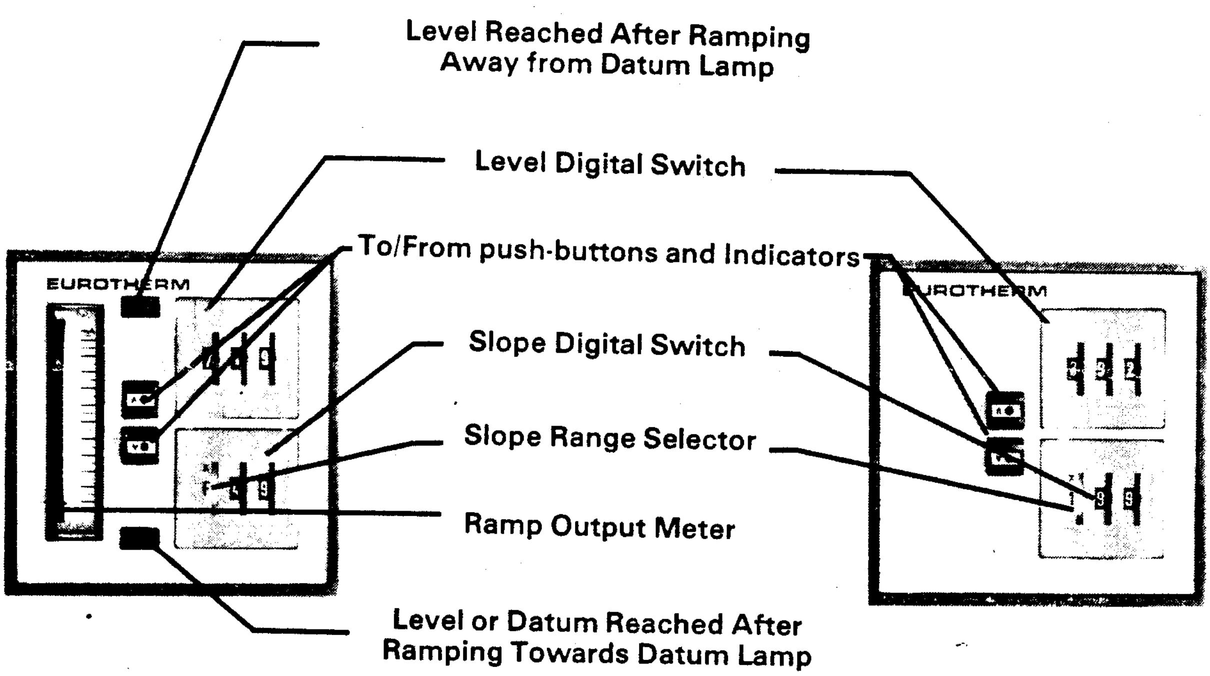
PROGRAMMER TYPE 125, 127 & AUXILIARY UNIT 126, 128

MAINTENANCE MANUAL

125 - 128



PROGRAMMER

AUXILIARY UNIT

Part No. HA013160

CONTENTS

Technical Specification

Output Voltage	Maximum Span (For spans below 5mV refer to your local Eurotherm Engineer)	50mV
	Output Impedance	1Ω/mV of Span (approx)
	Hold Level Linearity	±0.5% of Span
	Hold Level Calibration Accuracy	±0.75% of Span
	Zero Level Accuracy	±0.5% of Span
	Temperature Stability of Hold Level	≤250p.p.m./°C of Span
	Temperature Stability of Zero Level	≤150p.p.m./°C of Span
	9.1 volt ramp (available on rear terminal No.7.)	Max. current drain 500 Micro-amps.
Slope Output	Longest ramp on any range (Time for complete ramp with hold digit switch at Max. and Slope set to minimum permissible Value)	≤2500 hours (3 months approx)
	Shortest ramp on any Range (Time for complete Ramp with Hold and Slope Digit switches set to maximum)	≥2 seconds
	Number of Ranges	1, 2 or 3 (X1, X0.1 and X10 of Basic Range)
	Setting Range of Digit Switch to meet this Specification	4-100% of Span
	Slope set Point Linearity	±0.5%
	Slope Calibration Accuracy	±2% at 20°C
	Temperature stability of slope set point	≤2000p.p.m./°C of Span
	Fast range (reset) for complete Ramp with Hold and Slope Digit Switch set to Maximum	2-10 seconds
Ambient Temperature	Operating	0.50°C
	The above Temperature Stability figures apply only over the Range	10-30°C
Supply Voltage		115/230 volts ±15% 50-60Hz

