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SERIES --61X PROGRAMMABLE ROTARY VANE ATTENUATOR AND CP9241JN CONTROL PROCESSOR

OPERATION AND MAINTENANCE MANUAL

Ver 2.1 - Oct 1997

Flann Microwave

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SERIES --61X PROGRAMMABLE ROTARY VANE ATTENUATOR AND CP9241JN CONTROL PROCESSOR

OPERATION AND MAINTENANCE MANUAL

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INTRODUCTION

MICROWAVE ATE SYSTEM
Comprising
PROGRAMMABLE ROTARY VANE ATTENUATOR AND CONTROL PROCESSOR

This equipment has been designed to satisfy the demand for high precision electronically controlled microwave instruments for use in ATE and systems applications. Great attention has been paid to all aspects of the microwave, mechanical, electrical and software design to achieve a unique standard of accuracy and reliability.

The Programmable Rotary Vane Attenuator (PRVA) has been derived from the Company's highly successful series of manually operated rotary vane attenuators which have been universally accepted in both government and commercial organisations alike.

Manual (local) control of the system is exercised by operating the Control Processor front panel push-button facility.
Automatic (remote) control of the system is by means of the ANSI/IEEE Std 488 (GPIB) interface included in the Control Processor.

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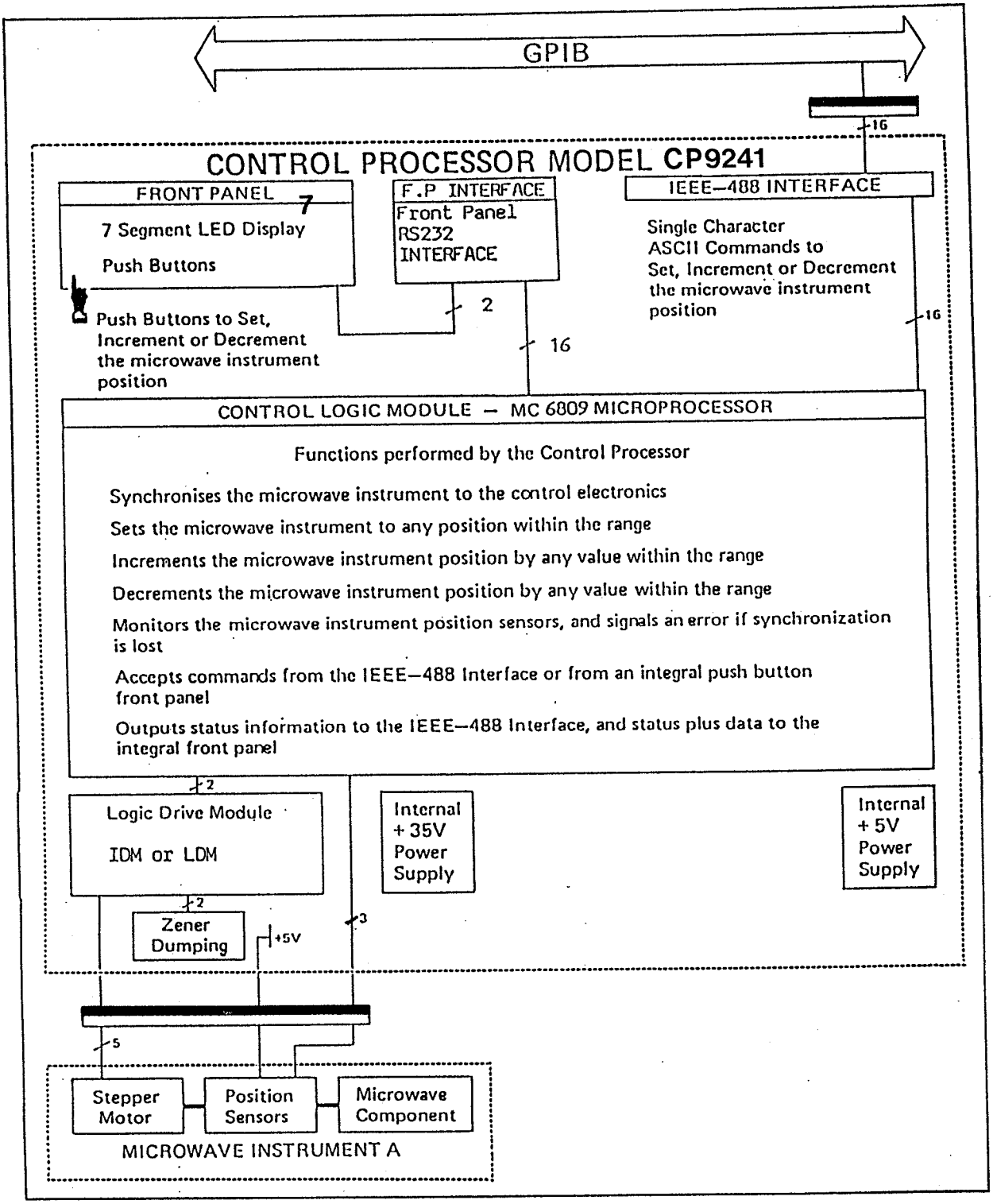


Figure 1

System Block Diagram

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SETTING-UP PROCEDURE

The equipment consists of the following:-

a. Programmable Rotary Vane Attenuator
b. Control Processor model CP9241JN
c. 15-way Microwave Unit connection cable
d. Line input cable

1.1 CONNECTING THE EQUIPMENT

Connect the PRVA to the CP using the 15-way cable as supplied. The connector is located on the rear panel of the CP. See Fig. 2 for details of the rear panel.

Connect the CP to the A.C. mains supply as specified on the rear panel of the CP. See Fig. 2 for details of the rear panel.

FOR GPIB OPERATION:-
Connect the CP to the ANSI/IEEE Std 488 GPIB using a standard GPIB cable as defined in the ANSI/IEEE Std 488. This cable is not supplied with the equipment.

Set the GPIB address switches on the rear panel of the CP as described in Section 3.2.

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1.2 COMMISSIONING THE EQUIPMENT

1.2.1 Commissioning for Manual Operation

The following steps are necessary to commission the equipment:-

Automatic Reset:
Ensure that the switch labelled "C" in the same group as the address switches on the rear panel is in the "1" (UP) position.

Switch the line supply ON, and observe that the following is true:-

When switch "C" is up, the attenuator will reset automatically on power up. After this has taken place, which will take no longer than 10 seconds, check that:

The DISPLAY SETTING indicator is ON.
60.0 appears as the ATTENUATOR SETTING.

Manual Reset:

Press the INSTRUMENT A button
Press the STORE SETTINGS button
Enter a value greater than 60dB (e.g. 66)
Press the SET button.
The SET light will illuminate until the instrument has reset, and the DISPLY SETTING indicator will illuminate. When the instrument has reset, the ATTENUATOR SETTING will be 60.0dB

Any other result will indicated that the equipment is not ready for use and that a fault may exist. See Section 1.3 for further information.

If the equipment is ready for use and GPIB operation is not required, then refer to Section 3 for operating instructions.
If GPIB operation is required, then continue on to Section 1.2.2.

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1.2.2 Commissioning for GPIB Operation

Read the Status Byte as described in Section 3.2.3 of this document, Section 6.5.2 of the ANSI/IEEE Std 488 document, and the appropriate section of the handbook of the Bus Controller used.
It is not possible to give detailed advice on how to read the Status Byte because it will depend on the controller used.

If the Status Byte is equal to Hex 20, then the equipment is ready for use. Any other value of the Status Byte indicates that the equipment is not ready for GPIB use and that a fault may exist.
See Section 1.3 for further details.

If the equipment is ready for GPIB use then refer to Section 3 for operating instructions.

As the controller is normally shipped from the factory, an apparent error code of E8 is to be expected. (See section on Error Codes). This means that the microwave instruments need to be initialised before proceeding. There are four ways of accomplishing this:-

1. Connect the microwave instruments, power up, and send the string "ARBR" over the GPIB.
2. Connect the microwave instruments, power up, and send a string containing new SETTING values, greater than the maximum instrument limits, over the GPIB. eg: "A66SB777S".
3. Connect the microwave instruments, set switch "C" on the rear panel to the "UP" position, and power up.
4. Each instrument may be reset in turn from the front panel, as described in Section 1.2.1.

If switch "C" remains in the "UP" position, the microwave instruments will initialise at each subsequent power-up.

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1.3 MALFUNCTIONS DURING COMMISSIONING

If Switch "C", in the same group as the address switches, was not in the UP position at power on, an apparent error code of E8 is to be expected. (See section on Error Codes). This means that the microwave instrument needs to be reset ("initialised") before proceeding. There are four ways of accomplishing this:-

1. Connect the microwave instrument, power up and send the string "AR" over the GPIB.
2. Connect the microwave instrument, power up and send a string containing new setting values greater than 60 over the GPIB: e.g. "66S".
3. Connect the microwave instrument, set switch "C" on the rear panel to the "UP" position, and power up.
4. From the front panel:-
   If the STORE SETTING indicator is off, press the STORE SETTING button.
   Press "6". 6.0 will appear as ATTENUATION SETTING.
   Press "6". 66.0 will appear as ATTENUATION SETTING.
   Press "SET". The SET indicator will come on, the Attenuator will Reset.

If Switch "C" remains in the "UP" position, the microwave instrument will be Reset at each subsequent power-up.

When an Attenuator is Reset, the Programmable Rotary Vane Attenuator (PRVA) runs fast in the direction of increasing attenuation until the MAXIMUM signal is generated, then slowly to the 60dB setting.

If the PRVA motor fails to run when Reset, then the the front panel LEDs will display an Error Code.
See Section 4 for an explanation of the Error Codes.
(N.B. A worthwhile point to check is that the PRVA is connected to the CP.)

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1.3 (Cont)

The various values of Status Byte and their meanings are listed below:-

Hex 20 - This status value means that the CP is ready to receive commands and the Error Code is 0. This is the likely status at power-on.

Hex 21 to 26 - These six status values include non-zero Error Codes indicating that some action is required before the unit is ready for use.

21 indicates Error Code E1
22 indicates Error Code E2
23 indicates Error Code E3
24 indicates Error Code E4
25 indicates Error Code E5
26 indicates Error Code E6
28 indicates Error Code E8

Hex 10 - This status value means that the CP is BUSY, changing the attenuation setting, and should revert to Hex 20 within 20 seconds.

Hex 00 - This status value cannot be output by the CP at any time so either the status has not actually been read, or the CP is faulty.

Further information about the Status Byte will be found in Section 3.2.3.

If the Status Byte is 0, or it is not possible to read the status, then check that the address switches on the rear panel of the CP correspond to the address being used to read the status. See the IEEE STD 488 document for details of the addressing convention.

If the address switches require changing, the CP must be switched off and on again before the new address is valid.

