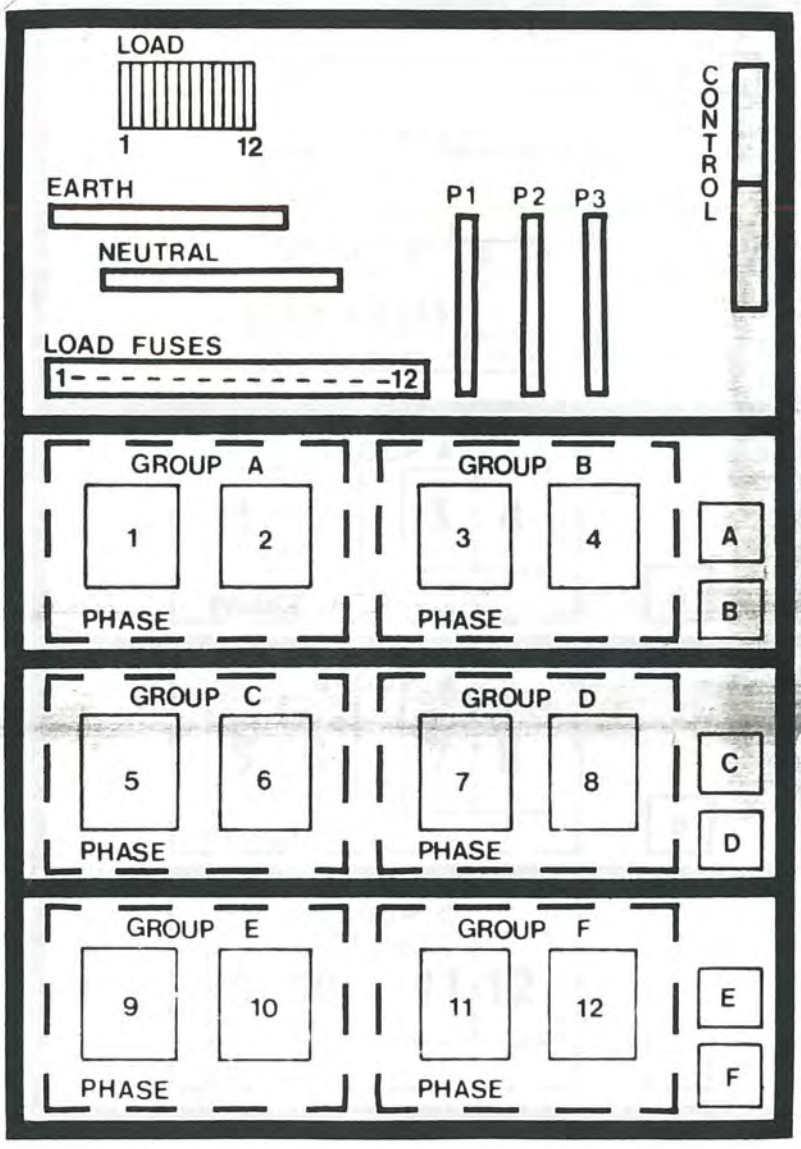
Adjustments should be made with the dimmer connected to a 1kW load and set to full level. The dimmer output, measured using a true RMS voltmeter, should be 5-6V below the measured supply voltage for that channel. Great care should be taken when using measuring equipment on live dimmers.

The bottom setting of the dimmer is automatic and no adjustment can be made.



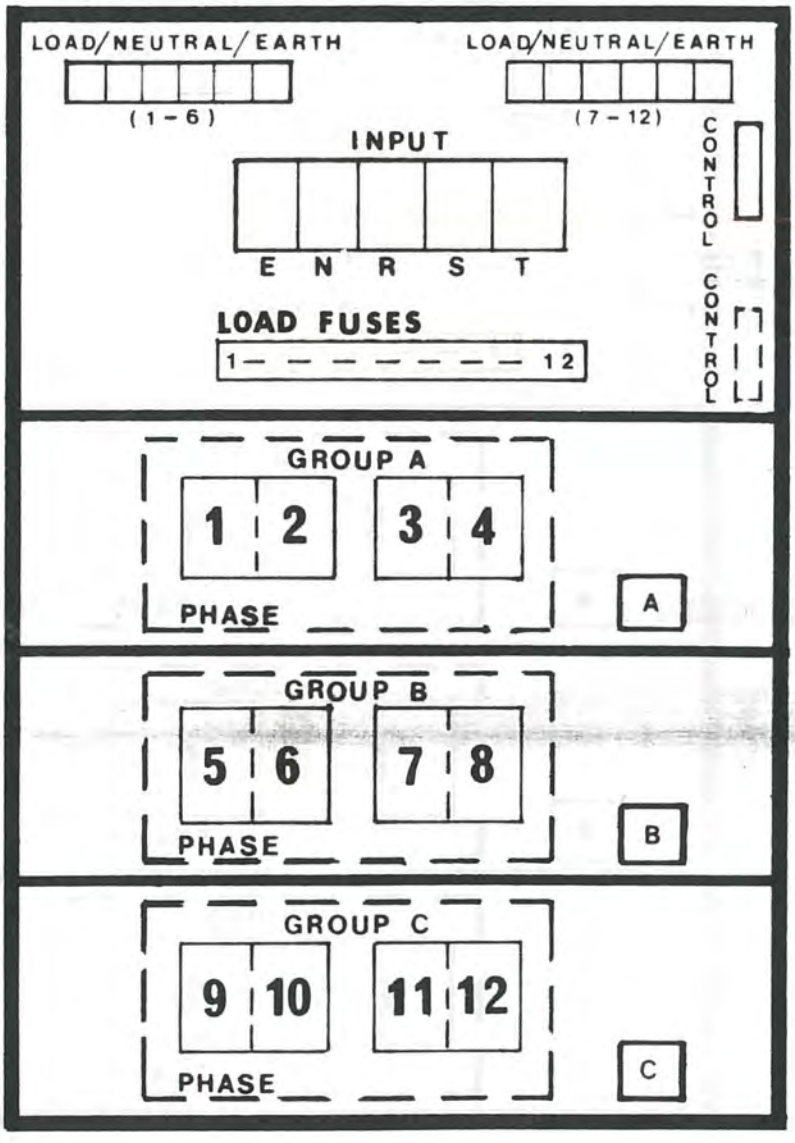
RACK LAYOUT - 24 x 10A DIMMER RACK

Fig. 3.1



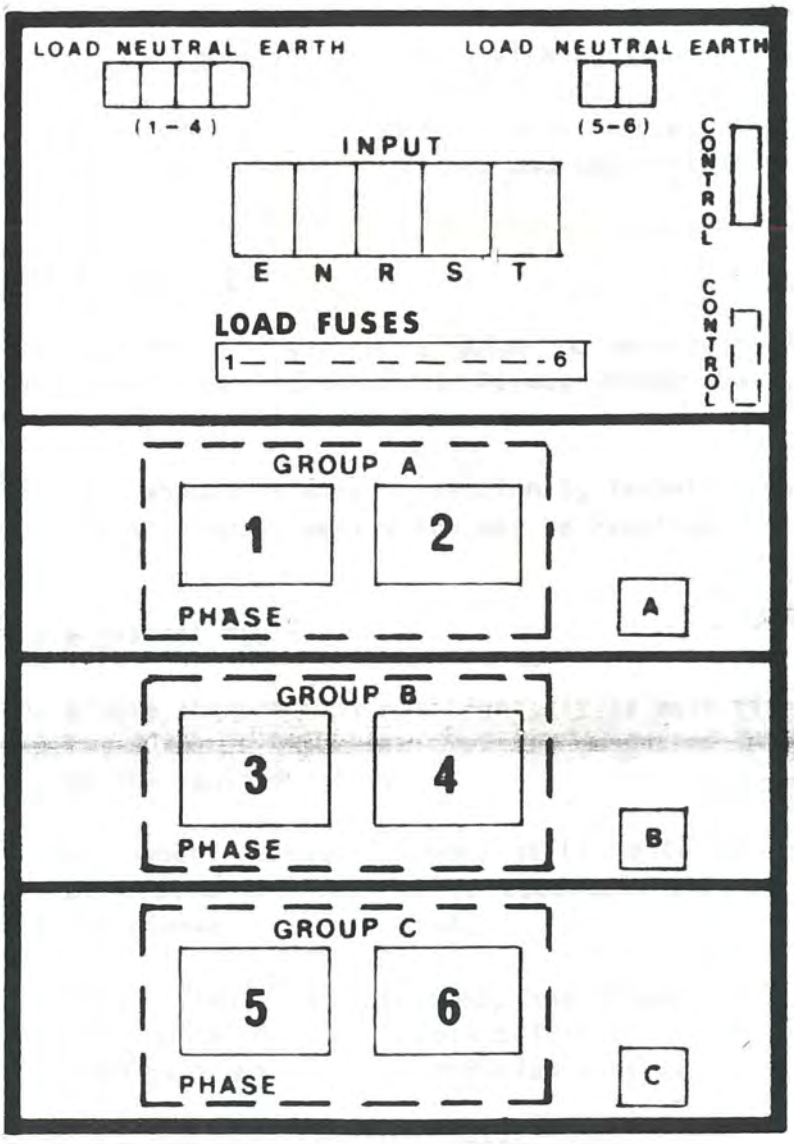
RACK LAYOUT - 12 x 20/25A DIMMER RACK

Fig. 3.2



RACK LAYOUT - 12 x 10A DIMMER RACK

Fig. 3.3



RACK LAYOUT - 6 x 20/25A DIMMER RACK

Fig. 3.4

4 MAINTENANCE

Maintenance of Strand Lighting Permus dimmer modules should only be carried out by a qualified electrician familiar with this type of equipment. High-voltage insulation testers must not be used.

WARNING: ISOLATE THE MAINS SUPPLY BEFORE REMOVING ANY COVERS. When the dimmers are in operation, the thyristor heat-sinks are at mains potential. Take suitable precautions when testing and measuring with the supply switched on.

The racks require little routine maintenance. A periodic inspection of each rack's associated wiring and connections is recommended.

4.1 Trouble-shooting

This section is given as a guide to ascertain the extent of any fault which may occur on a Permus dimmer rack, and indicate a solution.

Reference should be made to section 5, Technical Description, in the event of any repair work which may be required.

4.1.1 Single Channel Fault

If a single channel will not light, it is most likely that a fuse or lamp has blown. Replacement of the suspected fuse and/or lamp will isolate the fault further.

If the suspect control channel still fails to operate, check the control system and cables, to ascertain whether the problem lies with the dimmer or the control.

If a dimmer fault is suspected, the dimmer rack must be isolated from the source of mains supply before it is opened. It should only be opened by a qualified electrician familiar with the equipment.

Check for broken wiring or loose connections within the rack and rectify as necessary. If the fault still persists, replacement of the suspected module should cure it.

If it is found that a module is at fault, repair at electronic component level should only be carried out by an approved Strand Lighting agent or qualified engineer. Circuit descriptions are included in section 5, Technical Description.

4.1.2 Failure of a group of channels

Failure of a complete set of channels allocated to a group is almost certainly due to a blown control transformer fuse. This will be indicated by failure of that group's indicator neon. Replacement of control fuses may be achieved without removal of any front panels. The correct rating fuse must be used when replacing.

4.1.3 Failure of a phase

When groups of channels allocated to a single phase fail, this is probably due to failure of supply on that phase.

4.1.4 Thyristor faults

Generally a thyristor fails in one of two ways: either short circuit, in which case the load will be turned on fully all the time; or open circuit, in which case the dimmer will control the load from out to about 50% intensity. In the latter case, there will be noticeable flicker if one of the pair of thyristors still functions.

4.2 Module Removal and Replacement

If it is found necessary to replace a module, isolate the mains supply and remove the lower front cover.

Identify the module to be replaced, and remove the push-fit power connectors from the heatsinks. On a 20/25A dimmer module there are two of these, while on a dual 10A dimmer module there are four. The six-way control connector should be unplugged, and then the module may be released from the six support pillars and removed from the rack. Take care to avoid overstressing the side-latching support pillars and permanently deforming the latches.

When replacing a module, be sure that all the connections to the module are replaced and are sound.

Repair of modules at electronic component level should only be carried out by a Strand Lighting approved agent.

5 TECHNICAL DESCRIPTION

5.1 Phase Control of Mains Current

A thyristor dimmer functions as a fast-acting switch, operating every half-cycle to connect the mains supply to the load. The electrical energy applied to the the load is controlled by changing the switch-on period (conduction angle) of each half-cycle, a process known as phase control.