General

Power Consumption:	Type 125 and 127 without any Drain on 30V Supply	7.0 V.A.	These figures are approx. As consumption is supply voltage dependant.
	Type 125 and 127 with max. Drain on 30V Supply	7.5 V.A.	
	Type 126 and 128 (Fitted with option 78 with max. Drain on 30V Supply	0.5 V.A.	
Hold Relay:	Contact closure whilst at Hold after upslope	rating1A 240 volts a.c.	
Zero and Hold Relay:	Contact closure whilst at zero or hold after downslope	rating 1A 240 volts a.c.	
Maximum Drain from 30V d.c. supply	Type 125 and 127	150mA	
	Type 126 and 128	150mA	
Case:	Sheet Steel Case with 96 × 96mm facia. to din 43700 see dimensional details		
Protection:	P30 to Din 40050		
Terminals:	3.5mm screw terminals as standard (P20 to Din 40050)		
Weight	Type 125 and 127	1.9Kg (4 lbs)	
	Type 126 and 128 (with option 78)	1.1Kg (2 ½ lbs)	
	(without option 78)	0.8Kg (2 lbs)	

Options

Fastons:	¼" Faston blades fitted to rear terminal block instead of 3.5mm screw terminals.	
Plug-in facilities:	Sleeve type 152-12-00 for programmer type 125 and 127 Sleeve type 151-12-00 for auxiliary unit type 126 and 128	To be ordered separately
30 Volt Relay Supply:	(Standard on type 125 and 127, optional on type 126 and 128) Sufficient to drive 5-30mA relays ∴ In general every 5th auxiliary unit should incorporate this option to enable sufficient power for addressing all auxiliary units together.	

Installation and dimensional details

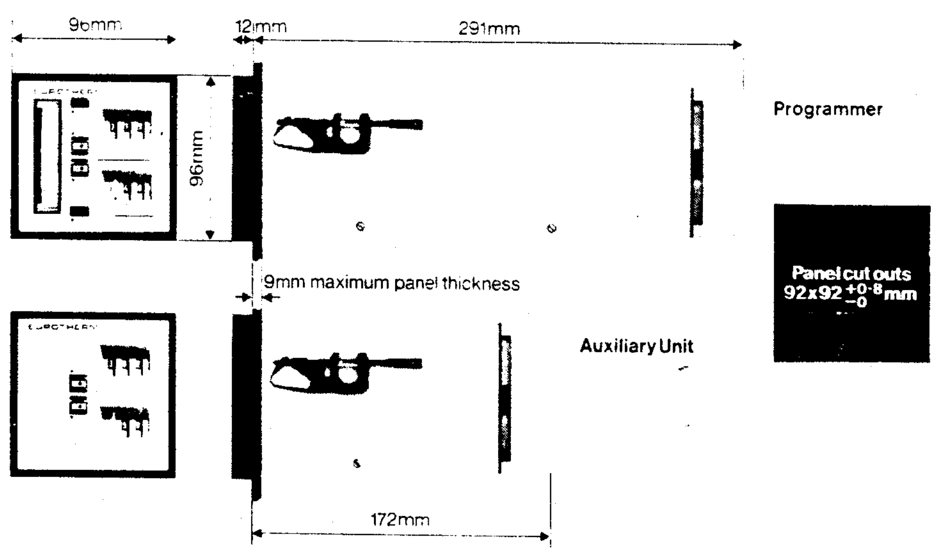


FIG 1.