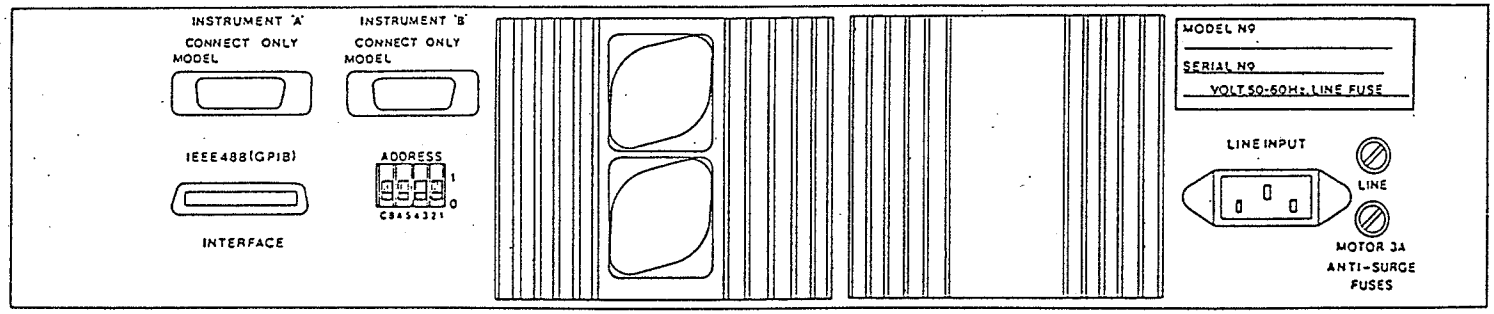
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1.3 (Cont)

The CP9242 contains non-volatile RAM, which retains the stored settings and increments during power-down. It is possible that corruption of this RAM may occur due to external events, such as switching off the power during initialisation, or an irregular / unstable power source. If this is suspected, then sending the 'Z' command via the GPIB (IEEE488) interface will clear the corrupted registers, and re-initialisation should restore operation. It may be necessary to set switch 'C' on the rear panel to '0' before this action is successful.

See Section 3.2.6.3 for " Cold Start Initialisation" .

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				TOLERANCES. NON-DEC. ± 0·5 mm. DEC. ± 0·1 mm. UNLESS OTHERWISE STATED		MATERIAL. SPEC.	FLANN MICROWAVE INSTRUMENTS LIMITED Dunmere Road, Bodmin, Cornwall. Tel. Bodmin (0208) 3161 (3 lines)
				DRN.	SCALE. 1/1	FINISH.	TITLE. REAR PANEL FOR CONTROL PROCESSOR
A	25/10/84		DRAWN	CHD.			DRG. Nº FIG 2
ISSUE.	DATE.	ZONE.	REVISION.	APP.			sheet size. D/ASS 1025 A

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DESCRIPTION AND SPECIFICATIONS

2.1 PROGRAMMABLE ROTARY VANE ATTENUATOR

Each Programmable Rotary Vane Attenuator (PRVA) has three constituent parts - a Microwave Rotary Attenuator, position sensors, and a precision stepper motor.

2.1.1 Microwave Rotary Attenuator

Each attenuator consists of two low-SWR rectangular-to-circular transitions and a rotating circular waveguide centre section. The three sections are fitted with high stability, high attenuation elements which ensure close agreement of the attenuation to the theoretical law. The attenuation is directly related to the angular position of the attenuating element in the circular section (ie: it follows the law 40 log sec O) and is insensitive to frequency changes; variations of phase with attenuation are negligible. Choking of the rotating joints is employed, to minimise RF leakage. The circular waveguide section is driven, via reduction gearing, by a precision stepper motor. To rotate the attenuator centre section through 90 deg. would require a motor movement of exactly 8750 steps. However, the attenuation change between 0dB and 60dB is executed in precisely 8574 steps.
Mechanical fail-safe end-stops are fitted to all units.

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2.1 (Cont) RF Specifications

The definitive model is derived from the table below.

SPECIFICATIONS - GROUP "J" INSTRUMENTS

* MODEL	FREQUENCY RANGE-GHz	WAVEGUIDE WG	R	WR	INSERTION LOSS - dB	MAX INPUT POWER - W	FLANGE TO FLANGE LENGTH - mm
11A61X	3.22-4.90	11A	40	229	0.5	10	687
1261X	3.94-5.99	12	48	187	0.5	10	560
1461X	5.38-8.18	14	70	137	0.5	8	420
1561X	6.58-10.0	15	84	112	0.5	6	340
1661X	8.20-12.5	16	100	90	0.5	4	300
1761X	9.84-15.0	17	120	75	0.5	3	276
1861X	11.9-18.0	18	140	62	0.5	2	250
1961X	14.5-22.0	19	180	51	0.5	2	250
2061X	17.6-26.7	20	220	42	0.8	1	250
2261X	26.4-40.1	22	320	28	1.0	0.7	175
2361X	33.0-50.1	23	400	22	1.0	0.7	140
2461X	39.3-59.7	24	500	19	1.0	0.7	134
2561X	49.9-75.8	25	620	15	1.0	0.5	100
2661X	60.5-92.0	26	740	12	1.5	0.3	89
2761X	73.8-112	27	900	10	1.5	0.3	89
2861X	92.3-140	28	1200	8	2.0	0.3	89

*

Model 610: Attenuation range: 0dB to 60dB
Transit time (full range): 1.2 secs approx
Settability: 0.1dB
Accuracy: 1% or 0.1dB whichever is the greater.
Operating Temp. range: 5 to 35 deg C.
VSWR: Less than 1.15.

*

Model 611: As Model 610 plus helical drum scale calibrated in dB, with manual control knob.

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2.1.2 Position Sensors

The position sensors in the PRVA provide three signals, ie: "Maximum", "Minimum" and "Reference", which are defined as follows:-

MAXIMUM A TTL signal which goes high when the attenuator is driven approximately 220 steps past the 60dB setting, stays high all the way to the mechanical end-stop, and is low at all other times.

MINIMUM A TTL signal which goes high when the attenuator is driven approximately 150 steps past the 0dB setting, stays high all the way to the mechanical end-stop, and is low at all other times.

REFERENCE A TTL signal which is high when the attenuation is 60dB and every 500 steps throughout the range and is high for only one step.

The "Maximum" and "Minimum" position sensors are mounted on the circular waveguide section of the attenuator; the "Reference" position sensor is located on the motor drive shaft.

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2.1.3 Precision Stepper Motor

The stepper motor is a five-phase unit giving precisely repeatable steps without gearing. Individual step accuracy is approximately +/- 3 minutes of arc and errors are not cumulative. The motor output shaft is coupled through a backlash-free flexible joint to a reduction gear unit and the waveguide centre section.

Stepper Motor Characteristics:

Stepping rate:	7500 steps/sec in this application.
Rotation:	Bi-directional.
Winding:	5-phase, 10-wire.
Winding resistance:	1.7 ohms (Type 610). 1.8 ohms (Type 611).
Rated Current:	0.95 A max per winding (Type 610). 1.2 A max per winding (Type 611).
Total current:	1.4 A max Static 2.4 A max Running

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2.1.4 Interface Cable Details

15-pin D-type connections:-

Pin No.	Function	Wire Colour
1	Reference Signal	Whi
2	Motor P5	Gry
3	Motor Common	Grn
4	Motor P1	Yel
5	Motor P3	Org
6	Motor P2	Red
7	Motor P4	Brn
8	0V Logic	L.Grn
9	(Unused)	-
10	(Unused)	-
11	+5V Logic	Vio
12	Maximum Signal	Pnk
13	(Unused)	-
14	(Unused)	-
15	Minimum Signal	Blu

NB: The cable screen is connected to the casing of each D-type connector, and the cable is fitted with an EMI attenuating ferrite sleeve.

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2.1.5 Installation Notes

2.1.5.1 All models are provided with M6 tapped fixing holes in their baseplates as shown on the outline drawing. The stepper motor shaft runs parallel to the baseplate and at right angles to the waveguide axis.

2.1.5.2 The greatest care must be taken to ensure that the attenuator casing is not subject to distortion caused by attachment to mounting faces. Individual shimming at the mounting holes is recommended.

2.1.5.3 Mating waveguide flanges must be parallel to the attenuator flanges, and their axis must be accurately aligned.

2.1.5.4 It is necessary to maintain an adequate airflow around the unit so that the upper temperature rating is not exceeded.

2.1.5.5 Dust covers should be fitted across waveguide apertures at all times when mating waveguides are not bolted to the flanges.

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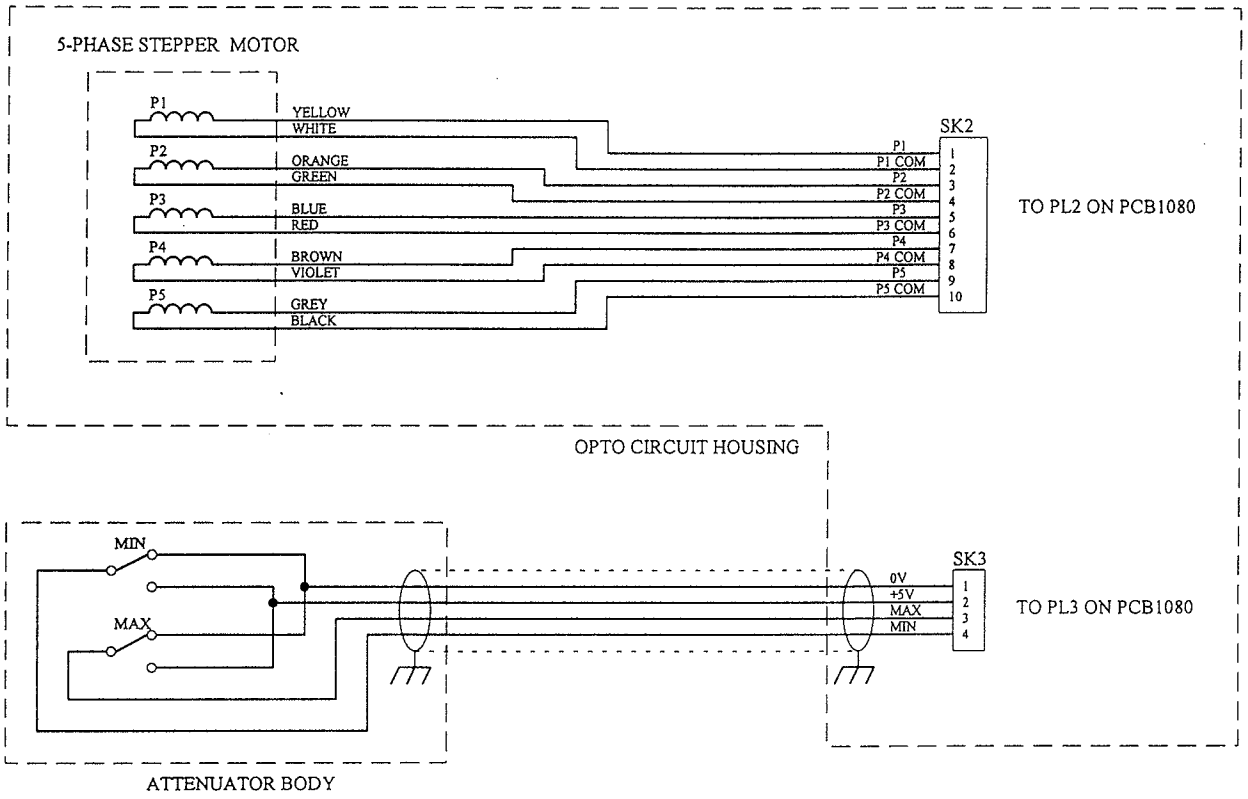
Drawings

The following pages contain circuit diagrams and other information as listed below:-

Dwg No.	Title
ECD 1117	PRVA Electrical Layout
ECD 1115	Reflective Optic Circuit Diagram for Type 611 Attenuators
ECD 1116	Reflective Optic Circuit Diagram for Type 610 Attenuators