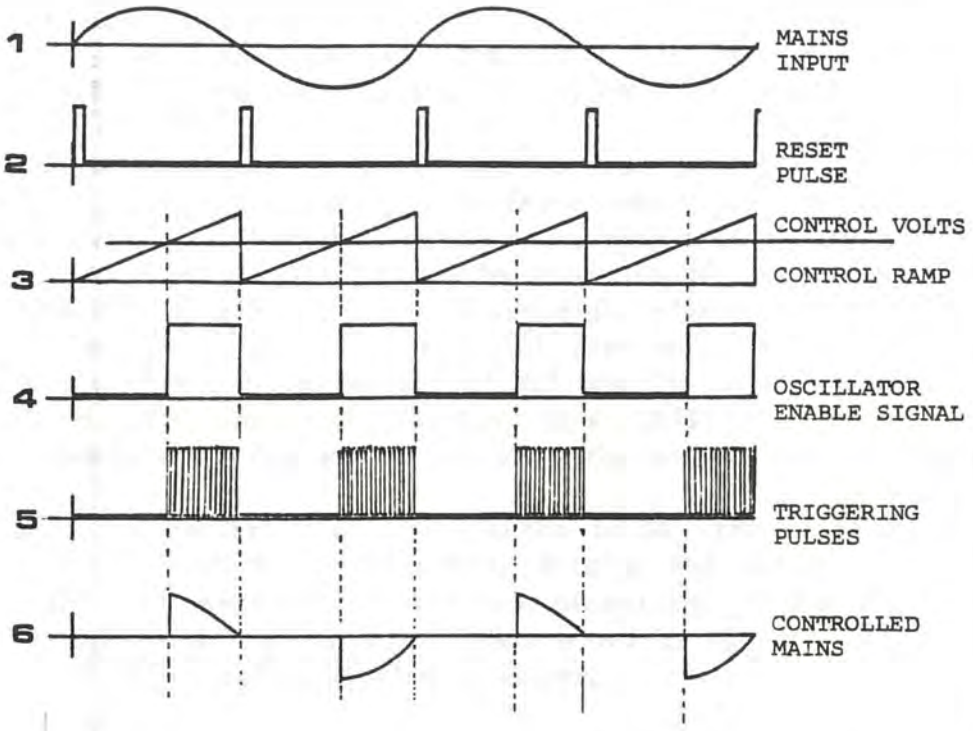
A thyristor is a three terminal device, having a main current path which becomes conducting when a pulse is applied to the third (gate) terminal. Once triggered, a thyristor will remain conducting until the current falls to zero at the end of the half-cycle. The device can only pass current in one direction and thus, if operation over the full mains cycle is to be achieved, a second device must be connected in inverse parallel with the first. This second device is triggered on alternate half-cycles to pass current in the other direction.

The earlier the gate pulse occurs in each half-cycle the greater the power applied to the load. For example, if the gate trigger pulse is produced five milliseconds after the start of each half-cycle (assuming a 50Hz supply), conduction only occurs during the second half of the half-cycle, reducing the mean load power by half.

Because of the fast switching times of the thyristors and the much distorted output waveform, mains harmonics are produced and these must be suppressed by means of a choke and other interference suppression components. Even with these components fitted, care must be taken to ensure that load cables are not installed in close proximity to audio cables.

In the case of low or inductive loads (e.g. tungsten lamps of less than 100W, fluorescent tubes or low-voltage transformer-fed lamps) it is possible for the thyristor to cease conduction before the end of the half-cycle. To overcome this, the thyristors in Permus dimmers are repeatedly triggered throughout the conduction period by a blocking oscillator which produces gate pulses at high frequency.

The blocking oscillator is controlled by comparing the control signal from the outstations with a ramp signal. The latter is locked to the mains frequency by means of a reset pulse which appears each time the mains cycle passes through 0V (see Fig. 5.1).



PHASE CONTROL OF MAINS CURRENT

Fig. 5.1

5.2 Dual 10A Dimmer Module (Ref. 1808)

Drawing No. 6B25916

WARNING: HAZARDOUS VOLTAGES ARE PRESENT ON THIS CARD.

5.2.1 Power Supplies

The card receives 10V a.c. derived from the appropriate phase of the mains by a separately mounted transformer. This is rectified by REC1 and smoothed by C2 and C2 to give positive and negative rails of +14V and -13V respectively. Additional smoothing is provided by C5 to remove any high frequency interference generated by the blocking oscillator.

5.2.2 Ramp Generator

A negative-going, unsmoothed, full-wave-rectified waveform with a peak of about -12V is derived from the incoming 10V a.c. supply by bridge rectifier REC1; diode D1 provides isolation from the negative

rail. This signal is routed via a potential divider formed by R9 and R26, to the base of transistor VT7. The latter detects the positive going peaks of the waveform and thus produces a signal, negative-going to -5.6V, with timing corresponding to the zero crossover of the mains waveform. The -5.6V reference applied to VT7 is derived from the negative rail by zener diode D3 and resistor R5.

The zero-crossover pulse is used to reset a ramp generator formed by IC1/8, IC1/14, and their associated components. At the end of each half-cycle of the mains waveform the output of IC1/14 (and thus the pin 10 input of IC1/8) will be close to OV. When the reset pulse appears, IC1 pin 8 will be driven high (+14V), forward biasing D11. The output on pin 14 of IC1 will then move rapidly negative, as a result of the Miller effect of R23 and C9, until the two inputs of IC1/8 are equal at -5.6V. Once this equilibrium state is established it doe not change until the end of the reset pulse.

When the collector of VT7 returns to OV, the equilibrium at the inputs of IC1/8 is disturbed, forcing the output of this device high. D11 therefore becomes back-biased and this allows the output of IC1/14 to rise at a rate determined by R20 and C9. A positive-going ramp waveform is thus produced.

The shape of this waveform is modified by modulation with the rectified sine-wave from the junction of REC1, D1 and R9 via C6 and R15, in order to improve the dimmer control characteristics.

5.2.3 Automatic Bottom-set Circuit

In addition to the modulation mentioned above, the slope of the ramp may be adjusted by means of a circuit formed by VT2, VT1 and their associated components; the latter circuit provides automatic Bottom-set adjustment by controlling the voltage offset applied to pin 12 of IC1/14 and thus the voltage across R20.

A reference voltage of about -0.6V is derived from the -5.6V rail by resistors R8 and R12; this voltage is applied to the base of VT1 and represents the required 'top of ramp' voltage. The ramp output from IC1/14 is applied to the base of VT2; as the ramp rises from -5.6V towards OV, VT2 is conducting, D9 is reverse biased, and C10 charges slowly via R22.

If the ramp voltage exceeds -0.6V, VT2 turns off, forward biasing D9. C10 then discharges rapidly via D9 and R21, until the next reset pulse from VT7 resets the ramp generator and VT2 turns on again.

The voltage on C10 is applied to the non-inverting input (pin 12) of IC1/14 and provides a voltage offset which has the effect of controlling the voltage across R20. This in turn controls the

integrator time constant and thus the voltage which the ramp will reach in the 20ms between reset pulses.

Each time power is applied to the dimmer rack, the voltage on C10 will be adjusted on successive mains half-cycles by the bottom-set circuit until an equilibrium is established; this is normally at about -0.3V. This effect may be observed by monitoring pin 14 of IC1 on switch on; the ramp will be seen to stabilise during the first few cycles of the mains.

5.2.4 Blocking Oscillator

The incoming control signals for the two dimmers are respectively connected via terminals 3 and 4 of PLUG 1 to TOPSET adjustment potentiometers RV1 and RV2. Taking RV1 as an example, the output from the wiper of the latter is compared with the ramp waveform from IC1/14 in comparator IC1/1, the output of which controls a blocking oscillator formed by VT3, VT5, TRX1, and their associated components.

At the beginning of each half-cycle, the ramp is more negative than the control signal and the output of IC1/1 is at about -12.5V; VT3 is therefore conducting, clamping the base of VT5 and inhibiting the oscillator. When the ramp becomes more positive than the control signal, the voltage on IC1 pin 1 falls to about -13V, turning off VT3. This allows VT5 to turn on due to base current flowing via R7 and R6. This current is then augmented by the voltage developed across a feedback winding on TRX1, which, at the same time, discharges capacitor C7. When the magnetic core of TRX1 reaches saturation, the feedback ceases and the base of VT5 is driven negative by C7, turning the transistor off. C7 then charges via R7 until VT5 again turns on and the process repeats.

The oscillator transformer has two separate secondary windings, the outputs from which are rectified and applied to the gate terminals of the two power thyristors, X1 and X2.

5.2.5 Ripple Rejection Filter

Connector PLUG 2 allows the fitting of the Strand Lighting Ripple Rejection Filter Board in situations where this is found to be necessary. The connector carries +14V, -13V, 10V a.c. and 0V. The output from the filter is a zero-crossover pulse which, applied to the junction of R9 and R26, overrides the u.d.c. waveform from REC1.

5.3 20/25A Dimmer Module (Ref. 1809)

Drawing No. 6B25974.

Permus 5kW racks use a depopulated version of the trigger card described in the previous section; this drives two 25 Amp thyristors mounted on larger heatsinks. The trigger circuit is identical to that described above, but the second blocking oscillator circuit and comparator are omitted.

5.4 R.F.I. Suppression Card (Ref. 1294)

Drawing No. 6C25219.

In order to provide radio frequency interference suppression, 0.47 microfarad capacitors are fitted from each phase to neutral, earth to neutral, and each load channel to neutral. These are located on Ref. 1294 printed circuit boards, one of which is fitted for every twelve dimmers.

6 SPARES

6.1 Order Codes

The following spares for Permus dimmer racks are available from Strand Lighting:

MD 10A HRC Reyrolle fuse-link (10)	0831814
MD 20A HRC Reyrolle fuse-link (10)	0832018
10A Neozed fuse-link (10)	0800131
25A Neozed fuse-link (10)	080014T
100mA Delay 20 x 5 mm control fuse-link (10)	0800571
Red pullcap fuse carrier (10)	0809512
Black pullcap fuse carrier (10)	0807108
Neozed D02 fuse-cap (10)	0800245
20mm fuseholder (2)	0800525
Dual 10A dimmer module (Ref. 1808)	0881119
20/25A dimmer module (Ref. 1809)	0881214
Control terminal block (2)	0860009
Control cable - 25 core	0860600
Control cable - 12 core	3560111
Control cable - 8 core	3560024
10A Filter	0886115
20/25A Filter	0886123

6.2 Approved Thyristor Replacements

Manufacturer	Dual 10A (Order Code 0889247)	Single 20/25A (Order Code 0889255)
Mullard	BTW 40-600 RSA BTW 40-600 RSB BTW 40-600 RSC	
Westinghouse	U 9033-B5	U 1342-B5 U 9034-B5
A.E.I.	RS 12/5 RS 24/5	RS 5/5 RS 13/5 RS 33/5 RS 41/5
International Rectifier	G 1109 TH	
Brown Boveri	CS 23-06-G05	

7 SERVICE AGENTS

A list of regional Strand Lighting Service Agents may be obtained from the Company's head office.

STRAND LIGHTING LIMITED
Grant Way,
(off Syon Lane),
Isleworth,
Middlesex, TW7 5QD
Tel: 01-560 3171
Telex: 27976
Cables: Rankaudio Brentford

STRAND LIGHTING Gmbh
3340 Wolfenbuettel-Salzdahlum,
Salzbergstrasse 2,
W. Germany.

Tel: 05331 7951
Telex: 09 56 41

APPENDICES

CONTENTS

APPENDIX A

PERMUS 120kW RACKS

A1 INTRODUCTION

This appendix provides additional details applicable to the 120kW double-size PERMUS dimmer racks. In general, the information given in the body of this handbook is relevant to the larger units, except as detailed below. Always use the seven digit Strand Lighting order code for reference.

	Reyrolle Fused	Neozed Fused
24 x 20/25A dimmers	0605206	0605214
12 x 40/50A dimmers	0605140	0605150

PERMUS 120kW Dimmer Racks
Supply Voltage Requirements - 220-250V three-phase or single-phase
Power Requirements - 120kW
Weight - 190kg Dimensions - 1800mm (H) x 190mm (D) x 1040mm (W)