TABLE 1

SENSOR & RANGE	PART No	SENSOR & RANGE	PART No	SENSOR & RANGE	PART No
0 - 199°C T/C J	01 - 271	200 - 1199°C C/A K	03 - 169	600 - 1599°C Pt 30% Rh Pt 6% Rh B	08 - 170
0 - 399°C T/C J	01 - 272	0 - 399°K C/A K	03 - 273	800 - 1799°C Pt 30% Rh Pt 6% Rh B	08 - 277
0 - 499°C T/C J	01 - 274	0 - 999°F C/A K	03 - 282	1000 - 1999°C W - W 26% Re (ENGEL HARD)	11 - 192
0 - 599°C T/C J	01 - 275	0 - 399°C Cu/Const T	04 - 272	0 - 99.9°C RT	70 - 270
0 - 999°C T/C J	01 - 276	0 - 699°F Cu/Const T	04 - 281	0 - 199°C RT	70 - 271
0 - 599°F T/C J	01 - 280	0 - 999°C Pt 10% Rh Pt S	06 - 276	0 - 399°C RT	70 - 272
0 - 999°F T/C J	01 - 282	200 - 1199°C Pt 10% Rh Pt S	06 - 169	0 - 999°C RT	70 - 276
200 - 1199°F T/C J	01 - 283	600 - 1599°C Pt 10% Rh Pt S	06 - 170	0 - 999°F RT	70 - 282
600 - 1599°F T/C J	01 - 284	0 - 999°C Pt 13% Rh Pt R	05 - 276	0 - 399°C RT 130Ω AT 0°C	71 - 272
0 - 399°C C/A K	03 - 272	200 - 1199°C Pt 13% Rh Pt R	05 - 169	0 - 199 *	D10698
0 - 599°C C/A K	03 - 275	600 - 1599°C Pt 13% Rh Pt R	05 - 170	0 - 399 *	D10699
0 - 999°C C/A K	03 - 276	600 - 1599°C Pt 20% Rh Pt 5% Rh (JMC)	07 - 170	0 - 999 *	D10700