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ISSUE	DATE	DCN	REVISION
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Title: ELECTRICAL LAYOUT FOR TYPE 610 & 611 PRVA

Size	Number		Revision
A4	ECD1117	DC 12639	1

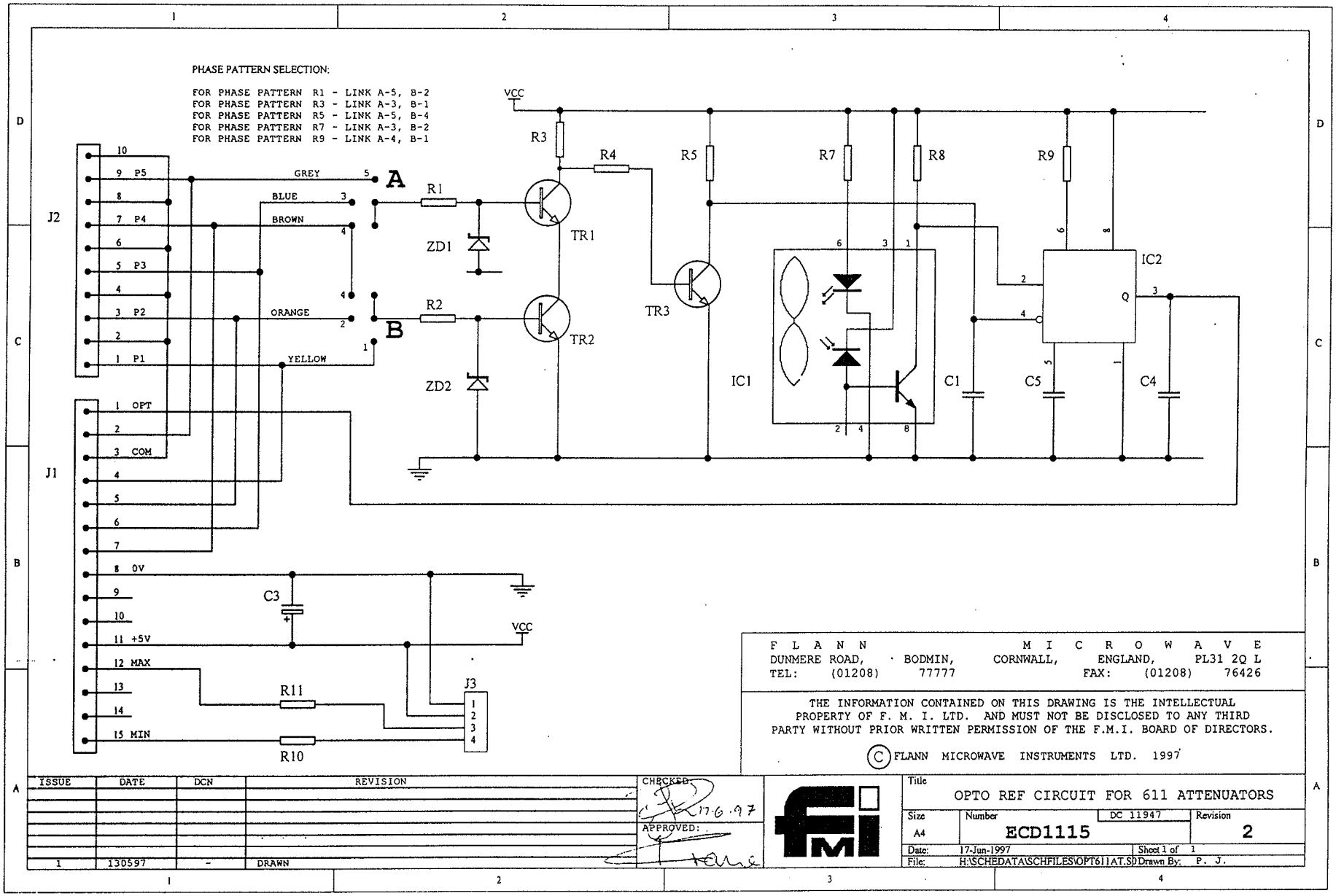
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1	130597	-	DRAWN

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Title: OPTO REF CIRCUIT FOR 611 ATTENUATORS

Size	Number	DC 11947	Revision
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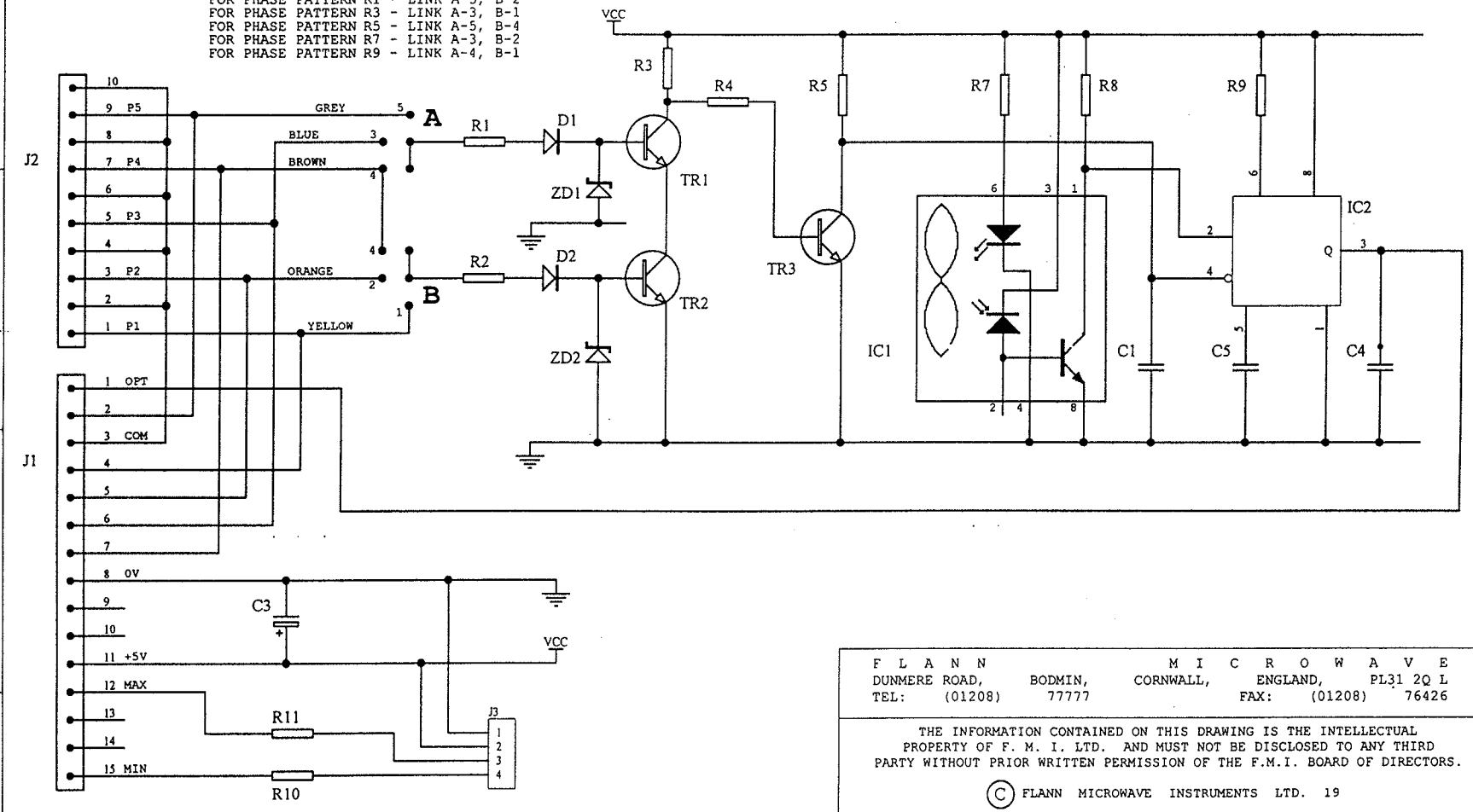
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PHASE PATTERN SELECTION:

FOR PHASE PATTERN R1 - LINK A-5, B-2
FOR PHASE PATTERN R3 - LINK A-3, B-1
FOR PHASE PATTERN R5 - LINK A-5, B-4
FOR PHASE PATTERN R7 - LINK A-3, B-2
FOR PHASE PATTERN R9 - LINK A-4, B-1



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ISSUE	DATE	DCN	REVISION
1	130597	-	DRAWN

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APPROVED:

Title: OPTO REF CIRCUIT FOR TYPE 610 ATTENUATORS

Size	Number	DC 12556	Revision
A4	ECD1116		2

Date: 6-Jun-1997 Sheet 1 of 1
File: H:\SCHEDATA\SCHFILES\OPT610AT.SC Drawn By: P. J.

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2.2 ATTENUATOR CONTROL PROCESSOR

The Control Processor processes information, either via the front panel manual control facility, or via the ANSI/IEEE Std 488 GPIB, to control the position of the Attenuator. The CP9241JN will control the position of the Attenuator in the range 0dB to 60dB in 0.1 dB increments.

2.2.1 Mechanical Details

The CP9241 is supplied free-standing or for 19" Rack mounting. All cable inputs and outputs are from the rear of the instrument.

Weight ..... 7.5 kg

Rack-mounted version:-

Width of Front Panel ..... 483mm (19")

Width of Case 431mm

Fixing centres 465mm

Depth of case excluding handles and rear panel protrusions 313mm

Depth of case including rear panel protrusions 348mm

Height of Front Panel 88mm

Bench version:-

Width of front panel 426mm

Height of case including feet 97mm

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2.2.2 Electrical Details

Mains (Line) Input: As specified on rear panel

230V model ..... 190 to 260 vac
Frequency ..... 47 to 60 Hz

115V model ..... 95 to 130 vac
Frequency ..... 47 to 60 Hz

Power consumption (max).... 130VA at upper voltage limit with motor running
..... 80VA at lower voltage limit with motor running

Fuses:- (All slow-blow, 20mm long)

F1 (Line) ..... 230V model, 1A.
..... 115V model, 2A.

F2 (+35V Motor) 3.15A

2.2.3 Environmental Details

Operating Temperature ..... 0degC to +40degC
For information only: The internal temperature of the CP must not exceed 50 deg C.

It is essential to maintain an adequate ventilation space around the unit during operation, especially under the unit. DO NOT OBSTRUCT THE FAN ORIFICE.

Bench Units are provided with feet. These should not be removed unless there is some other means of ensuring a free flow of air under the unit.

Rack-Mounted Units are not provided with feet, and should only be operated on the bench if there is some means of ensuring a free flow of air under the unit.

Failure to observe the above instructions will invalidate the warranty, and may result in costly repairs to the equipment.

Humidity ..... 95% without condensation

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2.2.4 Interface Details

For details regarding the ANSI/IEEE Std 488 interface, see the following document:-

"IEEE Standard Digital Interface for Programmable Instruments"

Available from:- IEEE, 345 East 47 Street,
New York, 10017.
U.S.A.

2.2.5 Removing the Instrument Cover

To remove the instrument cover, proceed as follows:-

Step 1 Stand the instrument on its rear with the bottom of the unit facing.

Step 2 BENCH MOUNTED UNIT ONLY
Remove the plastic cover from each handle by levering upwards and outwards.

Step 3 Remove both handles by removing two screws in each handle.