A2 40/50A DIMMERS

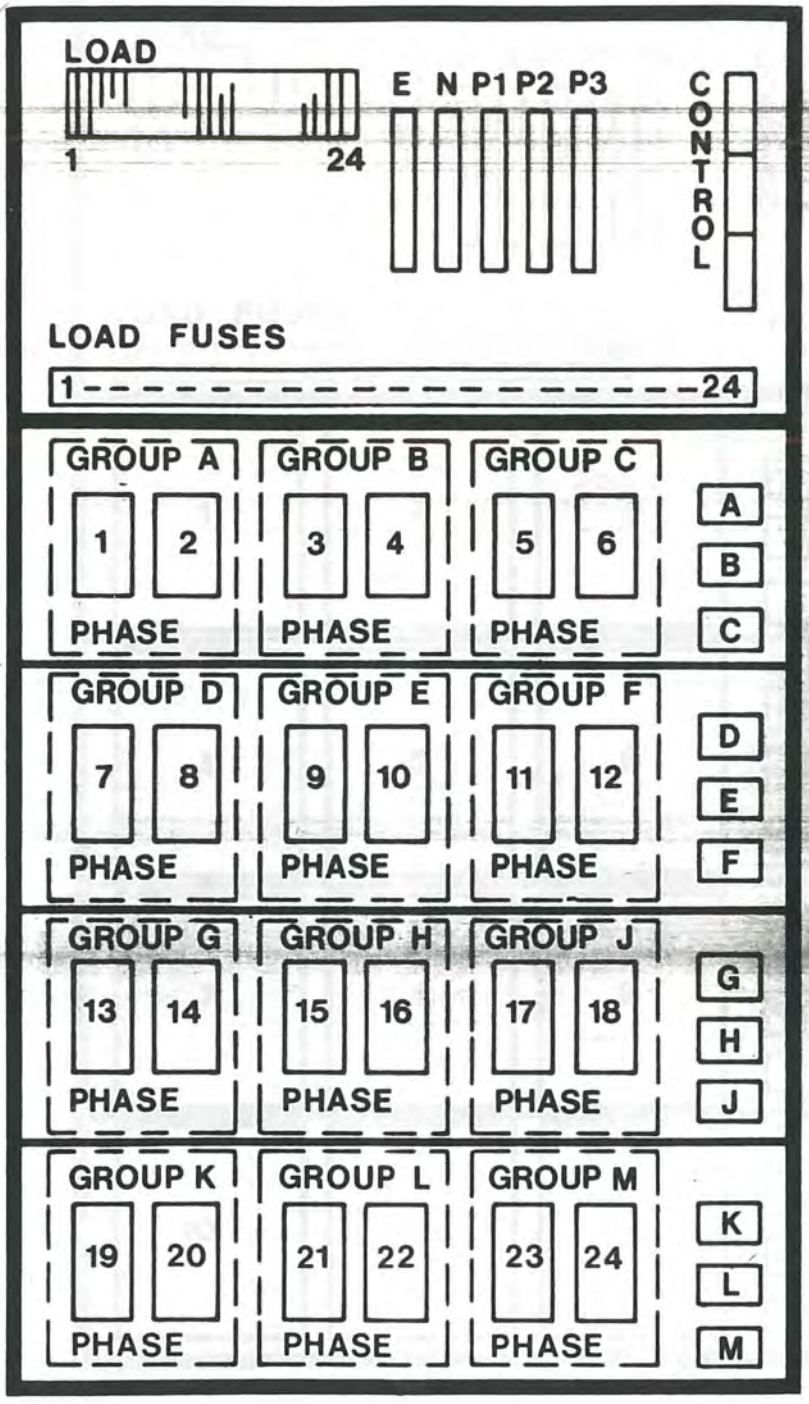
Each PERMUS 40/50A dimmer uses a single channel Ref. 1809/10 module with thyristors separately mounted on individual heatsinks. The dimmers are protected by 40A Reyrolle HRC cartridge fuses or 50A Neozed fuses depending on the installation.

A3 SUPPLY CONNECTIONS

A label showing the layout of the rack will be found inside the rack (see Fig. A1 and Fig. A2). 120kW racks are provided with busbars for the incoming supplies. Supply cables should be coupled to the M12 studs provided on the busbars using suitable heavy duty terminal lugs. If the installation is to be a single phase system, the coupling plate provided should be connected across the three phase busbars.

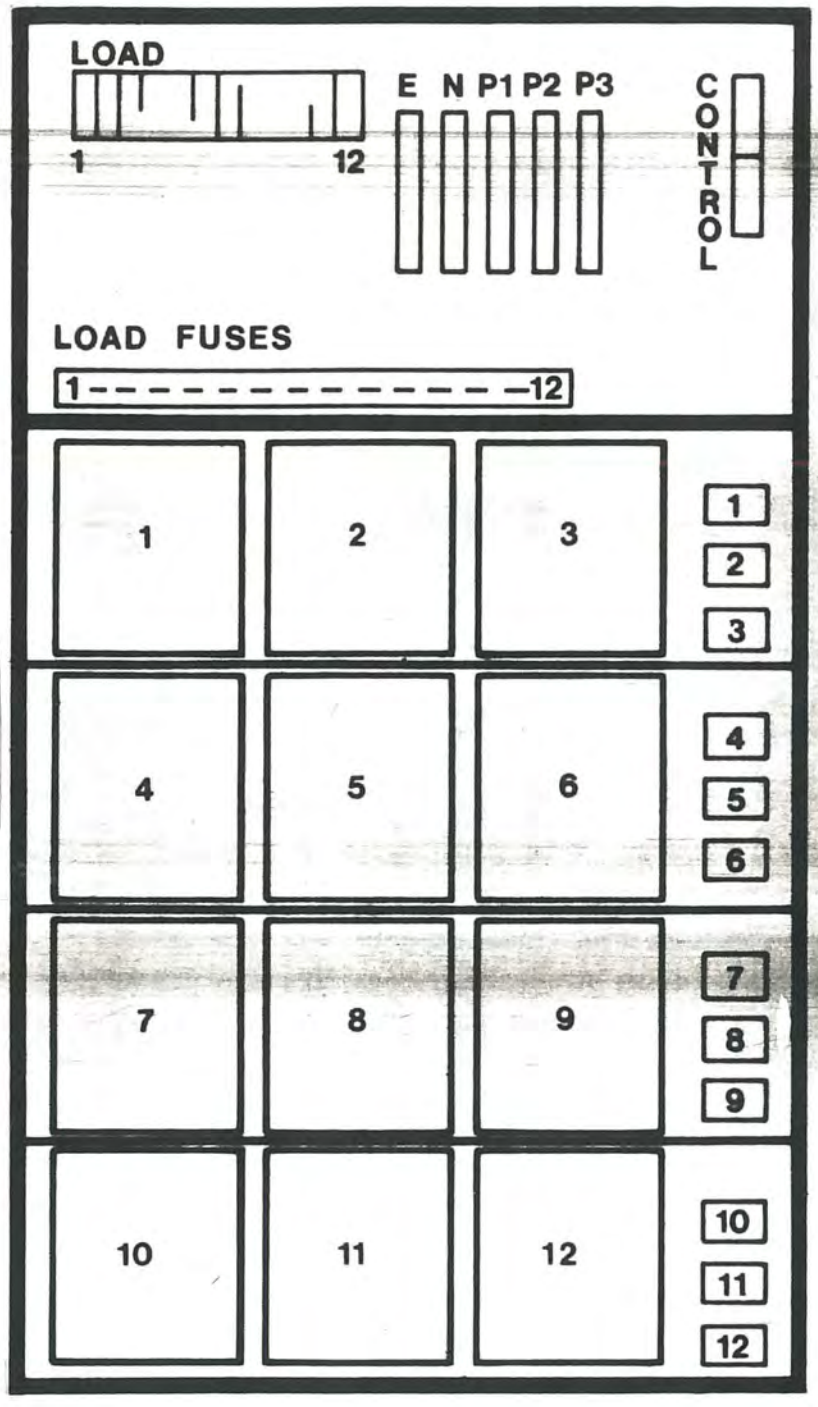
A4 40/50A MODULE (Ref. 1809/10)

PERMUS 40/50A dimmers use the same Ref. 1809 trigger card as that used on 20/25A dimmers, but with the thyristors and heatsinks removed. The larger devices required are mounted separately, adjacent to the trigger card, with their gate lead connected to the appropriate points on the card. Wiring diagrams are included with this appendix.



RACK LAYOUT - 24 x 20/25A PERMUS DIMMER RACK

Fig. A1



RACK LAYOUT - 12 x 40/50A PERMUS DIMMER RACK

Fig. A2

APPENDIX B

DE-MULTIPLEX CONTROL UNIT (Ref. 1866)

B1 INTRODUCTION

The Demultiplex Control Unit is an optional addition to dimmer racks in the Permus range; it permits the direct connection of the dimmers to any Strand Lighting control system which produces a multiplexed output (e.g. Tempus M24), without the need for a separate Multiplex Interface unit. The board produces the dimmer control signals for 24 dimmers, but may be used with any size of rack; one board will normally be required for each rack in a dimmer installation.

The unit fits inside the rack and carries multiplex input and dimmer control output connectors, and channel group selector switches. It is supplied complete with four six-way output cables, a mains lead and three 'tyrap' cable tidies.

B2 INSTALLATION

The Demultiplex Unit mounts on the right-hand side of the rack, adjacent to the upper row of dimmer modules.

WARNING: ISOLATE THE MAINS SUPPLY BEFORE REMOVING ANY COVERS. When the dimmers are in operation, the thyristor heat-sinks are at mains potential.

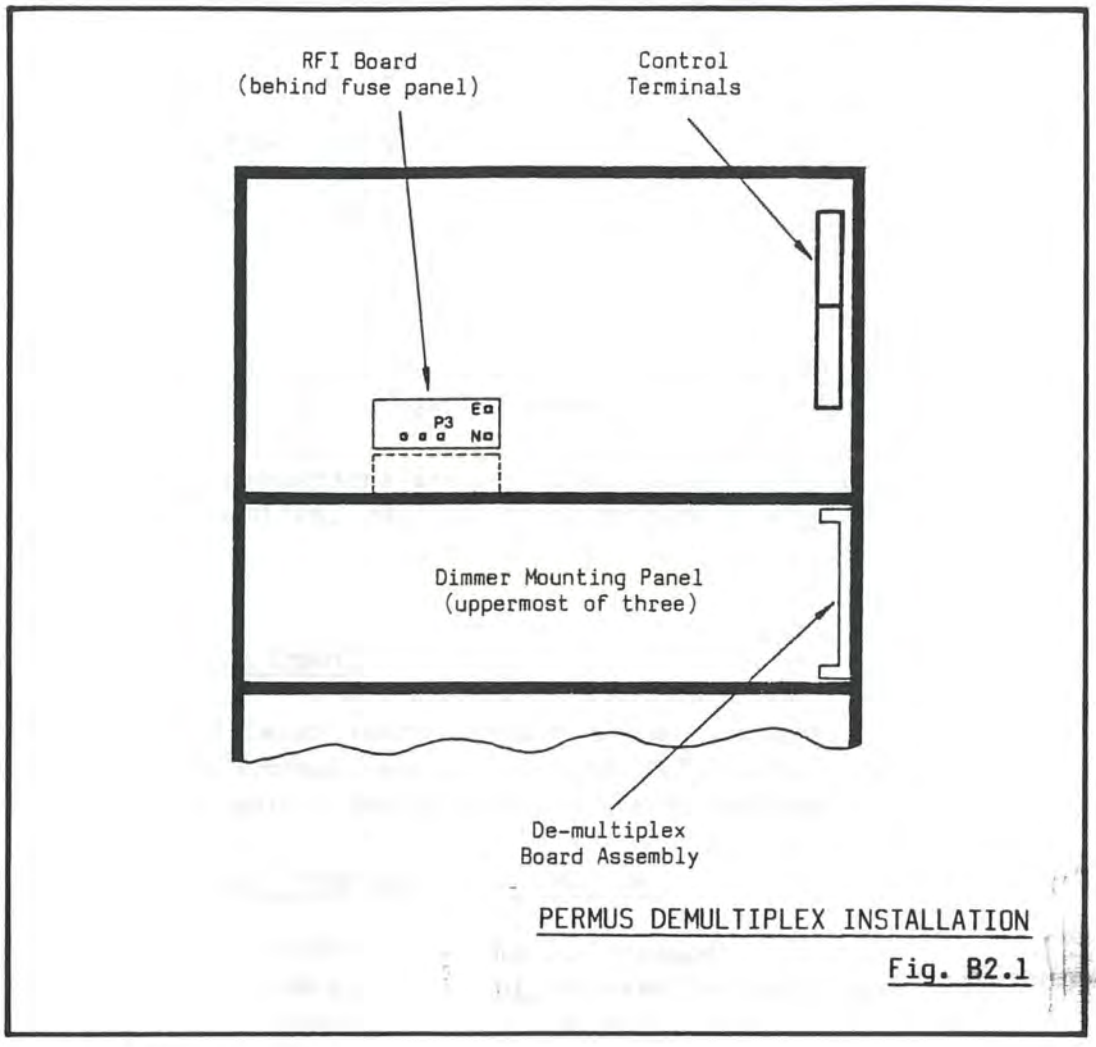
1) Remove the two front covers from the rack to gain access to the interior.

2) Remove the two screws securing the right-hand end of the uppermost dimmer mounting panel (see Fig. B2.1); retain these screws for later use.

3) Hold the Demultiplex Board assembly vertically, with the mains input connector at the top and the edge with the other connectors, etc. facing towards you. Passing the mounting bracket behind the existing cable loom, line-up the slots in the bracket with the holes in the dimmer mounting panel.

4) Replace the screws removed in '2' above, passing them through the mounting bracket.

5) Connect the dimmer control outputs, and the multiplex and mains inputs (see section B3). Set-up the board as described in section B4, to control the required group of channels.



PERMUS DEMULTIPLEX INSTALLATION

Fig. B2.1

B3 CONNECTIONS

B3.1 Control Outputs

Four multicore cables, fitted with eight-way sockets, are provided with the Demultiplex Board assembly. These connect between the multipin plugs below the Channel Group Selector switches (when the board is in situ) and the control input terminals at the top of the rack. Each board connector carries the outputs for six channels and is labelled with the appropriate channel numbers.

The individual wires in the control output cables are colour-coded as follows:

Cable No.	1	2	3	4	Wire Colours
	1	7	13	19	Red
	2	8	14	20	Blue
	3	9	15	21	Green
Channel	4	10	16	22	Yellow
Numbers	5	11	17	23	White
	6	12	18	24	Black
	N/U	N/U	N/U	N/U	Brown
	TE	TE	TE	TE	Violet

Note that in dimmer racks with less than 24 dimmers, some control outputs will not be needed; these should be left unconnected.

When the connections are complete, secure the cables using the cable tidies supplied, passing them through the holes in the mounting bracket.