* ALL KELVIN VARLEY EXCEPT THOSE MARKED THUS

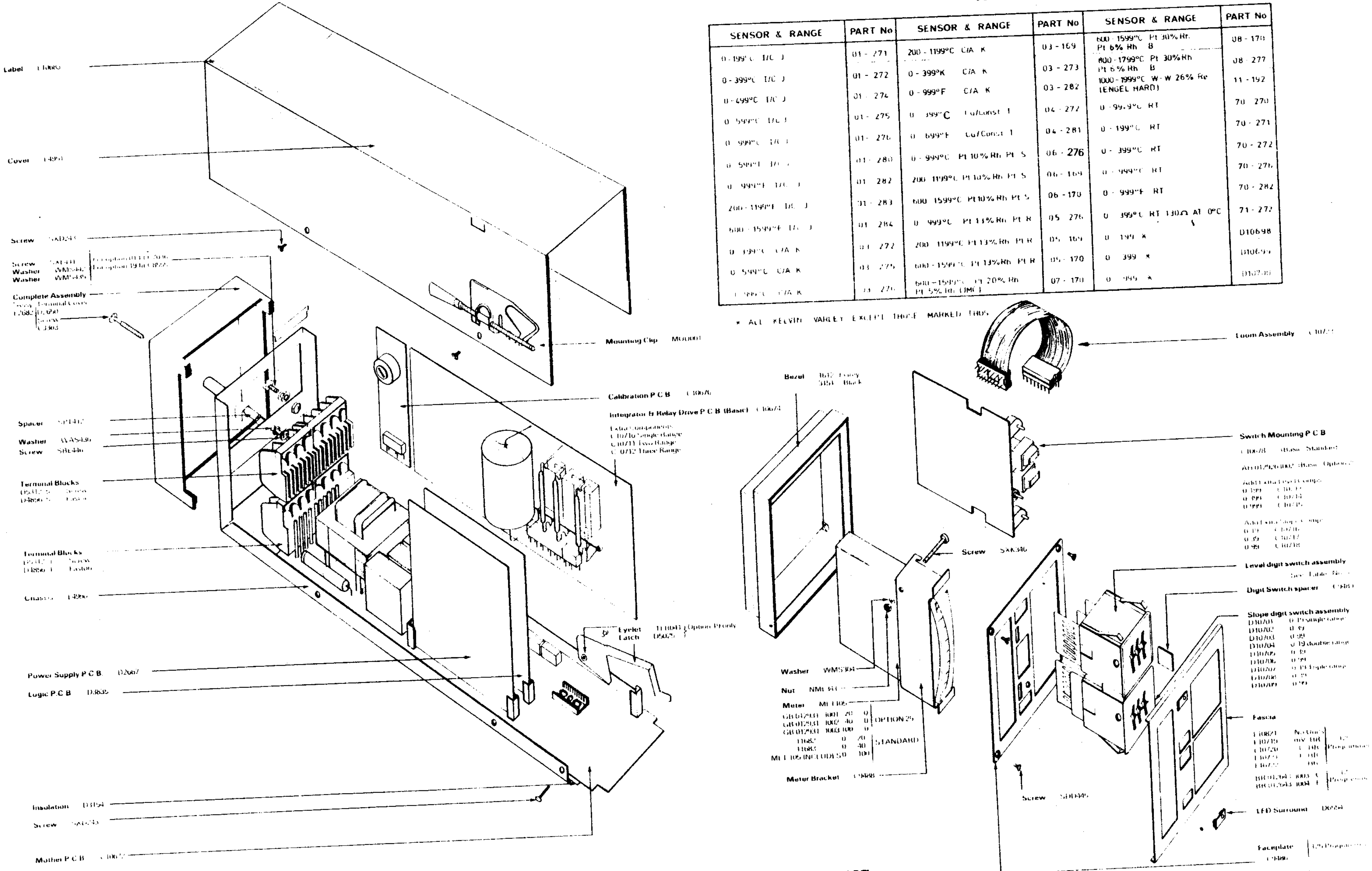


FIG 2. **Exploded View Programmer Type 125, 127.**

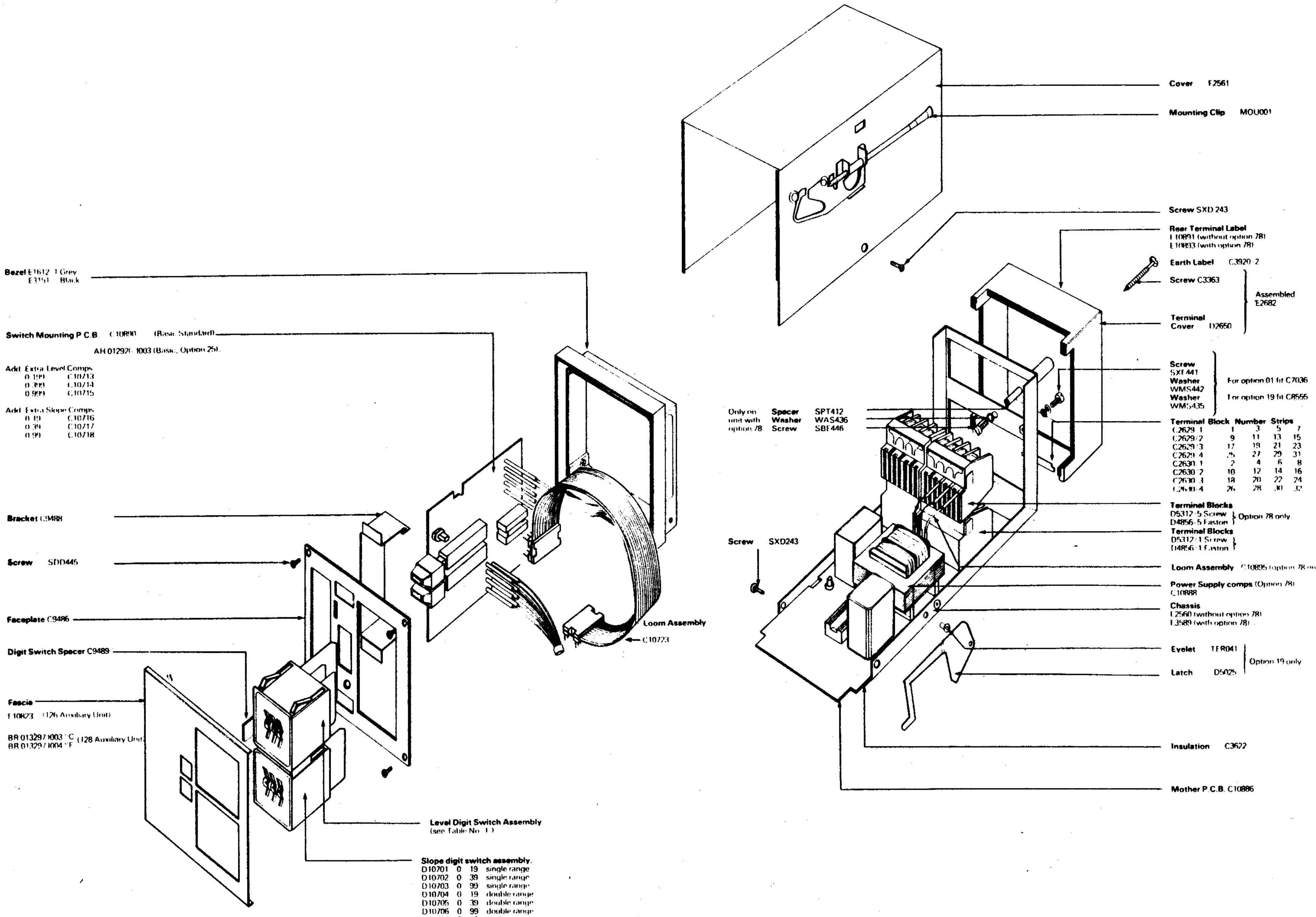
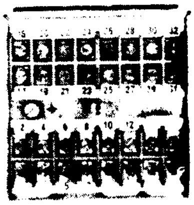
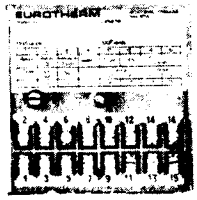


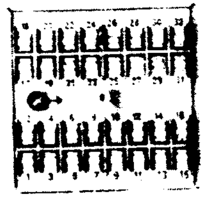
FIG 3. **Exploded View Auxiliary Unit Type 126, 128,**



Programmer



Auxiliary Unit



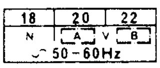
Auxiliary Unit
with Option 78

Connections and Wiring for Programmer 125 & 127

Electrical connections are made via 16-way terminal blocks fitted with either blade or screw terminals. All connections are low-current and a 16/0.20mm wire size is adequate. A label mounted above the terminal block shows input, output and power supply connections for the instrument. The wiring to the rear terminals should be long enough to allow complete withdrawal of the instrument from the panel. This will enable the case to be removed without disconnecting the instrument if internal adjustments are needed.

When fitting a plug-in assembly, bear in mind that the terminals on the mounting sleeve are not identified. The mounting sleeve is a general purpose unit which can be used with various instruments, and must be wired according to the identification label on the particular instrument that is being fitted. The instrument itself must be available for reference before making any termination, but apart from that the wiring procedure is the same as for a directly-wired instrument.

Supply

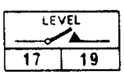


The instrument supply is connected to terminals 18 and 20 for a supply voltage in the range 100-130V, or 18 and 22 for a supply voltage in the range 200-260V.

Test Output

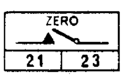
A ramp output voltage in the 0-9V range is available at terminal 7 for test purposes and high-level applications only. It must not be used with thermocouples or resistance thermometers.

Level reached after ramping away from datum relay contact



A normally-open contact rated at 1A/250V a.c. is available for external connection between terminals 17 and 19. The contact closes across the terminals when a level is reached after ramping away from Datum, remains closed while the level is held, and opens when a slope is initiated.