Step 4 Remove the four cover earthing screws located on the instrument sides towards the rear panel.

Step 5 Ease the front panel away from the unit until the cover is released, but do not remove the front panel assembly.

Step 6 Remove both halves of the cover.

N.B. When refitting the covers, ensure that the cover edges are correctly located in the front and rear panel grooves before tightening screws.

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2.3 CONNECTORS

Line Input Socket:

Belling-Lee L2131C/L with integral mains filter.
Mating connector:-
Belling-Lee L1949 (or equivalent)

Instrument Input Socket:

McMurdo DA15S
Mating connector:-
McMurdo DA15P (or equivalent)

IEEE-488 Connector:

Amphenol 57-20240 (or equivalent)
Mating connector:-
As specified in ANSI/IEEE Std 488 Manual, Section 4.

2.4 CABLES

Instrument Cable:

12-core, 16/0.2 (16 strands of 0.2mm), overall screened, PVC sheathed, 2 metres long.
NB. Any similar cable up to 5 metres may be used in place.

Line Input Cable:

3-core, 6-Amp, PVC sheathed.

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SYSTEM OPERATING INSTRUCTIONS

3.1 MANUAL OPERATION VIA THE FRONT PANEL

Introduction

Manual operation is only possible with the instrument in local mode. The instrument is in local mode when the "REMOTE" indicator is extinguished. Local is the default mode at power-up. If the CP is in REMOTE mode, the "CE" button may be used to switch to local. See Section 3.1.2.3.

All manual operations are via front panel mounted push-buttons (keys) which are electronically latched.

The front panel keys are divided logically into three groups:-

a. SELECT DISPLAY MODE — See Section 3.1.1
b. CHANGE STORED VALUES — See Section 3.1.2
c. CHANGE INSTRUMENT SETTINGS — See Section 3.1.3

3.1.1 Select Display Mode

There are two keys for selecting the display mode.

a. "DISPLAY SETTING" key — See Section 3.1.1.1
b. "DISPLAY STORED VALUES" key — See Section 3.1.1.2

3.1.1.1 "DISPLAY SETTING" key

When this key is pressed the associated indicator will illuminate to indicate the new display mode, and the display will show:-

a. The instrument setting in dB or degrees.
b. The stored incremental setting in dB or degrees.

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3.1.1.2 "DISPLAY STORED VALUES" key

When this key is pressed the associated indicator will illuminate to indicate the new display mode, and the display will show:-

a. The stored setting in dB or degrees.
b. The stored incremental setting in dB or degrees.

THE STORED INSTRUMENT SETTING (DEFINITION)

The microwave instrument setting will become equal to the stored setting when the "SET" key is pressed.

See Section 3.1.3.1.

THE STORED INCREMENTAL SETTING (DEFINITION)

The microwave instrument setting will be modified by the stored incremental value when either:
The "+ INCREMENT" key is pressed, or
The "- INCREMENT" key is pressed.

See Sections 3.1.3.2 and 3.1.3.3

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3.1.2 Change Stored Value Keys

There are two keys for determining the stored value to be changed, and twelve keys for changing the stored value.

a.	"STORE SETTING" key	See Section 3.1.2.1
b.	"STORE INCREMENT" key	See Section 3.1.2.2
c.	DATA ENTRY KEYS	See Section 3.1.2.3

3.1.2.1 "STORE SETTING" key

When this key is pressed the associated indicator will illuminate to indicate the new data entry mode, and the display mode will change to "DISPLAY STORED VALUES".
The data entry keys may then be used to change the STORED VALUE setting. (See Section 3.1.1.2).

3.1.2.2 "STORE INCREMENT" key

When this key is pressed the associated indicator will illuminate to indicate the new data entry mode, and the display mode will change to "DISPLAY STORED VALUES".
The data entry keys may then be used to change the STORED INCREMENTAL VALUE setting. (See Section 3.1.1.2).

The data entry mode will automatically revert to the "STORED SETTING" mode whenever "SET", "+ INCREMENT" or "- INCREMENT" is pressed.

3.1.2.3 DATA ENTRY KEYS: "0" to "9"; "."; and "CE"

These keys are used to change the predetermined stored value. They are used in the same way as the data entry keys on a calculator. No terminator is required; the value in the display is equal to the stored value after each key entry.

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3.1.2.3 (Cont)

In REMOTE mode, the action of all front panel keys is inhibited, except for the "CE" key. Pressing this key in REMOTE mode will have the same effect as sending the "LOCAL" bus command. However, unlike the "LOCAL" bus command, this function of the "CE" button may be inhibited by the "LOCAL LOCKOUT" command. (See your Controller handbook).

When the REMOTE light is off, the "CE" key performs the "Clear Entry" function.

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3.1.3 Change Instrument Settings

There are three keys to change the instrument settings:-

a.	"SET" key	See Section 3.1.3.1
b.	"+ INCREMENT" key	See Section 3.1.3.2
c.	"- INCREMENT" key	See Section 3.1.3.3

3.1.3.1 "SET" key

When this key is pressed, the associated indicator will illuminate for the duration of the operation, the display mode will change to DISPLAY SETTING, and the microwave instrument setting will become equal to the stored instrument setting.
If the stored instrument setting is greater than 60dB, then the instrument will be reset to the optical reference pulse and the microwave instrument setting will be 60dB.

NB: If "High Attenuation Setting" has been enabled (using the "Q1" command, see section 3.2.5.7), and the Stored Attenuation Setting is equal to 85, then the instrument will set to "High Attenuation" (nominally 85dB), instead of the normal operation which is "Reset".

3.1.3.2 "+ INCREMENT" key

When this key is pressed, the associated indicator will illuminate for the duration of the operation, the display mode will change to DISPLAY SETTING, and the microwave instrument setting will be increased by the stored incremental value.
If the resulting attenuation would have been greater than 60dB, then the attenuator setting will be 60dB.

NB: When the instrument is at "High Attenuation Setting" (see section 3.2.5.7), the "+ INCREMENT" key is ignored.

3.1.3.3 "- INCREMENT" key

As for 3.1.3.2, but the microwave instrument setting will be decreased by the stored incremental value.
If the resulting attenuation would have been less than 0dB, then the attenuator setting will be 0dB.

NB: When the instrument is at "High Attenuation Setting" (see section 3.2.5.7.), the "-INCREMENT" KEY is ignored.

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3.2 AUTOMATIC OPERATION VIA THE GPIB

Introduction

The CP9241 may be addressed as a Talker and/or Listener, and includes the following ANSI/IEEE Std 488 Interface functions:-

SH1	Source Handshake	Complete capability
AH1	Acceptor Handshake	Complete capability
T6	Talker	Basic talker, serial poll, unaddressed if MLA.
L4	Listener	Basic Listener, unaddressed if MTA.
SR1	Service Request	Complete capability
RL2	Remote Local	No Local Lockout
PPO	Parallel Poll	No capability
DCO	Device Clear	No capability
DTO	Device Trigger	No capability
CO	Controller	

TALKER

When addressed as a Talker during a serial poll, it will send one status byte. See Section 3.2.4 for details.
When addressed as a Talker other than during a serial poll, it will send the current setting of the Attenuator. See Section 3.2.5 for details.

LISTENER

Before the CP will accept data from the GPIB it must be addressed in the usual way with the "REN" bit active.
When addressed as a Listener, it will function as follows:-

- Switches for defining the GPIB address are located on the rear panel of the CP. They must be set to the required address before Power-on because changing them after has no effect.

- In Remote, the CP will accept strings of ASCII characters terminated by a CR/LF.

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3.2 (Cont)

- The string will be stored in the CP memory and then each character will be processed in the order that it was received until the string is empty. The CP will then come READY and a new string may be sent to the CP.

- The time until the CP comes ready to accept another command string will depend upon the contents of the previous command string. This may take up to 20 seconds in the worst case. (ie: Reset the attenuator from 0dB.)

- The maximum string length is 118 characters, excluding the terminators.

The control set codes divide logically into two groups:-

a. Change Stored Values See Section 3.2.1
b. Change Attenuator Settings See Section 3.2.2

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3.2.1 Change Stored Values

There are three codes to select the stored value to be changed, and eleven codes to change the selected stored value.

a. Select Stored Setting Code — See Section 3.2.1.1
b. Select Stored Increment Code — See Section 3.2.1.2
c. Data Entry Codes — See Section 3.2.1.3

3.2.1.1 Select Stored Setting — Code V Hex 56 Dec 86

When this code is received, the Data Entry Codes may be used to change the Stored Attenuation Setting.

3.2.1.2 Select Stored Increment — Code I Hex 49 Dec 73

When this code is received, the Data Entry Codes may be used to change the Stored Incremental Attenuation.

eg: "I0.1" will set the Stored Incremental Attenuation to 0.1dB.

3.2.1.3 Data Entry Codes 0 to 9 and "." Hex 30 to 39 and 2E

These codes are used to enter values into the selected register.

eg: "20.4" or "0.4" or "2" or "60" etc.

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3.2.2 Change Microwave Unit Settings

There are three codes to change the setting of the microwave unit:-

a. SET code — See Section 3.2.2.1
b. +INCREMENT Code — See Section 3.2.2.2
c. -INCREMENT Code — See Section 3.2.2.3

3.2.2.1 SET — Code S Hex 53 Dec 83

When this code is received, the Status Byte will indicate BUSY for the duration of the operation. (See Section 3.2.3) Then the attenuator setting will become equal to the Stored Attenuation Setting.
If the Stored Attenuation Setting is greater than 60dB, then the attenuator will be reset to the optical Reference Signal and the attenuator setting will be 60dB.

NB: If "High Attenuation Setting" has been enabled (using the "Q1" command, see section 3.2.5.7), and the Stored Attenuation Setting is equal to 85, then the instrument will set to "High Attenuation" (nominally 85dB) instead of the normal operation, which is Reset.

3.2.2.2 +INCREMENT — Code + Hex 2B Dec 43

When this code is received, the Status Byte will indicate BUSY for the duration of the operation. (See Section 3.2.3) Then the attenuator setting will be increased by the Stored Incremental Attenuation.
If the resulting attenuation would have been greater than 60dB, then the attenuator setting will be 60dB.

NB: When the instrument is at "High Attenuation Setting" (see section 3.2.5.7), the "+INCREMENT" is ignored.

3.2.2.3 -INCREMENT — Code - Hex 2D Dec 45

When this code is received, the Status Byte will indicate BUSY for the duration of the operation. (See Section 3.2.3) Then the attenuator setting will be decreased by the Stored Incremental Attenuation.
If the resulting attenuation would have been less than 0dB, then the attenuator setting will be 0dB.

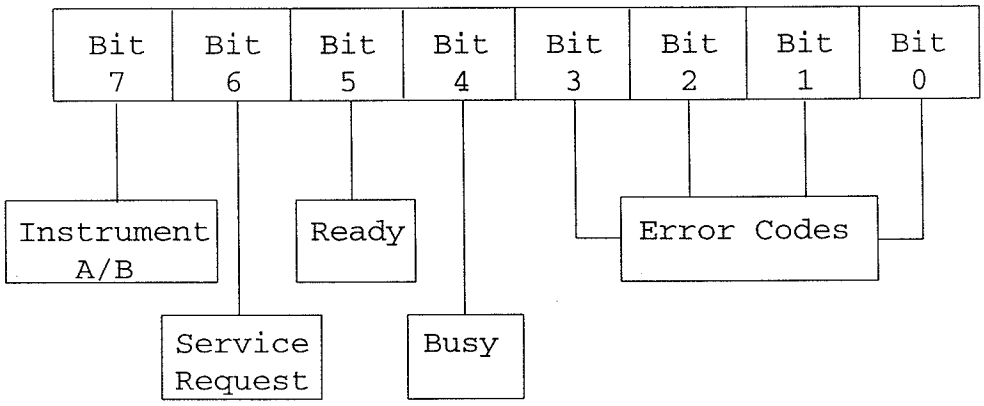
NB: When the instrument is at "High Attenuation Setting" (see section 3.2.5.7), the "-INCREMENT" is ignored.