B3.2 Multiplexed Input

The multiplexed control input signal connects via the four-way, plug-on terminal block labelled PL3, using single core 0.5mm^2 screened cable. The connections are as follows:

PL3 Terminal	Connection
SCRN	Screen (common)
ANLG	Multiplexed Control Signal (DMX)
SYNC-	Not Normally Used
SYNC+	Not Normally Used

The SYNC- and SYNC+ terminals are provided to allow the use of an alternative, four-wire system.

If the installation comprises two or more dimmer racks, the multiplexed input must be connected from rack to rack in 'daisy chain' fashion.

The connection at the control system is normally by means of a 3-pin type XLR connector, wired as follows:

Pin 1	Screen	0V
Pin 2	Red	FMX - Multiplexed Input (to control system)
Pin 3	Blue	DMX - Multiplexed Output (from control system)

The pin 2 connection is not used on Permus demultiplex installations.

B3.3 Mains Input

The mains cable supplied should be connected between the socket at the top of the board and the RFI card on the other side of the rack. The connections are as follows:

RFI Card Terminal	Wire Colour
P3	Brown
N	Blue
E	Green/Yellow

The unit includes a self-resetting fuse, thus making a fuse in the mains input unnecessary.

WARNING: In all installations using the Demultiplex Unit the equipment must be properly earthed if it is to function correctly. IT IS ESSENTIAL THAT EARTH BE AT THE SAME POTENTIAL AT ALL POINTS IN THE SYSTEM. If this is not the case, circulating currents may be generated in the signal earth connections, leading to fluctuating light levels and, in extreme cases, severe damage to the equipment.

In cases where the earth is provided via the supply neutral, the recommendations given in section 3.1 must be followed. If damage is caused as a result of failure to observe these recommendations, any warranty will be invalidated. If in doubt, your local Strand Lighting agent will be pleased to advise.

B4 SETTING-UP

Before the modified dimmer rack can be used, it must be decided which channel numbers will be assigned to the dimmers. The numbers chosen must be consecutive and the first number must be within the valid range of the control system.

The three rotary Channel Group Selector switches represent, from bottom to top, the hundreds, tens and units of the first channel number in the group, i.e. that assigned to dimmer 1. For instance, to assign the dimmers to channels 1 to 24, set the three switches to (from bottom to top) 0, 0, 1; dimmer 1 will then be assigned to channel 1, 2 to 2, 3 to 3, etc. Similarly if the channels required are numbers 25 to 48, the switch settings will be 0, 2, 5.

Notes: 1) If the first number is within 24 of the maximum valid channel number, or if the rack contains less than 24 dimmers, there will be some spare control outputs; for example, if the switches are set to channel 37 on a 48 channel installation, outputs numbers 13 to 24 will be unused.

2) Two or more dimmer racks may be assigned to the same lighting channels. This provides a simple method of patching multiple dimmers to single channels.

When the equipment is in operation, a 'Communication' indicator on the board lights to show that a valid multiplex signal is being received.

B5 TECHNICAL DESCRIPTION

Drawing No. 6A28237

B5.1 General

The Permus demultiplex control board receives a multiplexed analogue signal from the associated Control Console and generates the dimmer drive outputs for 24 channels. The multiplexed signal is sampled to extract the levels for the channels controlled by the board and these levels are stored on capacitors. The levels are typically refreshed or updated about every 50ms.

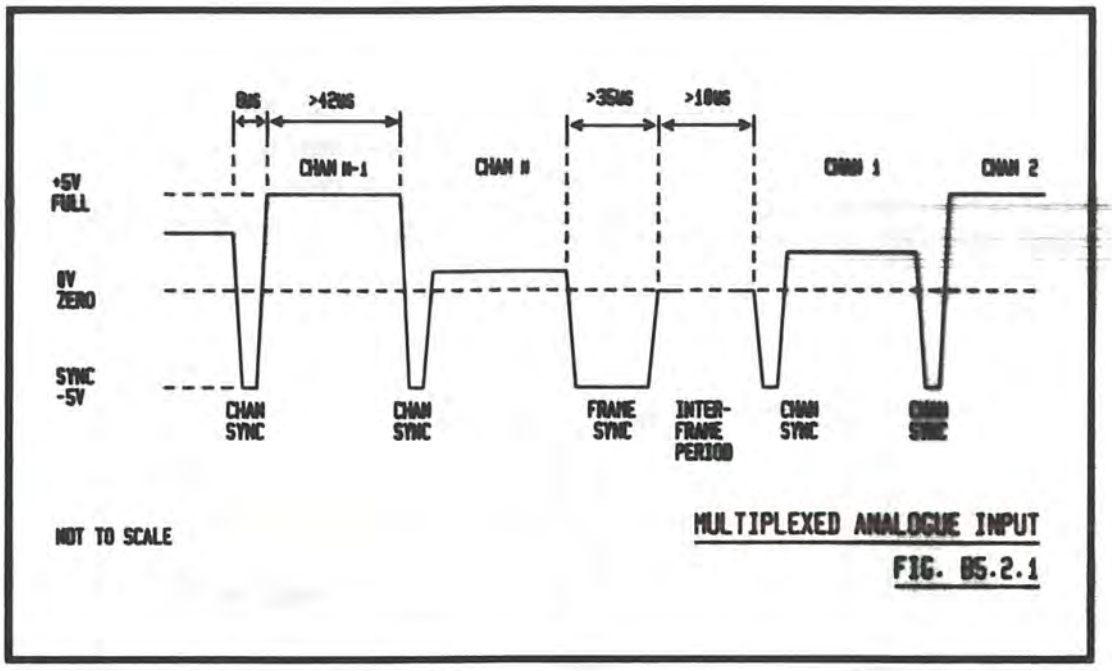
B5.2 Multiplexed Analogue Input

The incoming multiplexed analogue signal appears on terminals 1 and 2 of connector PL3 and, terminated by capacitor C12 and resistors R15 and R16, is applied to a differential amplifier formed by IC4/1 and its associated components. IC4/1 has a gain of three, set by resistors R17, R57, R58 and R59, to ensure stability. However, the incoming signal is routed via potential divider R17/R60, thus giving an overall gain of unity. The circuit ensures that the multiplexed signal remains isolated from ground, thus preventing interference which may be caused by earth loops.

Note that early, 'Issue 2' boards have the alternative circuit shown on the diagram. The incoming signal on terminal 2 of PL3 is terminated by capacitor C12 and resistors R15 and R16, and applied to unity-gain buffer IC4/1.

The multiplexed signal takes the form shown in Fig. B5.2.1. The analogue channel level varies between +5V (full level) and 0V (zero), while the sync pulses are negative-going to -5V.

Some equipment may use an alternative, four-wire system which has separate analogue and sync signals. In the latter case, the sync signals appear on terminals 3 and 4 of PL3 and are applied to Op-amp IC4/7 which acts as a differential line receiver.



MULTIPLEXED ANALOGUE INPUT

FIG. B5.2.1

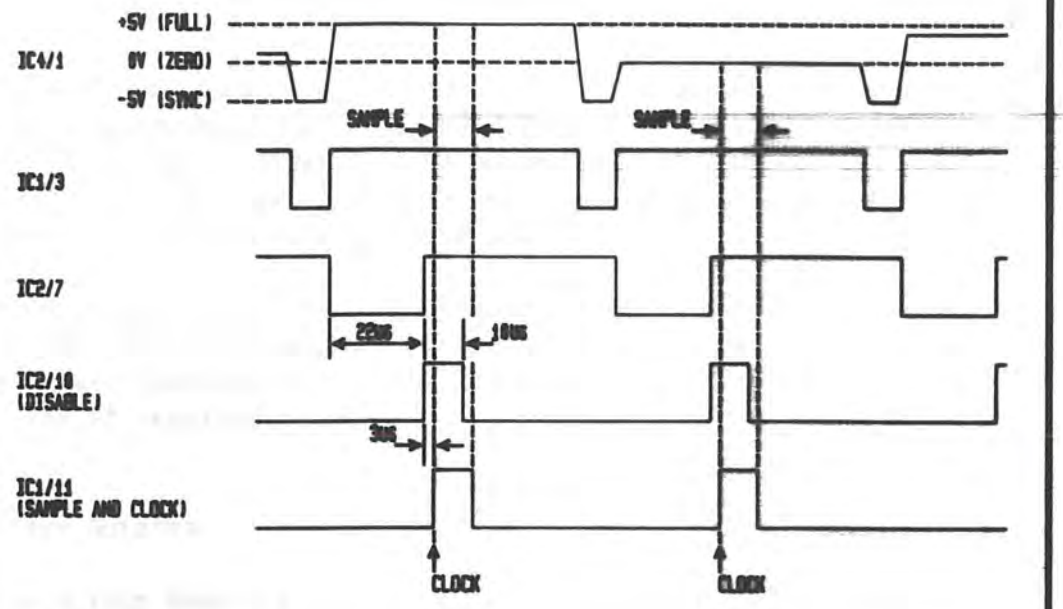
B5.2.1 Channel Sync Pulses

The output of IC4/1 is applied to the base of transistor VT3 which passes only the negative-going Channel Sync pulses. The base/collector diode of the transistor provides isolation from the analogue signals when the four wire system is in use, while resistor R53 protects the output of IC4/7 on two-wire systems.

The combined outputs of VT3 and IC4/7 are routed via Schmitt trigger IC1/3; the input of the latter is protected by diode D1, which clamps the positive-going excursions of the signal. The positive-going edges of the output from IC1/3 (i.e. the trailing edges of the sync pulses) trigger monostable IC2/7, which produces a 22us negative-going pulse on pin 7 (see Fig. B5.2.2). On the trailing edge of the latter signal, IC2/10 is triggered and the negative-going output (pin 9) of this monostable, routed via delay circuit R3/C10 (3us) and Schmitt trigger IC1/11, enables analogue switch IC7/2.

B5.2.2 Analogue Sampling

IC4/1 also feeds Op-amp IC4/8 which, has a gain of 2 and inverts the signal to produce the 0V to -10V control signals required by the dimmers. The output of IC4/8 is applied to the analogue input of IC7/2. When the latter device is enabled, the output of IC4/8 is applied to capacitor C17, which therefore charges to the analogue level of the channel currently being sampled (see Fig. B5.2.2).



ANALOGUE SAMPLING WAVEFORMS

FIG. B5.2.2

B5.2.3 Output Enable

The output of Schmitt trigger IC1/11 is also applied to the clock input of counter IC11 (see section B5.2.6). This produces outputs which are used to route the sampled analogue signal to the appropriate dimmer drive circuit. The counter outputs change on the front edge of the clock pulse.

A second counter, formed by IC5, IC8 and IC10, is clocked by the pin 9 output of IC2/10. The output from pin 12 of IC5 is a signal (First Channel) which becomes high at the beginning of the transmission period of the 24 channels served by the board. A second signal (Last Channel), from IC3 pin 12, appears 32 channels later. These two signals are applied to the select inputs of decoder IC14/10, on pins 13 and 14 respectively. The pin 10 output of the decoder is only selected with First Channel and Last Channel both high (i.e. for 32 channels following the appearance of the First Channel signal) and during this period, the output of IC2/10 (Disable) is routed via IC14/10 to enable the second half of decoder IC14 (on pin 1).

The latter device receives select inputs (C3 and C4) from the counter and produces a low output on one of pins 4, 5, or 6. These are each connected to the enable input of one of three 8-channel analogue demultiplexers which receive select signals C0 - C2 from

the counter. The analogue input to the demultiplexers is from Op-amp IC4/14, the input to which is the analogue voltage stored on C17.

The Disable signal from IC2/10 inhibits IC14/10 during the sample period for each channel (see Fig. B5.2.2) and thus, via the second half of the decoder, disables the selected demultiplexer. This ensures that the voltage on C17 is not connected to the selected output until it has attained a stable state.

Because there are only three 8-channel demultiplexers, only the first 24 of the 32 channels appear on a dimmer drive output. The remaining 8 are ignored, but may be processed by a demultiplexer in another rack if required.

B5.2.4 Dimmer Drive Outputs

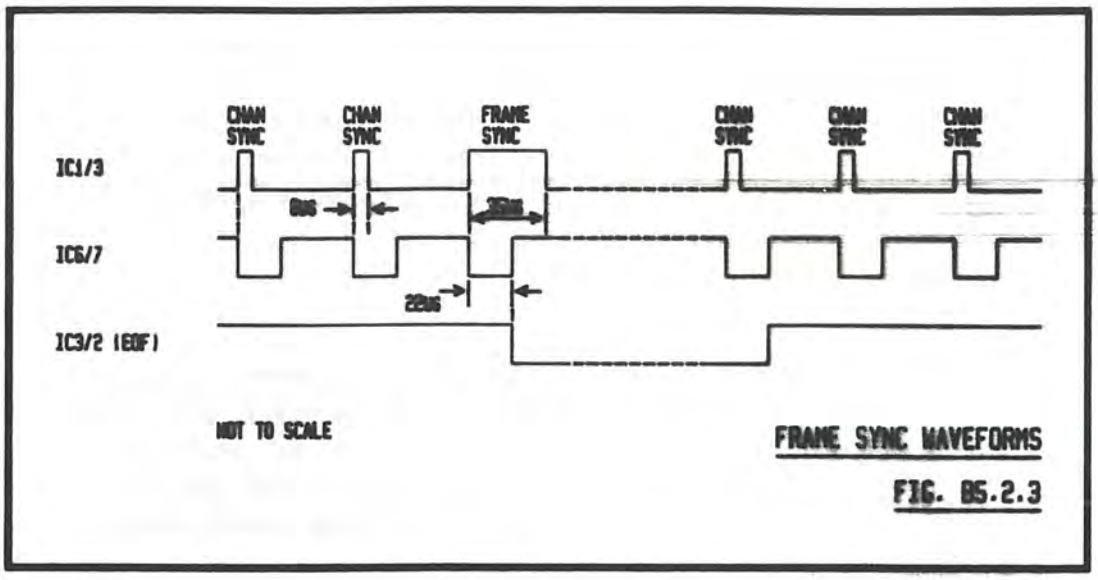
During the Output Enable period (i.e. while IC14 pin 10 is low) the output of IC4/14 is applied, via the selected analogue demultiplexer, to one of twenty four capacitors (C21 - C28, C31 - C38 and C41 - C48). These each provide the input to a unity gain Op-amp which, via a resistor and a diode, feeds the dimmer drive line for the corresponding channel. The diodes allow the outputs to combine on a Highest-takes-precedence basis with those of other control systems, while the resistor provides current limiting and protection against high voltages in the event of a fault.