Level or datum reached after ramping towards datum relay contact

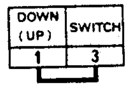


A normally-open contact rated at 1A/250V a.c. is available for external connection between terminals 21 and 23. The contact closes when level or Datum is reached after ramping towards datum, remains closed while level or datum is held, and opens again when a slope is initiated.

Auxiliary Connections

A number of internal connections are brought out to the rear terminals of the programmer for external connection to auxiliary slope units when fitted. For automatic operation, each of the four selector switches on the programmer is connected in series with the corresponding selector switch on every auxiliary slope unit, while d.c. supplies are connected in parallel. Parallel connections are also used for remote operation of the slope range relays A, B, and C in the programmer.

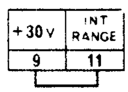
To/From Datum (or Up/Down) Switch



The to/from push-button switch is internally connected in series with terminals 1 and 3. The terminals are strapped together when the programmer is used by itself, and the strap is removed when an auxiliary slope unit is fitted.

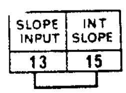
To/from push-buttons on auxiliary slope units are similarly connected in series with terminals 1 and 3 on each unit. Consequently, the correct series connection will be maintained when terminal 1 on the programmer is connected to terminal 3 on the first slope unit, and terminal 1 on the first slope unit is connected to terminal 3 on the second unit, and so on until terminal 1 on the last unit is returned to terminal 3 on the programmer to complete the external loop.

Range Selector



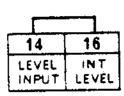
The slope range selector is internally connected in series with terminals 9 and 11. The terminals are strapped together when the programmer is used by itself, and the strap is removed when an auxiliary slope unit is fitted. Range selectors on auxiliary slope units are similarly connected in series with terminals 9 and 11 on each unit. Consequently, the correct series connection will be maintained when terminal 9 on the programmer is connected to terminal 11 on the first slope unit, and terminal 9 on the first slope unit is connected to terminal 11 on the second unit, and so on until terminal 9 on the last unit is returned to terminal 11 on the programmer to complete the external loop.

Slope Switch



The slope switch is internally connected in series with terminals 13 and 15. The terminals are strapped together when the programmer is used by itself, and the strap is removed when an auxiliary unit is fitted. Slope switches on auxiliary slope units are similarly connected in series with terminals 13 and 15 on each unit. Consequently, the correct series connection will be maintained when terminal 13 on the programmer is connected to terminal 15 on the first slope unit, and terminal 13 on the first slope unit is connected to terminal 15 on the second unit, and so on until terminal 13 on the last unit is returned to terminal 15 on the programmer to complete the external loop.

Level Switch



The level switch is internally connected in series with terminals 14 and 16. The terminals are strapped together when the programmer is used by itself, and the strap is removed when an auxiliary unit is fitted. Level switches on auxiliary slope units are similarly connected in series with terminals 14 and 16 on each unit. Consequently, the correct series connection will be maintained when terminal 14 on the programmer is connected to terminal 16 on the first slope unit, and terminal 14 on the first slope unit is connected to terminal 16 on the second unit, and so on until terminal 14 on the last unit is returned to terminal 16 on the programmer to complete the external loop.

D.C. Supplies

0V	26	28	30
5	-10v	±10v	+10

Auxiliary slope units are supplied in parallel with OV from terminal 5, -10V d.c. from terminal 26, and either +10V or -10V d.c. from terminal 28, depending on ramp voltage polarity.

Terminal 5 on the programmer is connected to terminal 5 on each slope unit in parallel.

Terminal 26 on the programmer is connected to terminal 12 on each slope unit in parallel.

Terminal 28 on the programmer is connected to terminal 10 on each slope unit in parallel.

Slope Range Relays

2	4	6
RELAY C	RELAY B	RELAY A

Four alternative slope ranges are obtained with three relays energized by the range switch, as follows: —

(1) Fast, with relay A energized.
(2) Multiply by ten, with relay B energized.
(3) Normal, with relay C energized.
(4) Divide by ten, with no relay energized.