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3.2.3 The Status Byte

The CP maintains a Status Byte, which may be read by the GPIB Controller during a Serial Poll. The Status Byte contains the following information, which is depicted below.

a. The CP Ready Bit — See Section 3.2.3.1
b. The CP Busy Bit — See Section 3.2.3.2
c. The Attenuator Error Code — See Section 3.2.3.3
d. Service Request Bit — See Section 3.2.3.4



3.2.3.1 The CP Ready Status

When the CP is ready to receive new instructions, Bit 5 (Hex 20) is logical 1.

3.2.3.2 The CP Busy Status

When the CP is busy, ie: when changing the setting of the attenuator, Bit 4 (Hex 10) is logical 1.
When the CP is busy, it will not read device dependant data from the IEEE Bus; only interface messages will be read.

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3.2.3.3 Attenuator Error Codes as indicated in the Status Byte

The four least significant bits of the Status Byte are reserved for the Error Code associated with the attenuator.

An Error Code of zero is normal and signifies that no error has been detected. See Section 4 for details of other Error Codes that may be generated.

3.2.3.4 Service Request

When the CP generates a Service Request, Bit 6 (Hex 40) of the Status Byte is logical 1.

The CP may be configured to generate a Service Request, and thus force the controller to read the Status Byte, under the following conditions:-

a. When changing from Busy to Ready — See Section 3.2.3.5
b. When an Error is detected — See Section 3.2.3.6

3.2.3.5 Generating a Service Request When Ready

By means of Code K (See Section 3.2.5.4), the CP may be configured to generate a Service Request whenever it is ready to accept a new command string.

3.2.3.6 Generating a Service Request on Detection of an Error

By means of Code G (See Section 3.2.5.5), the CP may be configured to generate a Service Request whenever it detects an error in the operation of the Microwave Unit.

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3.2.4 Talk String

When the CP is addressed to Talk, it will send a string of ASCII characters ending in Carriage Return/Line Feed.

The ASCII characters will be the String Representation of the setting of the Microwave Unit.

3.2.5 Special Operations

There are seven codes associated with special operations.

a. Inhibit Opto Error Checking — See Section 3.2.5.1
b. Resynchronise Microwave Unit — See Section 3.2.5.2
c. Cold Start Initialisation — See Section 3.2.5.3
d. Service Request when Ready — See Section 3.2.5.4
e. Service Request on Detection of an Error — See Section 3.2.5.5
f. Inhibit Front Panel Display Updating — See Section 3.2.5.6
g. Enable High Attenuation Setting — See Section 3.2.5.7

3.2.5.1 Inhibit Opto Error Checking Code P Hex 50 Dec 80

This code is used in conjunction with a 1 (Hex 31 Dec 49) or a 0 (Hex 30 Dec 48), and is provided for those users who wish to operate the system without using the Microwave Unit Reset to synchronise the Opto Reference signal with the software at power-on.

a. To inhibit Opto Error Checking, send "P1".
   Following the receipt of the above characters, the CP will not generate any E4 Errors.

b. To allow Opto checking send "P0".
   Following the receipt of the above characters, the CP will generate an E4 if it fails to find the Opto Reference signal as defined in Section 4.4.

Because the CP92 has non-volatile memory, the above condition will remain true following power-off.

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3.2.5.2 Resynchronise Microwave Unit Code C Hex 43 Dec 67

This code is used in conjunction with a Microwave Unit setting determined by the user, and is provided for those users who do not wish to use the Microwave Unit Reset to synchronise the Microwave Unit Setting with the software at power-on.

a. Read the Setting from the scale on the microwave unit or by any other means at your disposal.
b. Send a string to the CP from a GPIB controller, consisting of the character "C" followed by the string representation of the setting determined in a. above.
c. If the Opto Checking is not already inhibited then you must now inhibit it. (See Section 3.2.5.1)

3.2.5.3 Cold Start Initialisation Code Z Hex 5A Dec 90

This code is used to set all software registers and programmable options to a predefined state.

Failure of the Non-Volatile RAM IC will cause total loss of operation of the instrument. Both manual (front panel) and remote (GPIB) control will be lost. It is likely that during power-up, the front panel displays will all illuminate as normal, but the programmable instruments will not reset. The displays will remain fully illuminated, i.e. all eights.

It is possible that the RAM has been corrupted by external events, such as switching off the power during initialisation, or an irregular / unstable power source. If this is suspected, then sending the 'Z' command via the GPIB (IEEE488) interface will clear the corrupted registers, and re-initialisation should restore operation. It may be necessary to set switch 'C' on the rear panel to '0' before this action is successful.

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3.2.5.4 Service Request When Ready Code K Hex 4B Dec 75

This code is used in conjunction with a 1 (Hex 31 Dec 49) or a 0 (Hex 30 Dec 48), and is provided for those users who require the CP to generate an SRQ when the Ready bit is set in the Status Byte.

a. To enable SRQ on Ready send K1
Following the receipt of the above characters, the CP will generate an SRQ whenever the Status Byte indicates Ready.

b. To disable SRQ on Ready send K0
Following the receipt of the above characters, the CP will NOT generate an SRQ whenever the Status Byte indicates Ready.

Because the CP92 has non-volatile memory, the above condition will remain true following power-off.

3.2.5.5 Service Request on Detection of an Error
Code G Hex 47 Dec 71

This code is used in conjunction with a 1 (Hex 31 Dec 49) or a 0 (Hex 30 Dec 48), and is provided for those users who require the CP to generate an SRQ when a non-zero Error code has been generated.

a. To enable SRQ on Error send G1
Following the receipt of the above characters, the CP will generate an SRQ whenever the Status Byte indicates an Error.

b. To disable SRQ on Error send G0
Following the receipt of the above characters, the CP will NOT generate an SRQ whenever the Status Byte indicates an Error.

Because the CP92 has non-volatile memory, the above condition will remain true following power-off.

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3.2.5.6 Inhibit Front Panel Display Updating

Code H Hex 48 Dec 72

This code is used in conjunction with "1" or "0", and is used to inhibit the updating of the Front Panel Display during Remote operation to reduce the delay between successive movements of Microwave Units.

When the CP92 is used in a fully computerised IEEE488 system requiring frequent operation of the Microwave Unit, significant increase in overall speed can be obtained by inhibiting the Front Panel Display update.

a. To Inhibit Front Panel Display Updating, send "H1".

When the CP receives "H1" the Front Panel will display "FP OFF". The "H1" command is remembered until the "H0" command is received. It should be noted, however, that this mode of operation is inhibited by the following conditions:

i) If there is an error code displayed on the Front Panel, the "H1" command will be suspended until the error is cleared. Only when the error is cleared will the "H1" command be restored.

ii) If the CP is taken out of REMOTE mode, the "H1" command will be suspended until the CP is put back into REMOTE mode. When the CP is put back into REMOTE mode the "H1" command will be restored.

b. To reverse the above condition, and restore normal Front Panel Display operation, send "H0".

When the CP receives "H0" the Front Panel Display will return to normal operation, and will immediately display the latest settings from memory. The "H0" command is remembered until the "H1" command is received.

Because the CP92 has non-volatile memory, the above condition will remain true following power-off.

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3.2.5.6 Service Request When Ready Code K Hex 4B Dec 75

This code is used in conjunction with a 1 (Hex 31 Dec 49) or a 0 (Hex 30 Dec 48), and is provided for those users who require the CP to generate an SRQ when the Ready bit is set in the Status Byte.

a. To enable SRQ on Ready send K1
Following the receipt of the above characters, the CP will generate an SRQ whenever the Status Byte indicates Ready.

b. To disable SRQ on Ready send K0
Following the receipt of the above characters, the CP will NOT generate an SRQ whenever the Status Byte indicates Ready.

Because the CP92 has non-volatile memory, the above condition will remain true following power-off.

3.2.5.7 Service Request on Detection of an Error
Code G Hex 47 Dec 71

This code is used in conjunction with a 1 (Hex 31 Dec 49) or a 0 (Hex 30 Dec 48), and is provided for those users who require the CP to generate an SRQ when a non-zero Error code has been generated.

a. To enable SRQ on Error. send G1
Following the receipt of the above characters, the CP will generate an SRQ whenever the Status Byte indicates an Error.

b. To disable SRQ on Error send G0
Following the receipt of the above characters, the CP will NOT generate an SRQ whenever the Status Byte indicates an Error.

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ERROR CODES

INTRODUCTION

To assist in the detection of equipment malfunction, various Error Codes are generated by the CP if it detects an error. The Error Code is displayed on the front panel and is included in the Status Byte, which may be read by the GPIB controller during a Serial Poll. See Sections 4.1 to 4.8 for details of Error Codes.

Once an error has been detected, all Change Microwave Unit Setting commands will be ignored until the error has been corrected. See Section 4.9 for details of how to correct errors.

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4.1 "E1" ERROR

E1 Error can only occur during a Microwave Unit Reset.

E1 Error will be generated if Phase 1 of the Microwave Unit Reset ends without detection of the Maximum signal.

Phase 1 of the Microwave Unit Reset:-
- Starts on receipt of the RESET command.
- Consists of stepping the motor at high speed towards the Maximum signal generator looking for the Maximum signal.
- Ends on detection of the Maximum signal or when the motor has stepped a predefined number of steps.

Possible causes of repeated E1 Errors:-

a. The Microwave Unit is not connected to the CP.
b. The Maximum signal generator is not set to oper-ate within the limits of movement of the motor.
c. Mechanical or electrical failure of the Maximum signal generator or wiring, causing the Maximum signal to remain low.
d. Electrical or mechanical failure of the motor drive system.

4.2 "E2" ERROR

E2 Error can only occur during a Microwave Unit Reset.

E2 Error will be generated if Phase 2 of the Micro-wave Unit Reset ends with detection of the Reference signal or with the detection of the Minimum signal.

Phase 2 of the Microwave Unit Reset:-
- Starts on error free completion of Phase 1.
- Consists of testing the Reference signal and the Minimum signal.
- Ends when the test is complete.

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4.2 (Cont)

Possible causes of repeated E2 Errors:-

a. Mechanical or electrical failure of the Reference signal generator or wiring, causing the Reference signal to remain low.
b. Mechanical or electrical failure of the Minimum signal generator or wiring, causing the Minimum signal to remain high.

4.3 "E3" ERROR

E3 Error can only occur during a Microwave Unit Reset.

E3 Error will be generated if Phase 3 of the Microwave Unit Reset ends without detection of the Reference signal.

Phase 3 of the Microwave Unit Reset:-
- Starts on error free completion of Phase 2.
- Consists of stepping the motor slowly towards the Reference signal generator looking for the Reference signal.
- Ends on detection of the Reference signal or when the motor has stepped a predefined number of steps.