When IC14 pin 10 goes high, the analogue demultiplexer channel is disabled and presents a high impedance to the capacitor. As the input to the Op-amp is also high impedance, the capacitor retains its charge until refreshed on the next frame of the multiplexed analogue signal.

B5.2.5 Frame Sync

At the end of each frame of channel level data, a Frame Sync pulse with a duration of at least 35us appears on the multiplexed analogue input. This is detected by means of monostable IC6/7 (22us), which is triggered on the leading edge of every sync pulse by the output of IC1/3. On the trailing edge of the 22us pulse from IC6/7, IC3/2 is clocked and its output is set low or high, depending on the state of its D input. In the case of the Channel Sync pulses, IC1 pin 3 returns high after 8us and IC3 pin 2 is therefore set high. When the longer Frame Sync pulse appears, however, IC1 pin 3 is still low after 22us and pin 2 of IC3 is set low.

The end of Frame (EOF) signal thus produced is used to reset the channel counter as described in section B5.2.6, and to trigger multiplex detector IC6/10. The latter device has a period of 0.5s and it is therefore continually retriggered. Its output is used,



FRAME SYNC WAVEFORMS

FIG. B5.2.3

via transistor VT1, to drive the 'Communication' indicator LED (Mux OK) and, if the multiplex signal ceases, to reset bistable IC3/12.

B5.2.6 Channel Counter

The channel counter is formed by IC11, IC5, IC8, and IC10. It is divided into two sections. IC5, IC8 and IC10 are clocked by sync pulses from IC2/9 and count down from a preset value which depends on the particular group of channels served by the board; the latter is set on the Channel Group Selector switches, SW1, SW2 and SW3, and is loaded by the End of Frame pulse from IC3/2. When a count of zero is reached, IC5 pin 12 (First Channel) goes high and this part of the counter is inhibited.

The other half of the counter (IC11) is enabled only when First Channel is high; it is also clocked by the channel sync pulses - taken in this case from IC1/11 - and produces the C0 - C4 signals which select each analogue output circuit in turn as the 24 channels are scanned (see section B5.2.3).

32 channels after First Channel appears, bistable IC3/12 is clocked by the pin 4 output (C5) of IC11. The pin 12 output of the bistable (Last Channel) is applied to decoder IC14/10, to disable the analogue demultiplexer.

B5.3 Power-up and Power-down Inhibit

When power is applied to the board, VT2 is initially off, C39 is discharged and IC6/10 is reset via D30. When the -15V rail reaches about -10V, D5 conducts and VT2 switches on, back biasing D30 and charging C39. IC6/10 remains reset, however, via R24, until C39

reaches the threshold of the monostable; hysteresis about this threshold is produced by positive feedback via R54.

When the power is switched off, the -15V rail rapidly collapses to below -10V, switching off VT2 and resetting IC6/10 via D30. D4 ensures that C39 discharges rapidly.

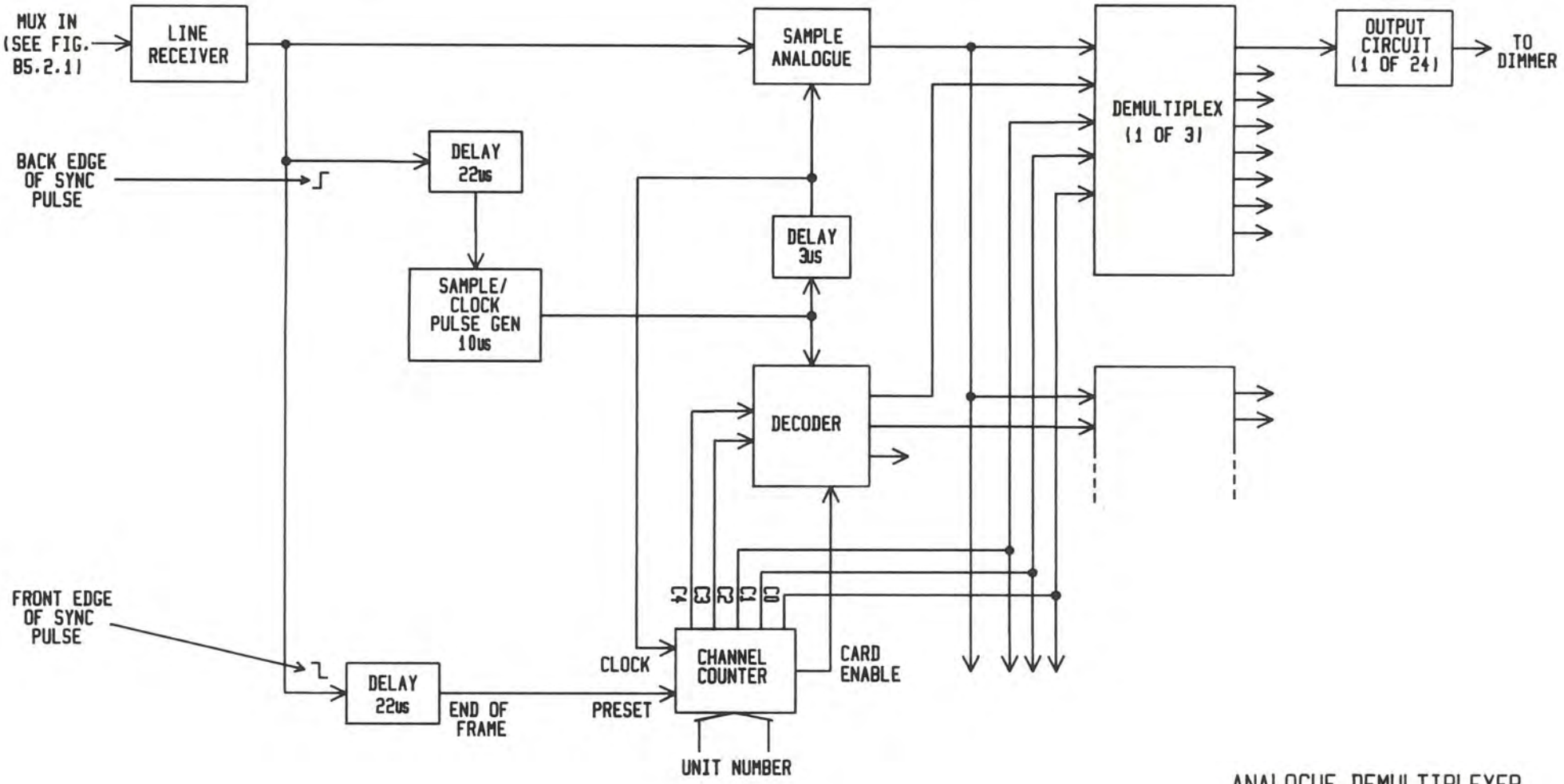
B5.4 Power Supplies

The incoming mains connects via plug PL1 and is routed via a self-resetting fuse (R1) to transformer TRX1; the output of the latter is full-wave rectified by REC1 and smoothed by C1 and C6. The resulting 24-0-24V d.c. supply is applied to regulators REG2 and REG1 which respectively generate +15V and -15V rails.

A third rail (-0.7V) is produced by D32 and R2. This rail supplies all the CMOS logic, but is primarily needed to ensure that the analogue demultiplexers can pass the full control voltage range (0V to -10V).

B6 MAINTENANCE

If maintenance of the Demultiplex Control Unit should be necessary, the printed circuit board should be removed and returned to an approved Strand Lighting service agent. To remove the board, unplug the mains input, multiplexed input and control outputs, and lift the board off its mounting pillars.



ANALOGUE DEMULTIPLEXER

FIG. B5.2.4

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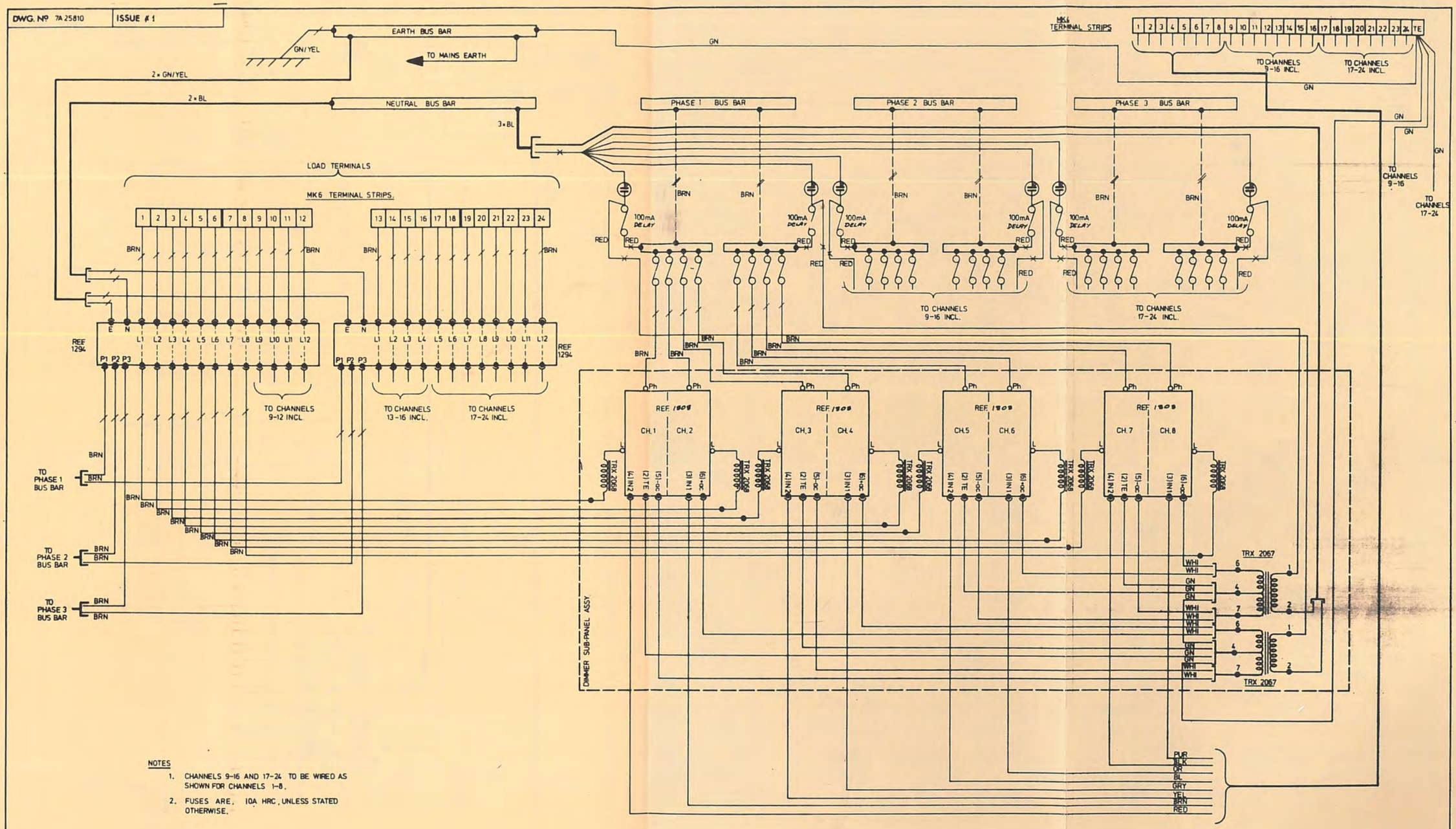