The relays can be energized remotely by range switches in auxiliary slope units when fitted. Parallel connections are used since only one switch at a time is activated during a programme. Terminals 6, 4 and 2 in the programmer are connected to terminals 6, 4 and 2 respectively on each slope unit in parallel.

Ramp Output for Thermocouple or Resistance Thermometer

10	12
− mV	+

A ramp output in the normal millivoltage range is provided across terminals 10 and 12 for connection to the input circuit of the controller. Any output between 0-5mV and 0-50mV is available for use with different types of sensor, and the range is preset during manufacture to customer's specification.

30
+10v

A +10V supply is available from terminal 30 if required.

Ramp
7

A −9V ramp synchronised to the ramp appearing across terminals 10 and 12 is available at terminal 7. W.R.T. the OV line terminal 5.

Wiring of Auxiliary Slope Unit 126 & 128

General

Auxiliary slope units are fitted when automatic operation is required. The slope units are panel-mounted like the programmer, and wired in much the same way. Each front-panel switch is wired in series with the corresponding switch on the programmer and on other auxiliary slope units, while the range relays and d.c. supplies are wired in parallel to all units.

To/From Datum (or Up/Down) Switch

DOWN (UP) IN	OUT
1	3

The to/from switch across terminals 1 and 3 is connected in series with the to/from switches on the programmer and all other units in the installation.

Range Selector

RANGE OUT	IN
9	11

The range selector switch across terminals 9 and 11 is connected in series with the range selector switches on the programmer and all other units in the installation.

Slope Switch

SLOPE IN	OUT
13	15

The slope digit switch across terminals 13 and 15 is connected in series with the slope switches on the programmer and all other units in the installation.

Level Switch

14	16
IN LEVEL	OUT

The level digit switch across terminals 14 and 16 is connected in series with the level switches on the programmer and all other units in the installation.

D.C. Supplies

0V	10	12
5	±10V	-10V

D.C. Supplies from the programmer are connected in parallel to terminals 5, 10 and 12 on all auxiliary slope units, with OV to terminal 5, -10V to terminal 12, and either +10V or -10V depending on ramp polarity to terminal 10.

Slope Range Relays

2	4	6
RELAY C	RELAY B	RELAY A

The slope range relays in the programmer are operated remotely by parallel connections to terminals 2, 4 and 6 on auxiliary slope units. Terminal 2 is connected to relay C; terminal 4 to relay B; and terminal 6 to relay A (fast).

Unit Selection

8
SELECT

The unit is activated by a built-in relay which is energized when a +30V d.c. supply is applied to terminal **8**.

Optional Functions

30V Relay Supply — 78

Option 78 provides an auxiliary slope unit with a 30V 150mA d.c. supply for activating up to five 30mA relays in parallel. The first five auxiliary slope units in a sequence can be activated from a similar supply in the programmer. Consequently, option 78 is normally specified for one auxiliary slope unit in every five thereafter.

18	20	22
N	A V	B
∿ 50 - 60Hz		

The a.c. supply is connected to terminals 18 and 20, or 18 and 22 according to supply voltage. Terminal 18 is the neutral connection. Terminals 20 and 22 are the live connections for 100/130V and 200/260V supplies respectively.

0V	+30V
5	7

The +30V d.c. relay supply is available at terminal 7, with OV at terminal 5.