Possible causes of repeated E3 Errors:-

a. Mechanical or Electrical failure of the Reference signal generator causing the Reference signal to remain low.
b. Mechanical failure or faulty adjustment causing the Reference signal to be out of phase with the motor steps.

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4.4 "E4" ERROR

E4 Error can only occur during Microwave Unit Repositioning, and only if OPTO CHECKING is ON.

E4 Error will be generated if OPTO CHECKING is ON and the software fails to detect the reference signal at the predefined motor step during repositioning.

Microwave Unit Repositioning:-

- Starts on receipt of the SET command, or the +INCREMENT command, or the -INCREMENT command, if the Error Code is zero.
- Consists of moving the motor N steps in direction D, stopping en-route to test for the presence of the Reference signal at a predefined motor step. (If OPTO CHECKING is OFF then the Reference signal will always be detected as present) and testing for the absence of the Maximum signal or Minimum signal (depending upon direction D) before each step.
- Ends when N steps have been moved or an error is generated. (No E4 error can be generated if OPTO CHECKING is OFF.)

Possible causes of frequent E4 errors:-

a. Intermittent Reference signal generator.
b. Reference signal out of phase with motor steps.
c. Excessive motor wear causing motor to drop steps.
d. Increased mechanical loading on the motor.

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4.5 "E5" ERROR

E5 Error can only occur during Microwave Unit Repositioning.

E5 Error will be generated if the Maximum signal or the Minimum signal is detected during Microwave Unit Repositioning. Microwave Unit Repositioning is defined in Section 4.4.

Possible causes of repeated E5 Errors:-

a. Wrongly adjusted Maximum or Minimum or Reference signal generator after Microwave Unit repair, service or manufacture.
b. Intermittent Maximum or Minimum or Reference signal generator fault.

4.6 "E6" ERROR

E6 Error will be generated if the software detects that the Logic Drive Board within the CP is not plugged in.

This error is for use during manufacture and service, and is only included here for completeness.

4.7 "E7" ERROR

E7 Error is an undefined error used during software development, and is only included here for completeness.

4.8 "E8" ERROR

E8 Error is defined as a Cold Start Error, and as such is not a true error but serves to inhibit operation until corrective action is taken.

E8 Error will be generated under the following normal conditions:-

a. Power-on of a CP with volatile RAM and no automatic Microwave Unit Reset at power-on.
b. On receipt of the Cold Start command.

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4.9 CORRECTING ERRORS

Error correction may be achieved in one of two ways:-

a. Microwave Unit Reset See Section 4.9.1
b. Microwave Unit Resynchronise See Section 4.9.2

4.9.1 Correcting Errors by Reset

If the user can accept a change of Microwave Unit setting to correct errors then the RESET is preferred.

RESET method:-

a. Note the error number for future reference.
b. Initiate a Microwave Unit Reset. See Section 1.3.
c. If no further errors are generated then continue operation.

4.9.2 Correcting Errors by Resynchronisation

If the user cannot accept a change of Microwave Setting to correct errors then Resynchronisation is provided.

RESYNCHRONISATION method:-

a. Note the error number for future reference.
b. Inhibit Opto Error checking. (See Section 3.2.5.1).
c. Resynchronise the Microwave Unit. (See Section 3.2.5.2).
d. Continue operations.

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MOTHER BOARD WIRING SCHEDULE

5.1 POWER SUPPLY INPUT SK9/PL9

SK9 FREE SOCKET:-

Pin No.	Signal	Wire colour
1	NC	-
2	Mains indicator LED +ve	Pnk
3	0V Sense (+5V power supply)	Whi
4	NC	-
5	Mains indicator LED -ve	Vio
6	+5V Sense (+5V power supply)	Yel
7	+35V motor supply	Red
8	NC	-
9	0V Logic supply (to chassis)	Grn/Yel
10	+5V Logic supply	Org
11	Motor static supply	Org
12	0V Motor and static supplies (to chassis)	Grn/Yel

PL9 P.C. PLUG:-

Pin No.	Signal
1	NC
2	Mains indicator +ve. to R4
3	0V sense to SK3/23a, b.
4	NC
5	Mains indicator -ve. 0V to PL9/9.
6	+5V sense to SK3/21a, b.
7	+35V supply to SK4/32, SK5/32
8	NC
9	0V Logic supply to AD1/1, 2; AD2/26, 28, 30, 32, 39: SK3/23a,b; SK4/22; SK5/22; SK7/8, 9; SK8/5, 9.
10	+5V Logic supply to AD1/3, 4; AD2/15, 36, 37, 38; SK3/21a,b; SK4/28; SK5/28; SK7/12; SK8/12.
11	Motor Static supply to SK4/17; SK5/17.
12	0V Motor & Static supplies to SK4/6, 7; SK5/6, 7; PL6/2, 5.

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5.2 RIBBON CABLE ADAPTER AD1 - FRONT PANEL INTERFACE

Pin No.	Signal
1 - 9	NC
10	DA0 to SK3/24a
11	NC
12	DA1 to SK3/24b
13	AD INH to SK3/22a
14	DA3 to SK3/25a
15	+5V to PL9/10
16	DA2 to SK3/25b
17, 18	NC
19, 20	KDD0 to SK3/26a
21	KDD1 to SK3/26b
22	KDD4 (or RX) to SK3/27a
23	KDD3 (or TX) to SK3/27b
24	KDD2 to SK3/28a
25	KDD7 to SK3/28b
26	0V to PL9/9
27	KDD6 to SK3/29a
28	0V to PL9/9
29	KDD5 to SK3/29b
30	0V to PL9/9
31	KR0 to SK3/30a
32	0V to PL9/9
33	KR1 to SK3/30b
34	KR3 to SK3/31a
35	KR2 to SK3/31b
36 - 38	+5V to PL9/10
39	0v to PL9/9
40	FP out to SK3/7a

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5.3 RIBBON CABLE ADAPTER AD2 - IEEE 488 GPIB INTERFACE

Pin No.	Signal
1,2	0V to PL9/9
3,4	+5V to PL9/10
5	T/R2 to SK3 pin 20b
6	BT/R2 to SK3/20a
7	T/R1 to SK3/19b
8	EOI to SK3/19a
9	REN to SK3/18b
10	SRQ to SK3/18a
11	IFC to SK3/17b
12	ATN to SK3/17a
13	DAC to SK3/16b
14	RFD to SK3/16a
15	DAV to SK3/15b
16	IB7 to SK3/15a
17	IB6 to SK3/14b
18	IB5 to SK3/14a
19	IB4 to SK3/13b
20	IB3 to SK3/13a
21	IB2 to SK3/12b
22	IB1 to SK3/12a
23	IB0 to SK3/11b
24	F3 to SK3/11a
25	F2 to SK3/10b
26	F1 to SK3/10a
27	MLA4 to SK3/9b
28	MLA3 to SK3/9a
29	MLA2 to SK3/8b
30	MLA1 to SK3/8a
31	MLA0 to SK3/7b
32 - 40	NC

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5.4 MICROPROCESSOR CONNECTOR SK3

Pin No	Signal	Pin No	Signal
1a	Motor B Opto Ref to SK8/10	16a	RFD to AD2/14
1b	Motor A Opto Ref to SK7/10	16b	DAC to AD2/13
2a	Motor B Max Sensor to SK8/7	17a	ATN to AD2/12
2b	Motor A Max Sensor to SK7/7	17b	IFC to AD2/11
3a	Motor B Min Sensor to SK8/11	18a	SRQ to AD2/10
3b	Motor A Min Sensor to SK7/11	18b	REN to AD2/9
4a	Motor B Inc to SK5/26	19a	EOI to AD2/8
4b	Motor A Inc to SK4/26	19b	T/R1 to AD2/7
5a	Motor B Dec to SK5/24	20a	BT/R2 to AD2/6
5b	Motor A Dec to SK4/24	20b	T/R2 to AD2/5
6a	LDM2 Out to SK5/21	21a,b	+5V to PL9/10
6b	LDM1 Out to SK4/21	22a	AD INH to AD1/13
7a	FP Out to AD1/40	22b	NC
7b	MLA0 to AD2/31	23a,b	0V to PL9/9
8a	MLA1 to AD2/30	24a	DA0 to AD1/10
8b	MLA2 to AD2/29	24b	DA1 to AD1/12
9a	MLA3 to AD2/28	25a	DA3 to AD1/14
9b	MLA4 to AD2/27	25b	DA2 to AD1/16
10a	F1 to AD2/26	26a	KDD0 to AD1/19,20
10b	F2 to AD2/25	26b	KDD1 to AD1/21
11a	F3 to AD2/24	27a	KDD4 to AD1/22
11b	IB0 to AD2/23	27b	KDD3 to AD1/23
12a	IB1 to AD2/22	28a	KDD2 to AD1/24
12b	IB2 to AD2/21	28b	KDD7 to AD1/25
13a	IB3 to AD2/20	29a	KDD6 to AD1/27
13b	IB4 to AD2/19	29b	KDD5 to AD1/29
14a	IB5 to AD2/18	30a	KR0 to AD1/31
14b	IB6 to AD2/17	30b	KR1 to AD1/33
15a	IB7 to AD2/16	31a	KR3 to AD1/34
15b	DAV to AD2/15	31b	KR2 to AD1/35
		32a,b	NC

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5.5 LDM5 CONNECTOR SK4

Pin No	Signal
1	NC
2,3	Motor A Common to PL6/2, SK7/4
4,5	NC
6,7	Motor A 0V to PL9/12
8	NC
9	Motor A Phase 1 to SK7/6
10	NC
11	Motor A Phase 2 to SK7/3
12	NC
13	Motor A Phase 3 to SK7/2
14	NC
15	Motor A Phase 4 to SK7/1
16	Motor A Phase 5 to SK7/5
17	Motor A Static Supply from PL9/11
18	NC
19	Power Dissipation Output to PL6/6
20	NC
21	LDM1 Out to SK3/6b
22	0V Supply from PL9/9
23	NC
24	Motor A Inc from SK3/4b
25	NC
26	Motor A Dec from SK3/5b
27	NC
28	+5V Logic from PL9/10
29	NC
30	NC
31	+35V Motor Supply from PL9/7
32	NC

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5.6 POWER DISSIPATION OUTPUT PL6/SK6

To BZY93C75 Zener Diode(s) mounted on rear panel

Pin No	Signal	Wire Colour
1	NC	
2	ZD1 Cathode (from SK4/2,3)	Grn
3	NC	
4	NC	
5	NC	
6	ZD1 Anode (from SK4/19)	Yel

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5.7 MOTOR INTERFACE CONNECTOR SK7/PL7

SK7 P.C. CONNECTOR:-

Pin No	Signal
1	Motor A Phase 4 from SK4/15
2	Motor A Phase 3 from SK4/13
3	Motor A Phase 2 from SK4/11
4	Motor A Common from SK4/2,3
5	Motor A Phase 5 from SK4/16
6	Motor A Phase 1 from SK4/9
7	Motor A Max Sensor to SK3/2b
8	0V to PL9/9
9	0V to PL9/9
10	Opto Ref to SK3/1b
11	Min Sensor to SK3/3b
12	+5V from PL9/10