NOTES

1. CHANNELS 9-16 AND 17-24 TO BE WIRED AS SHOWN FOR CHANNELS 1-8.
2. FUSES ARE, 10A HRC, UNLESS STATED OTHERWISE.

WIRE SIZES

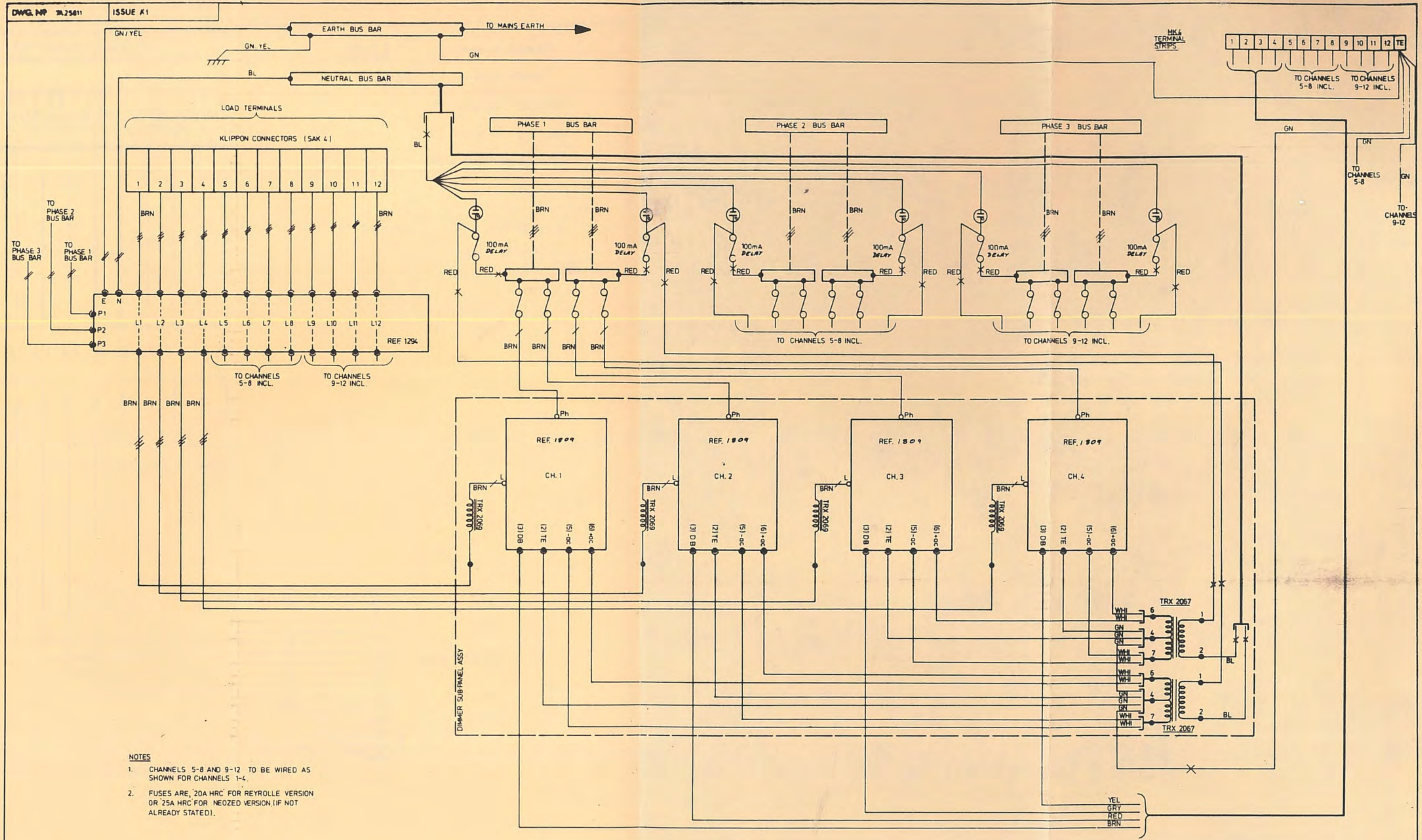
- 0·75mm²
- 2·5mm²
- 6·0mm²

ALL OTHER WIRES 0·5mm²

RANK STRAND ELECTRIC — A RANK AUDIO VISUAL LIMITED	TOLERANCES (IMPERIAL / METRIC)	SCALE: NTS	DATE: 4-2-80
	FRACTION ± 1/64" ; 1 DEC PLACE ± 0·4mm	DRAWN: P MCB.	31-3-80
	DECIMAL ± .005 ; 2 DEC PLACE ± 0·1mm	CHECKED:	
	ANGULAR ± 0·25°	APPROVED:	
	UNLESS OTHERWISE STATED	MATERIAL:	
	IL25700	FINISH:	
	DIMENSIONS IN INCHES/MILLIMETRES — THIRD ANGLE PROJECTION	PERMUS (SINGLE RACK)	

TITLE: PERMUS 10A 'STAR' WIRING DIAGRAM.

ISSUE #1 — DWG. Nº 7A 25810



NOTES

1. CHANNELS 5-8 AND 9-12 TO BE WIRED AS SHOWN FOR CHANNELS 1-4.
2. FUSES ARE, 20A HRC FOR REYROLLE VERSION OR 25A HRC FOR NEOZED VERSION (IF NOT ALREADY STATED).

WIRE SIZES

- 6·0 mm²
- 4·0 mm²
- 2·5 mm²
- 0·75 mm²

ALL OTHER WIRES 0·5 mm²

RANK STRAND ELECTRIC
PO BOX 70 Great West Road Brentford Middlesex TW8 9HR Telephone 01-568 9222 Telex 27976
A DIVISION OF
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DIMENSIONS IN INCHES/MILLIMETRES
THIRD ANGLE PROJECTION

TOLERANCES	
IMPERIAL	METRIC
FRACTION ± 1/64"	1 DEC PLACE ± 0·4mm
DECIMAL ± ·005"	2 DEC PLACE ± 0·1mm
ANGULAR ± 0·25°	
UNLESS OTHERWISE STATED	

USED ON:- IL 25700
PERMUS (SINGLE RACK)

SCALE	NTS	DATE
DRAWN	P.McB.	4-9-80
CHECKED		
APPROVED		
MATERIAL:-		
FINISH:-		

TITLE:- PERMUS 20/25A 'STAR' WIRING DIAGRAM.

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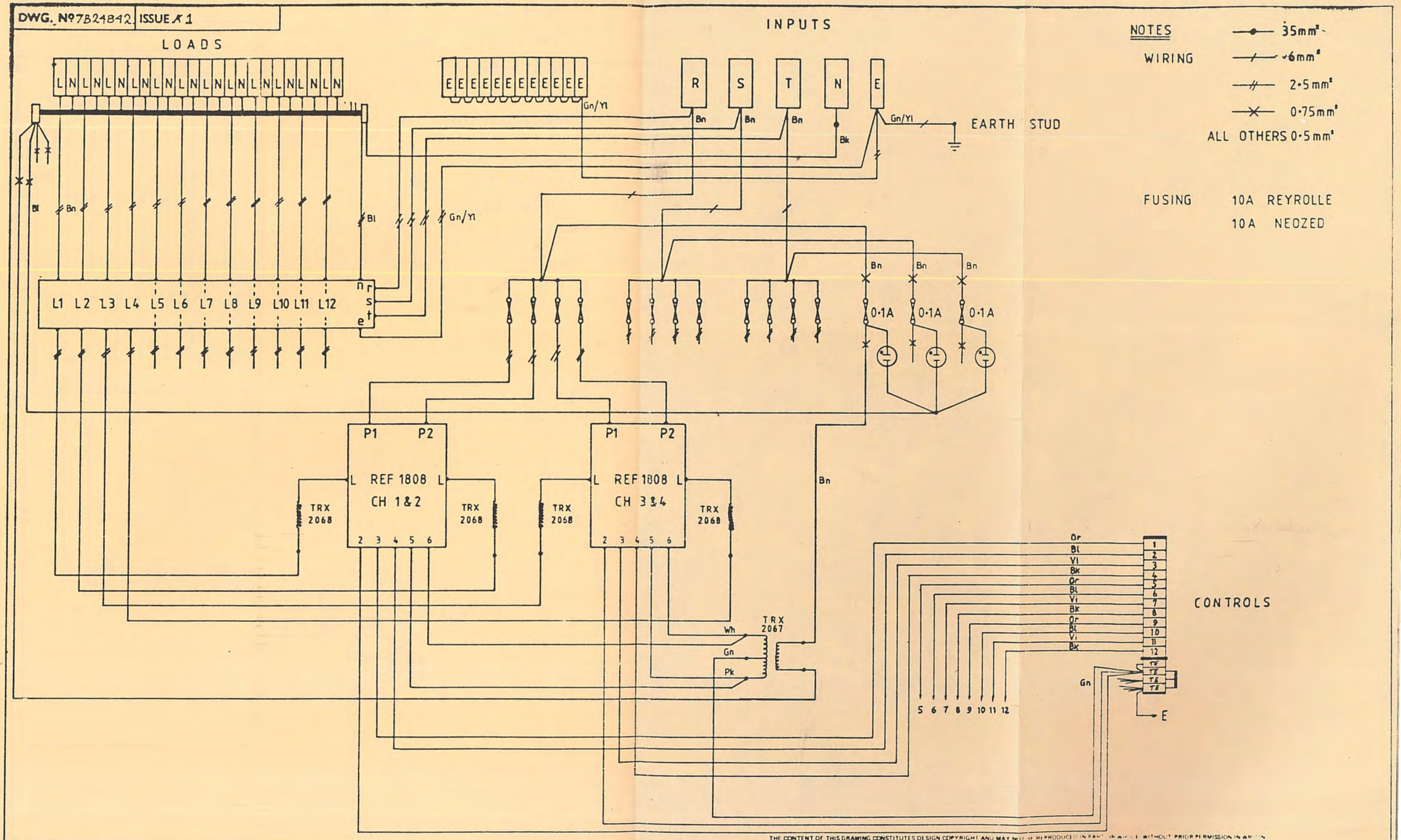

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1. ISSUE 1	E.3933
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DIMENSIONS IN INCHES/MILLIMETRES
THIRD ANGLE PROJECTION

TOLERANCES	
IMPERIAL	METRIC
FRACTION ± 1/64"	1 DEC PLACE ± 0.4 mm
DECIMAL ± .005"	2 DEC PLACE ± 0.1 mm
ANGULAR ± 0 25'	
UNLESS OTHERWISE STATED	

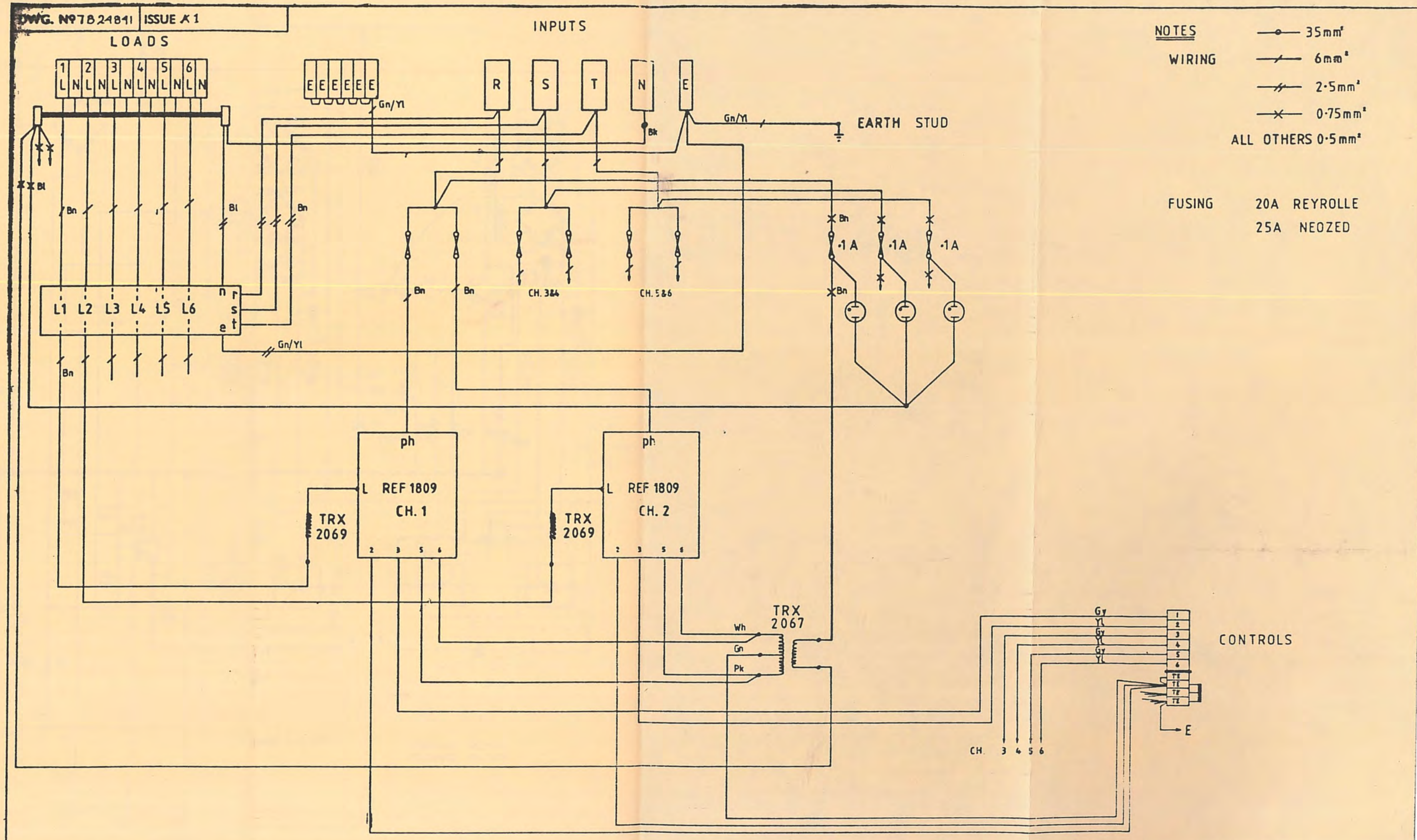
USED ON 27005
FERMUS 24869

SCALE
DRAWN
CHECKED
APPROVED
MATERIAL
FINISH

PERMUS 12 x 2·5 Kw WIRING DIAGRAM

ISSUE 1

DWG. Nº 7B 24842



REV.	C. Nº	
1. ISSUE 1	E.3933	DRG. RAISED TO PRODUCTION ISSUE R.R. 25/1/82.

RANK STRAND ELECTRIC

PO Box 70 Great West Road Brentford Middlesex TW8 9HR
Telephone 01-568 9222 Telex 27976

A DIVISION OF
RANK AUDIO VISUAL LIMITED

DIMENSIONS IN INCHES/MILLIMETRES
THIRD ANGLE PROJECTION

TOLERANCES	
IMPERIAL	METRIC
FRACTION ± 1/64"	1 DEC PLACE ± 0.4mm
DECIMAL ± .005"	2 DEC PLACE ± 0.1mm
ANGULAR ± 0.25°	
UNLESS OTHERWISE STATED	

USED ON: 27005 / PERMUS S 24869

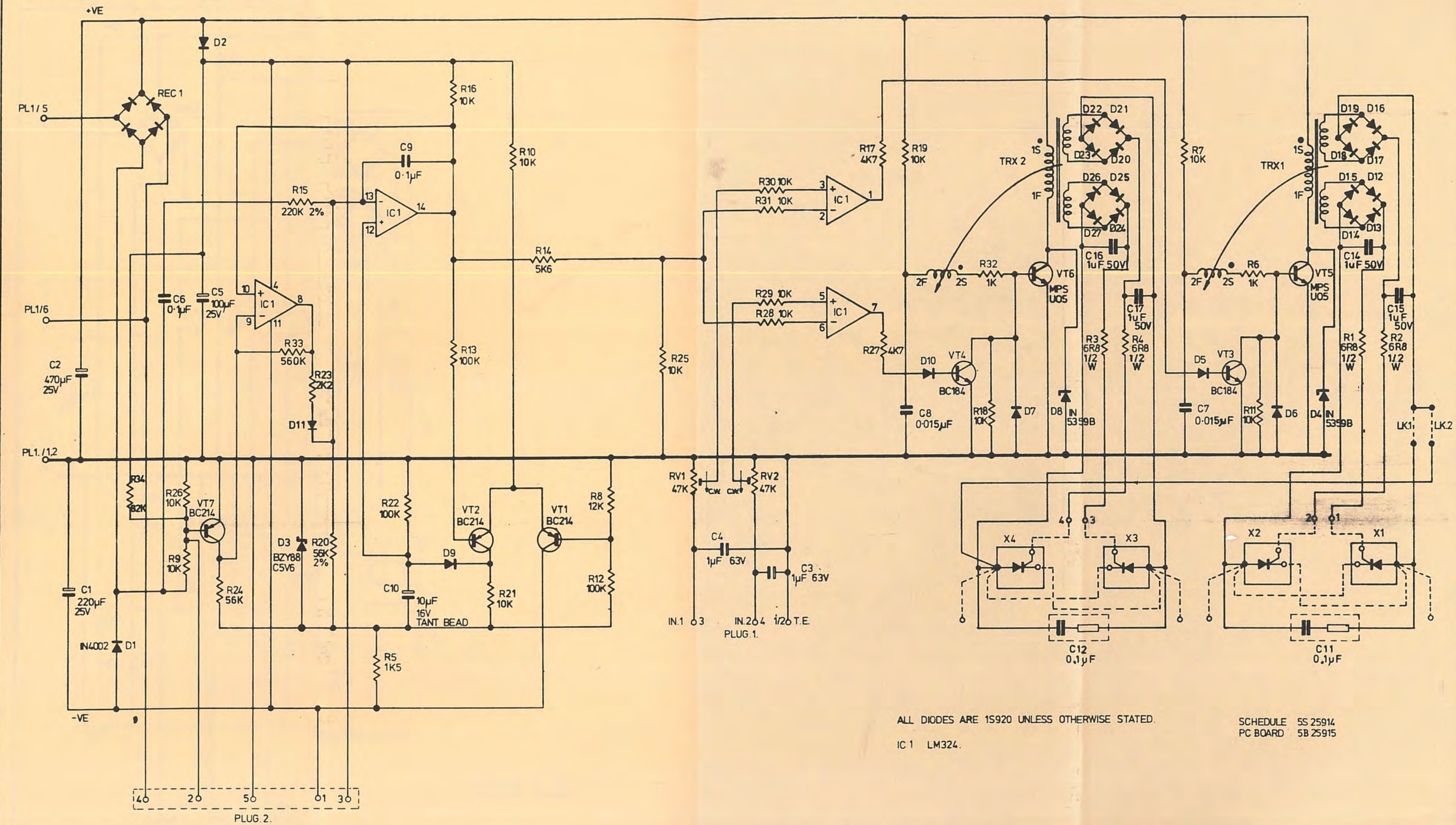
SCALE
DRAWN [signature] DATE 12.5.81
CHECKED
APPROVED
MATERIAL
FINISH

TITLE: PERMUS 6 x 5Kw WIRING DIAGRAM

ISSUE ✗ 1

DWG. Nº 7B 24841

DWG. N° 6B25916	ISSUE



ALL DIODES ARE 1S920 UNLESS OTHERWISE STATED.

IC 1 LM324.

SCHEDULE 5S 25914
PC BOARD 5B 25915

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DIMENSIONS IN INCHES/MILLIMETRES
THIRD ANGLE PROJECTION

TOLERANCES		
	IMPERIAL	METRIC
FRACTION	± 1/64"	1 DEC PLACE ± 0·4 mm
DECIMAL	± ·005"	2 DEC PLACE ± 0·1 mm
ANGULAR ± 0·25°		
UNLESS OTHERWISE STATED		

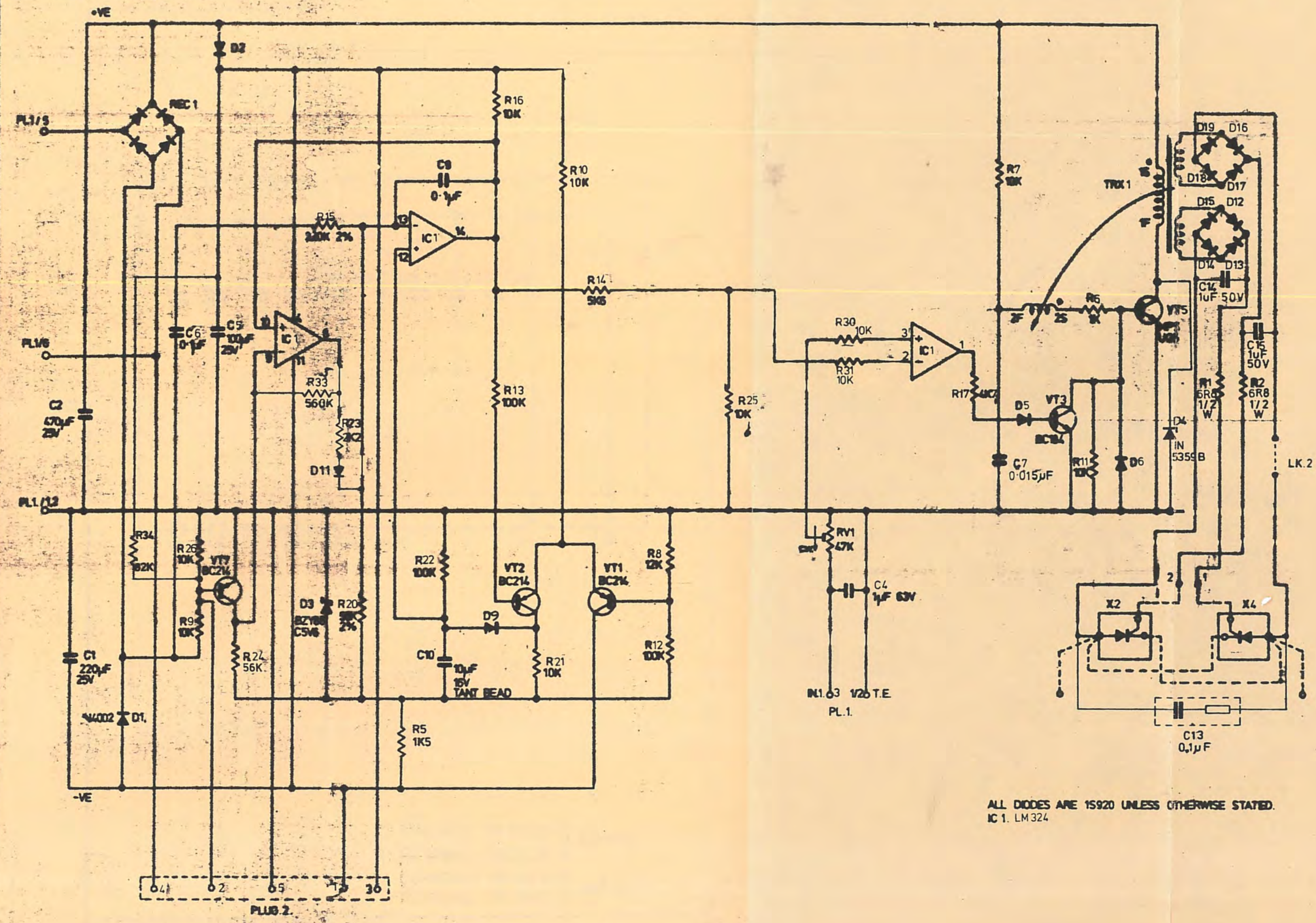
USED ON :- IL25700
PERMUS

SCALE	—	DATE
DRAWN	P.McB.	16-3-81
CHECKED		7-4-81
APPROVED		9-4-81

MATERIAL :- —
FINISH :- —

TITLE :- DUAL 2·5KW DIMMER CARD
P.C.B. 810/6
REF 1808
ISSUE
DWG. N° 6B25916

DWG. Nº 6B 25974 ISSUE



ALL DIODES ARE 1S920 UNLESS OTHERWISE STATED.
IC 1. LM 324

SCHEDULE 5S 25973
PC BOARD 5B 25915

REV 1. C.DESIGNE D9 WAS D6.	REV 2. CN°EA3429 RAISED TO PROD. ISSUE 1 C.E.BARNETT 15-4-82	Rev 3. C.N° EA479 C7 was 6.8nF R12 was 10K	REV 4 E4487 R23 WAS 4K7	REV 5 E6048	REV 6 E7049 D4 WAS BZY88C9V1	REV 7. E8105 R33 ADDED	REV 8 E8593 C12 ADDED. D16-19 WAS REC 5 D12-15 WAS REC 4 C14 & 17 ADDED C7 WAS 0.01μF	REV 9 E8666 C14, C15 WERE C16, C17	REV 10 E9722 R34 ADDED R10 WAS 47K R21 WAS 18K R24 WAS 1M2		

RANK STRAND ELECTRIC
A DIVISION OF RANK AUDIO VISUAL LIMITED

DIMENSIONS IN INCHES/MILLIMETRES
THIRD ANGLE PROJECTION

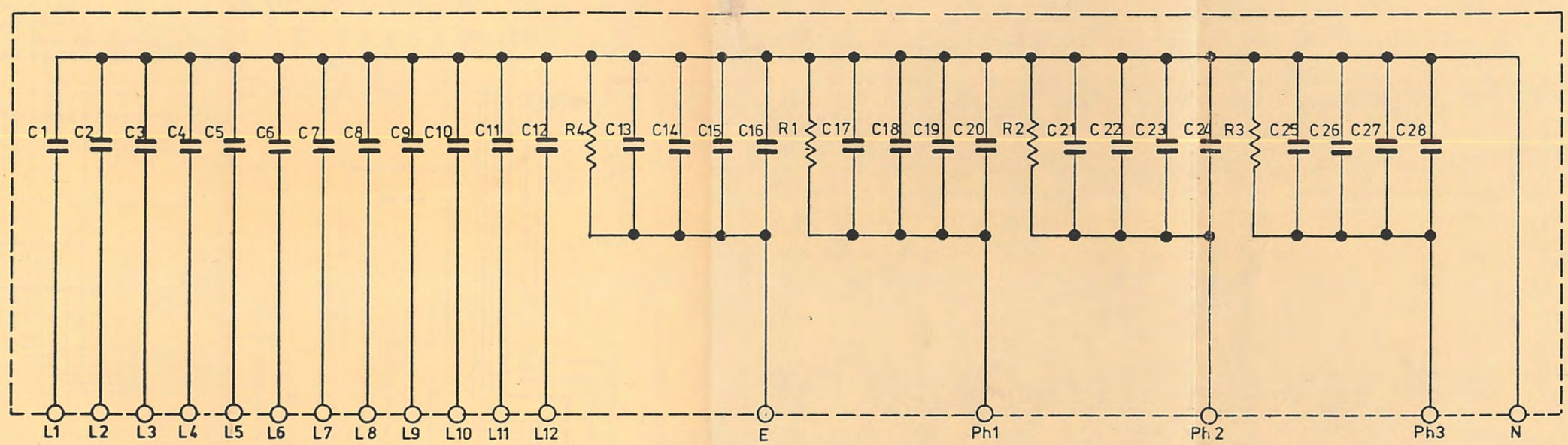
TOLERANCES		SCALE	—	DATE
IMPERIAL	METRIC	DRAWN	P McB	7-4-81
FRACTION ± 1/64"	1 DEC PLACE ± 0·4mm	CHECKED		
DECIMAL ± ·005"	2 DEC PLACE ± 0·1mm	APPROVED		
ANGULAR ± 0·25°		MATERIAL:	—	
UNLESS OTHERWISE STATED		FINISH:	—	
USED ON: 1625700				
PERMUS				

TITLE: SINGLE 5KW DIMMER CARD.