PL7 FREE PLUG:-

Pin No	Signal			Wire Colour
1	Phase 4	to Motor A output pin 7		Brn
2	Phase 3	to Motor A output pin 5		Org
3	Phase 2	to Motor A output pin 6		Red
4	Common	to Motor A output pin 3		Grn/Red
5	Phase 5	to Motor A output pin 2		Gry
6	Phase 1	to Motor A output pin 4		Yel
7	Max Sensor	to Motor A output pin 12		Pnk
8	0V Screen	to Motor A output pin 10		Grn
9	0V Logic	to Motor A output pin 8		Grn/Yel
10	Opto Ref	to Motor A output pin 1		Whi
11	Min Sensor	to Motor A output pin 15		Blu
12	+5V Logic	to Motor A output pin 11		Red/Blk

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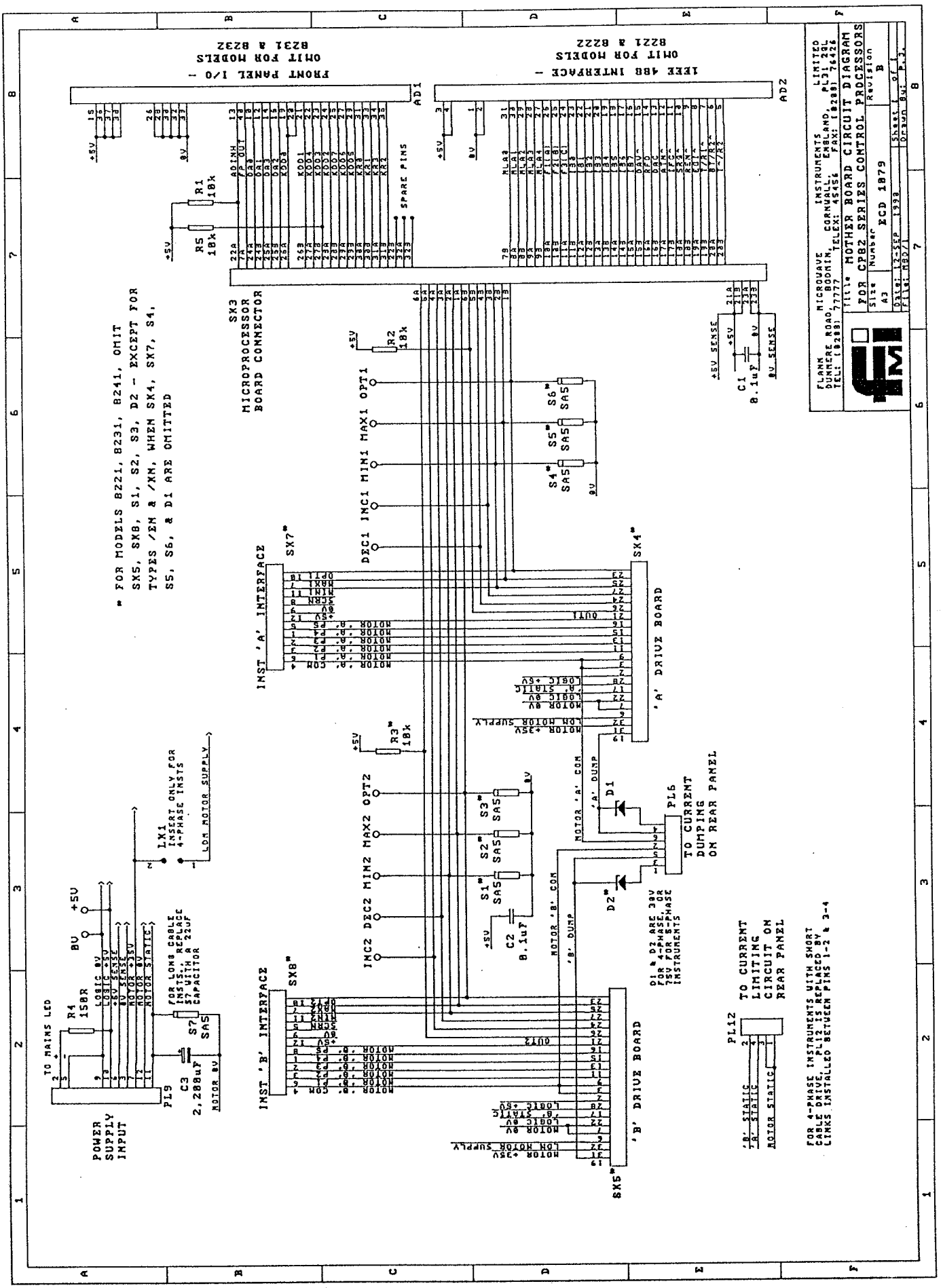
Drawings

The following pages contain circuit diagrams and other information as listed below:-

Dwg No.	Title
ECD 1079	Mother Board Circuit Diagram
ECD 1114	LDM5 Circuit Diagram
ECD 1019	GPIB Interface Board Circuit Diagram
ECD 1039	Front Panel Wiring Diagram
ECD 1078	Power Supply Circuit Diagram
ECD 1044	Static Current Limiting Circuit

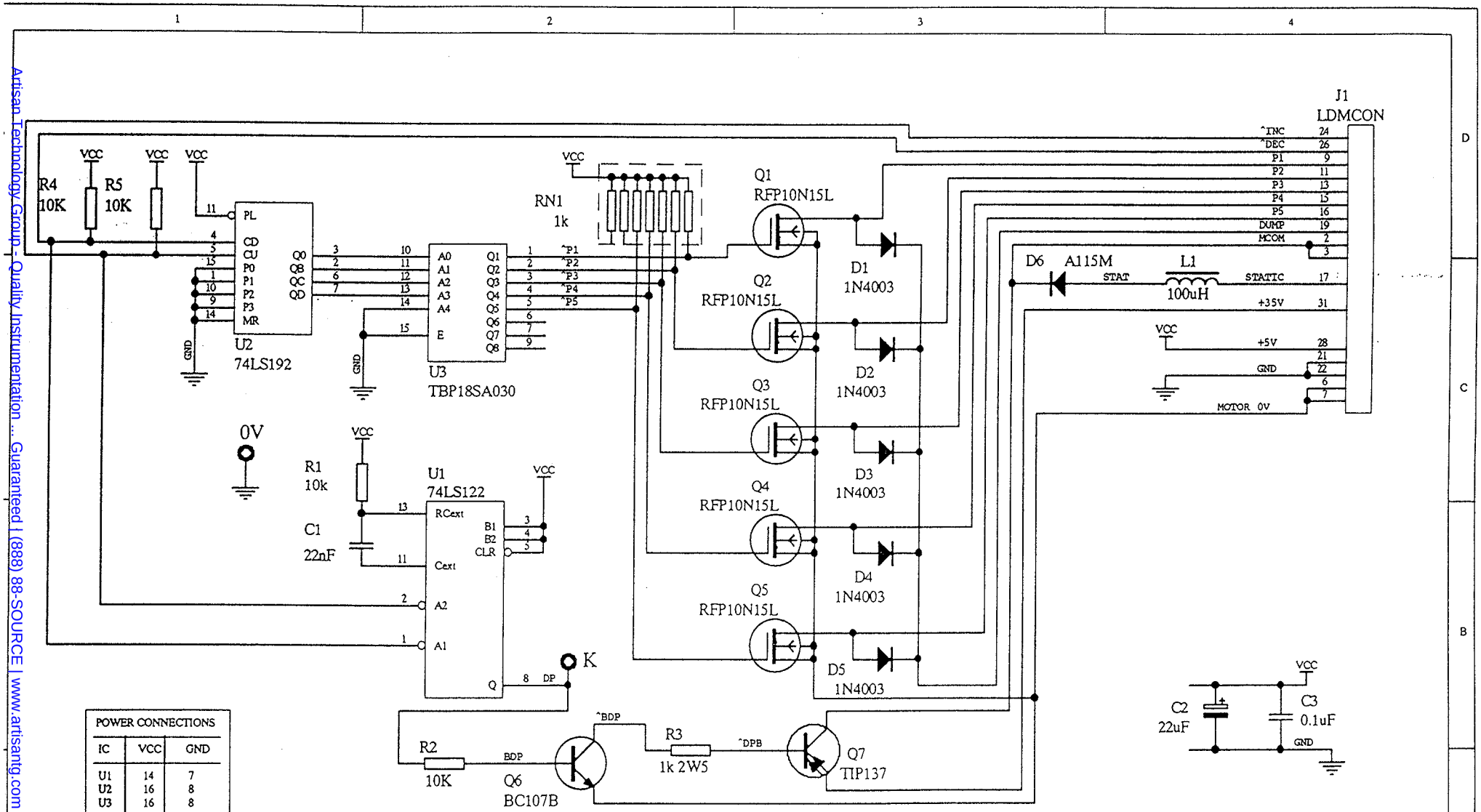
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POWER CONNECTIONS		
IC	VCC	GND
U1	14	7
U2	16	8
U3	16	8

All ICs have a 0.1uF decoupling capacitor between VCC and GND identified on the PCB by the prefix 'dc', e.g. 'dc1' for IC U1

ISS	DCN	DATE	CHANGES
1		130696	Drawn

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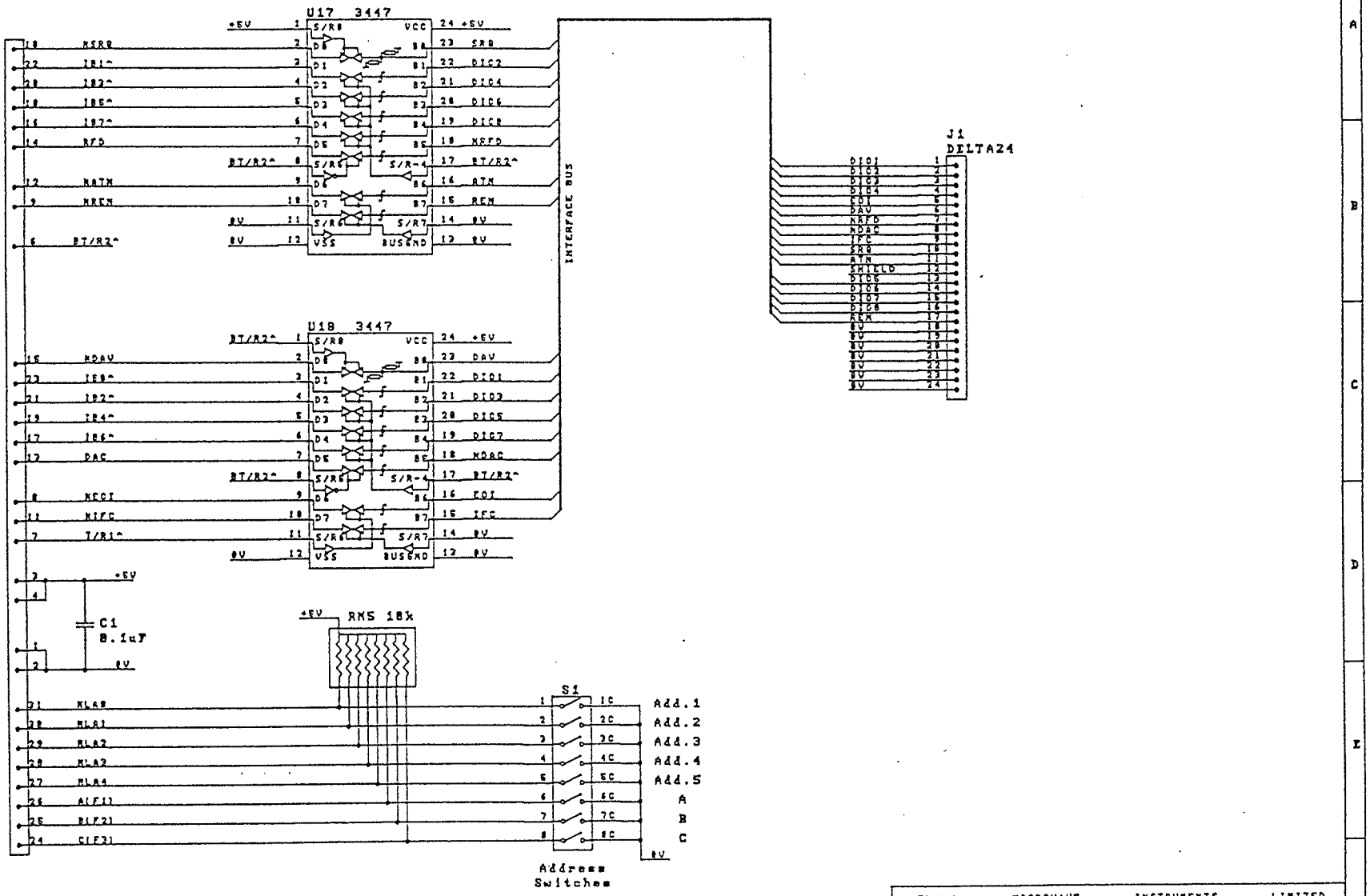
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Title: LDM5 DRIVE BOARD CIRCUIT DIAGRAM