PC B 810/6 REF 1809

ISSUE DWG. Nº 6B 25974

DWG. Nº 6C 25219	ISSUE XYZ3



NOTE

ALL CAPACITORS ARE 0·47µF 250 Vac

ALL RESISTORS ARE CR 25 330K

SCHEDULE 5S 25220 } REF 1294
PC BOARD 5A 25221 }

SCHEDULE 5S 29622 } REF 1877
PC BOARD 5A 29623 }

REV.1 C.N.Nº 84349 RAISED TO PRODN ISSUE 1 C.E.BARNETT. 13-4-82

REV 2 E0190 '12 WAY' IN TITLE WAS 'PERMUS' CS 9/7/85

REV 3 E0428 REF TO REF. 877 ADDED. 10/1/86.

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DIMENSIONS IN INCHES/MILLIMETRES
THIRD ANGLE PROJECTION

TOLERANCES		SCALE		DATE
IMPERIAL	METRIC	DRAWN	P McB	26-6-80
FRACTION ± 1/64"	1 DEC PLACE ± 0·4 mm	CHECKED		31-3-81
DECIMAL ± .005"	2 DEC PLACE ± 0·1 mm	APPROVED		9.4.81
ANGULAR ± 0·25°		MATERIAL :-		
UNLESS OTHERWISE STATED				
USED ON :- IL25700		FINISH :-		

PERMUS

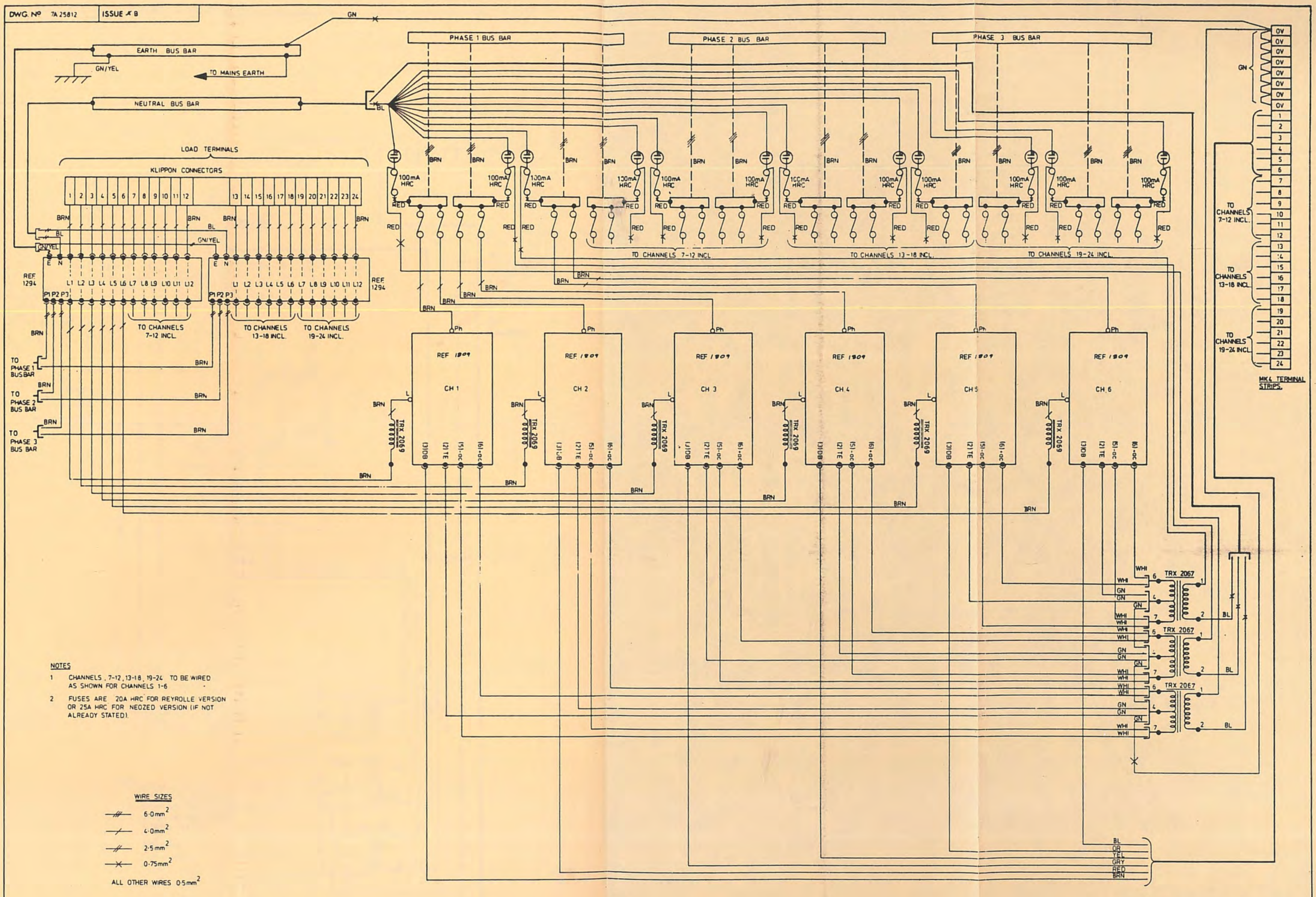
TITLE :- '12 WAY' RFI CIRCUIT DIAGRAM

PCB 913 REF 1877
PCB 783/1 REF 1294

ISSUE XYZ3

DWG. Nº 6C 25219

DWG. Nº 7A 25812 | ISSUE B



NOTES

1. CHANNELS 7-12, 13-18, 19-24 TO BE WIRED AS SHOWN FOR CHANNELS 1-6
2. FUSES ARE 20A HRC FOR REYROLLE VERSION OR 25A HRC FOR NEOZED VERSION (IF NOT ALREADY STATED).

WIRE SIZES

- 6·0mm²
- 4·0mm²
- 2·5mm²
- 0·75mm²

ALL OTHER WIRES 0·5mm²

CONTROL LOOM SCHEDULE 1S28105
LOAD LOOM SCHEDULE 1S28095

REV. | C.Nº
REV B. PHASE 1 WAS BLUE PHASE. PHASE 2 WAS RED PHASE. PHASE 3 WAS YELLOW PHASE. 12 × 100mA WAS 12 × 500mA. TRX 2069 WAS TRX 2066. TRX 2067 WAS TRX 2062. SCHEDULES 1S28105 & 1S28095 ADDED

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DIMENSIONS IN INCHES/MILLIMETRES
THIRD ANGLE PROJECTION

TOLERANCES		
IMPERIAL		METRIC
FRACTION ± 1/64		1 DEC PLACE ± 0·4mm
DECIMAL ± ·005		2 DEC PLACE ± 0·1mm
ANGULAR ± 0·25°		
UNLESS OTHERWISE STATED		

USED ON:- IL 25700
PERMUS (DUAL RACK)

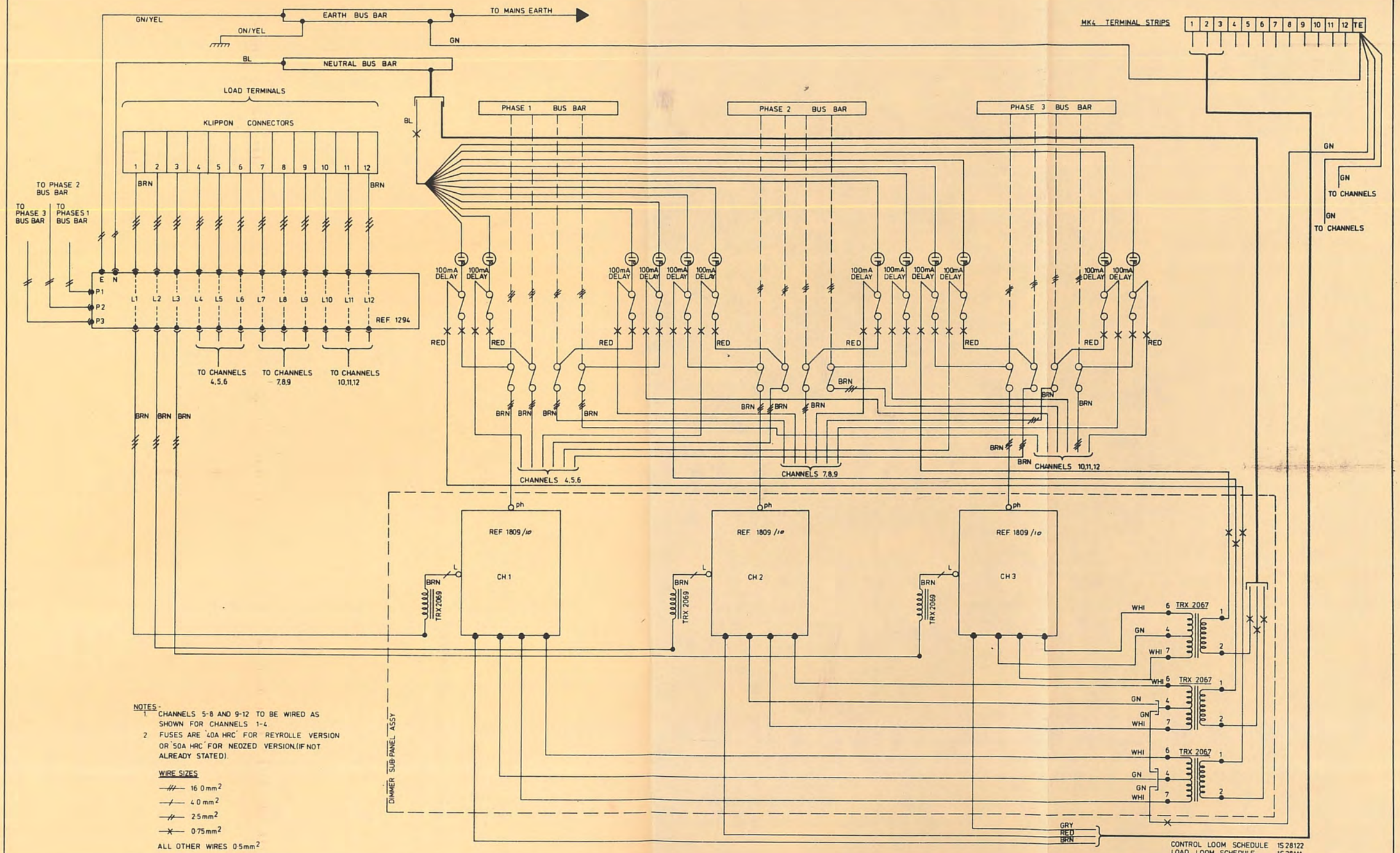
SCALE	NTS	DATE
DRAWN	PMcB	9-9-80
CHECKED	[illegible]	[illegible]
APPROVED	[illegible]	[illegible]

MATERIAL -
FINISH:-

TITLE - PERMUS 20/25A STAR WIRING DIAGRAM

ISSUE B | DWG. Nº 7A 25812

DWG. Nº 7A28/26 | ISSUE A



NOTES -

1. CHANNELS 5-8 AND 9-12 TO BE WIRED AS SHOWN FOR CHANNELS 1-4
2. FUSES ARE '40A HRC' FOR REYROLLE VERSION OR '50A HRC' FOR NEOZED VERSION (IF NOT ALREADY STATED).

WIRE SIZES

- 16.0mm²
- 4.0mm²
- 2.5mm²
- 0.75mm²

ALL OTHER WIRES 0.5mm²

CONTROL LOOM SCHEDULE 1S28122
LOAD LOOM SCHEDULE 1S28111

REV. | C.N°

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DIMENSIONS IN INCHES/MILLIMETRES
THIRD ANGLE PROJECTION

TOLERANCES		SCALE		DATE
IMPERIAL	METRIC	DRAWN	ARG	20/6/83
FRACTION ± 1/64"	1 DEC PLACE ± 0·4mm	CHECKED		21-7-83
DECIMAL ± .005"	2 DEC PLACE ± 0·1mm	APPROVED		11-7-85
ANGULAR ± 0·25°		MATERIAL:-		
UNLESS OTHERWISE STATED				
USED ON:- IL27600		FINISH:-		
PERMUS				

TITLE:- PERMUS 40/50A STAR WIRING DIAGRAM

ISSUE 1 | DWG. Nº 7A28/26