Size	Number	DC10339	Revision
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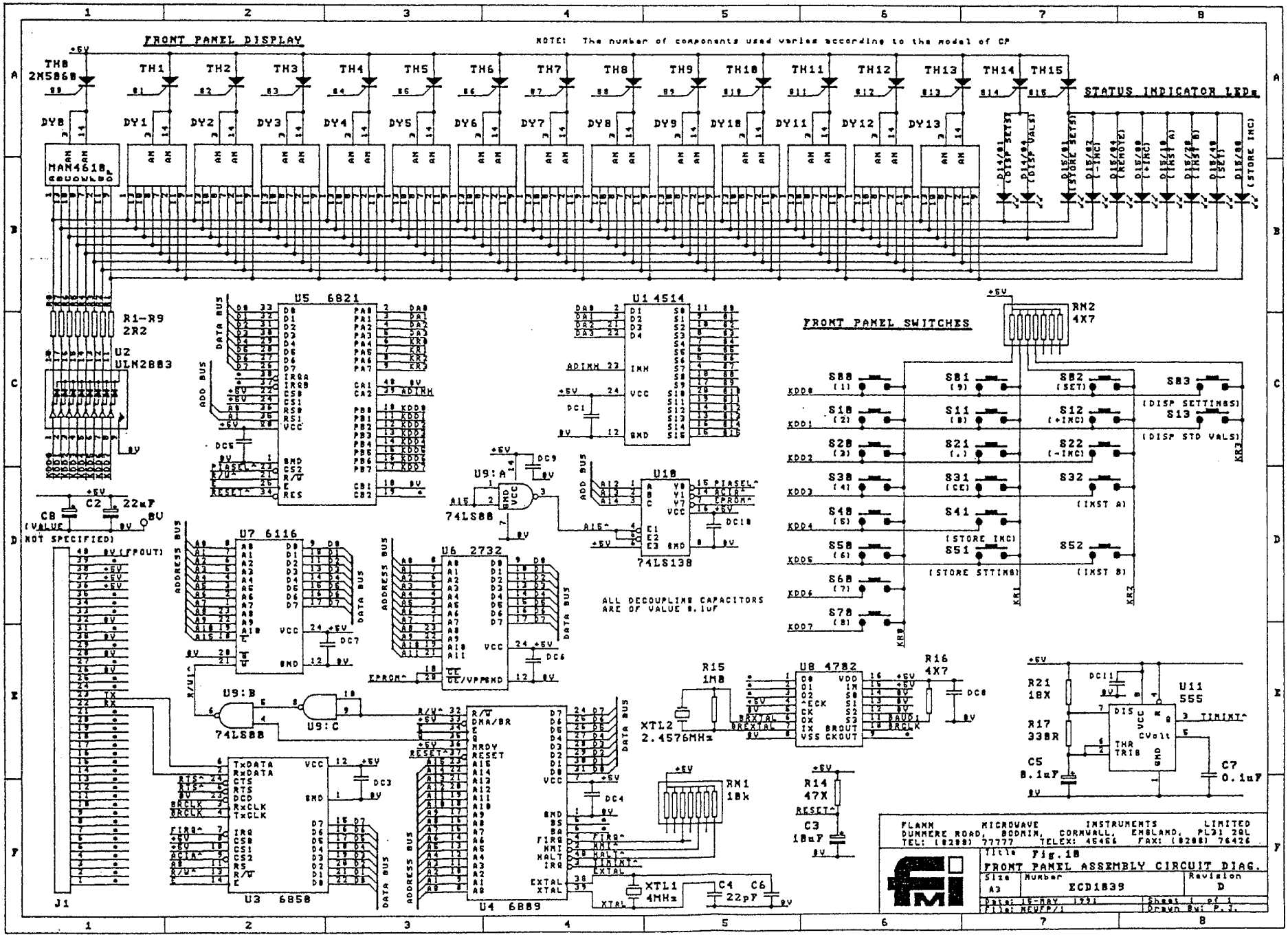
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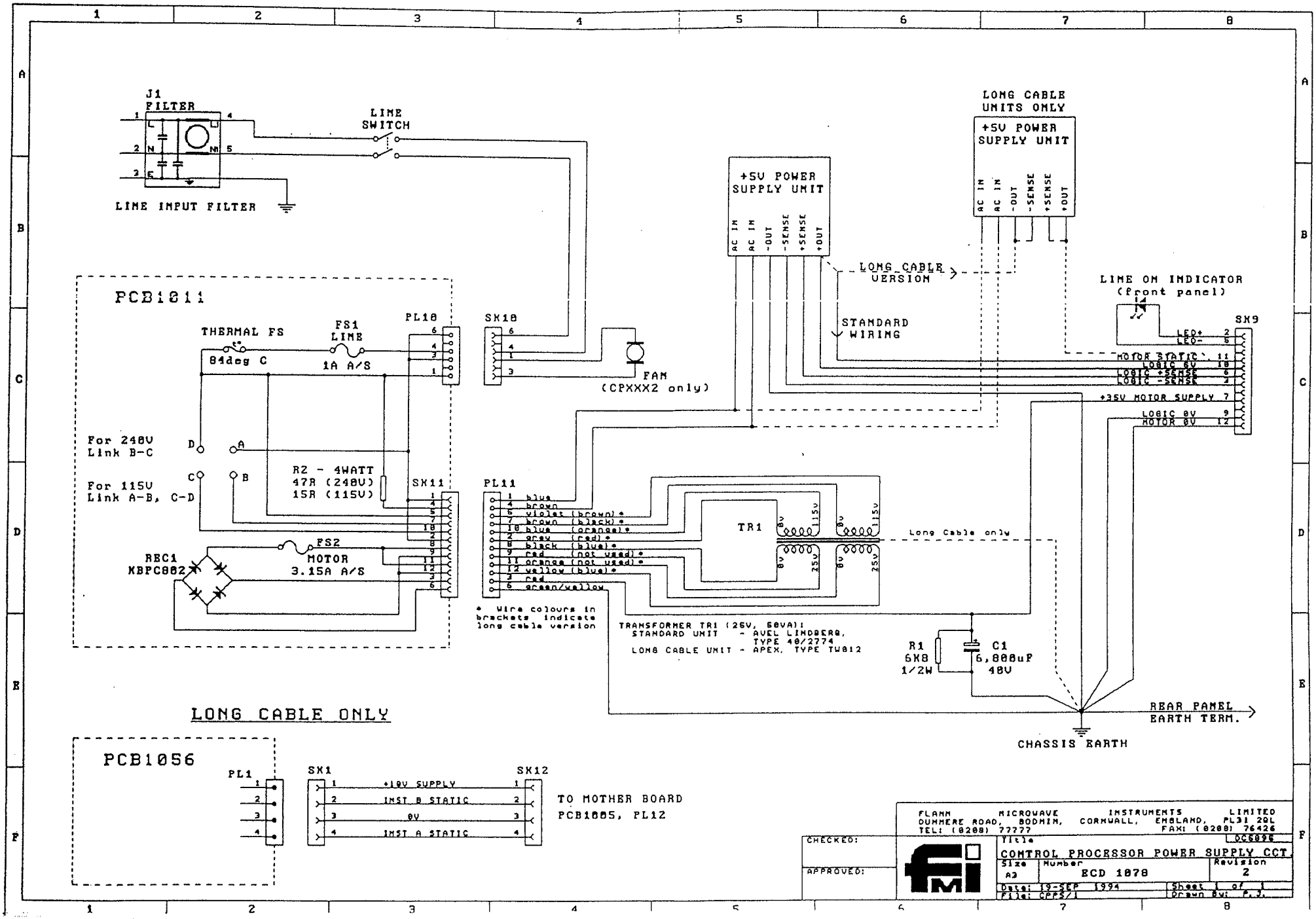
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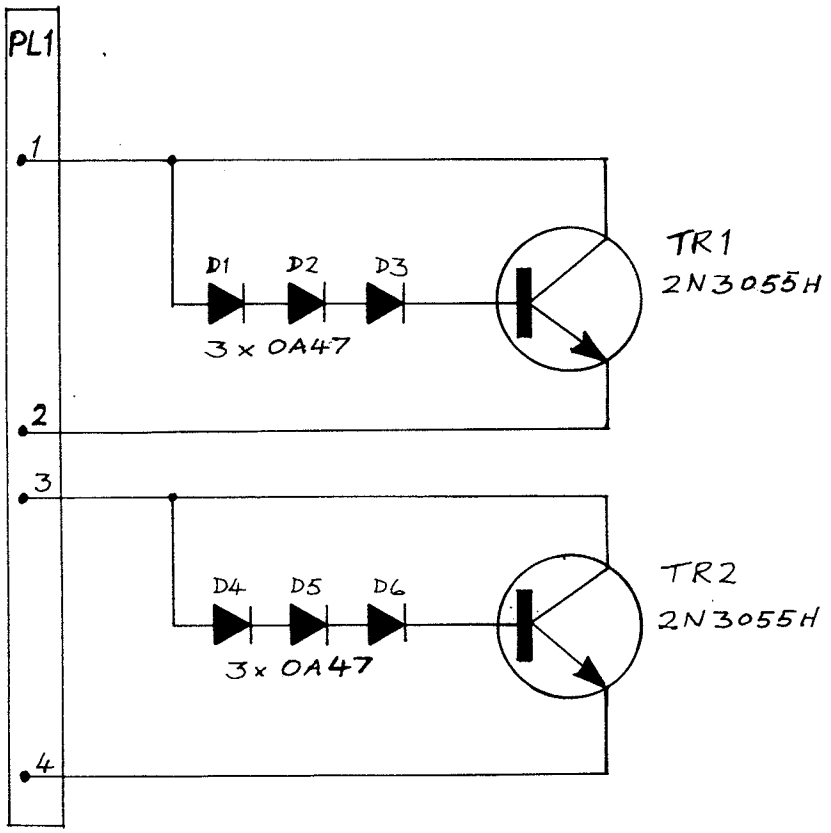
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