Motherboard for Programmer 125, 127
Assembly E99526 — Circuit E99527

General Description

The motherboard carries the power supply transformer and rectifiers together with three relays. However, its main function is to provide interconnections for five daughterboards as follows:—

(1) Integrator and Relay Drive Board
(2) Millivolt Board
(3) Mk4 Logic Board
(4) Stabilized 10V Power Supply
(5) Front Assembly

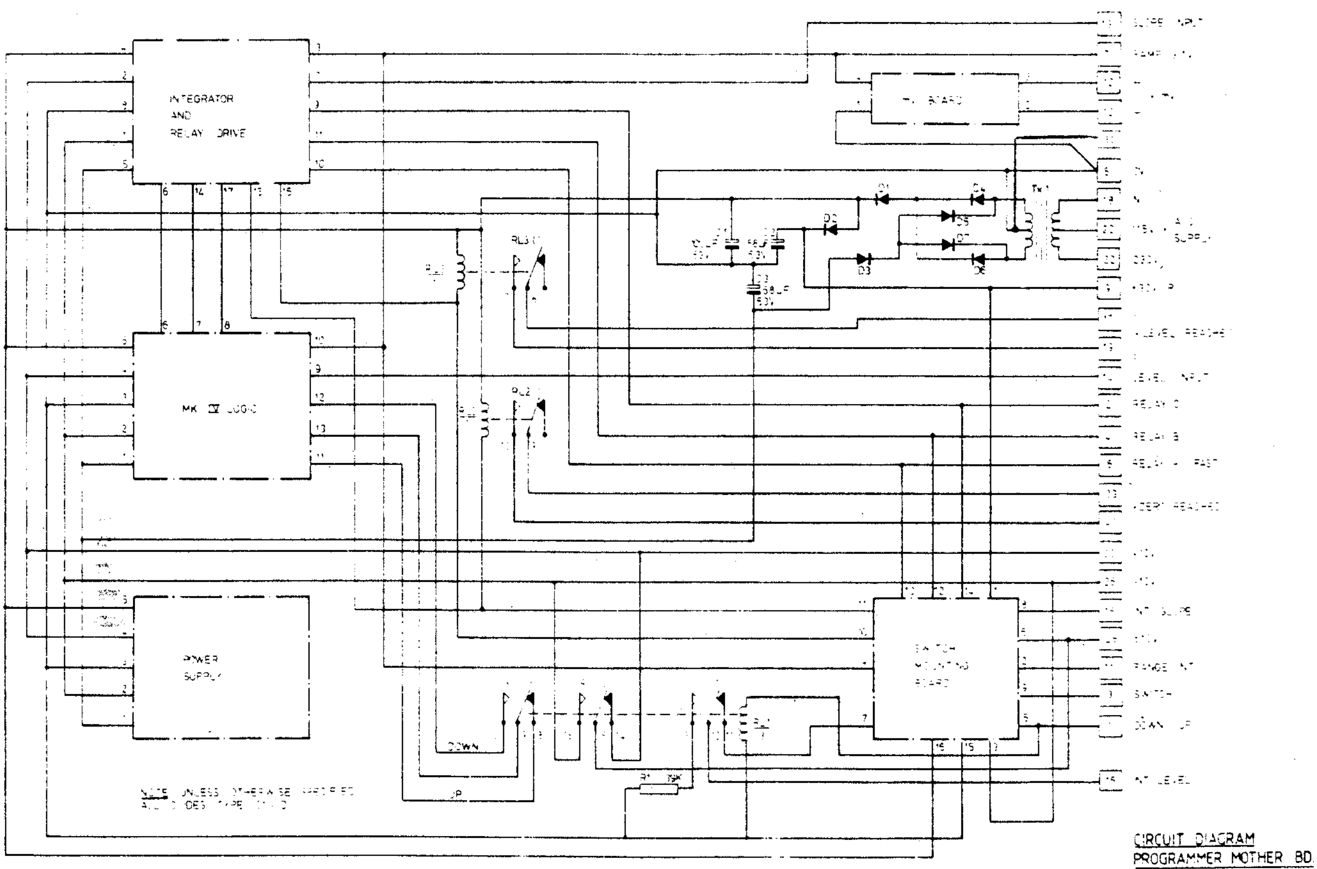
Each daughterboard is described separately on following pages. Except for the front assembly, which is connected by a 16 pin dual in-line header and socket, the daughterboards are connected to the mother board with a P.C.B. connector.

Power Supply

With a.c. mains connected to the primary, the secondary of transformer TX1 provides a nominal output of 30-0-30V which is rectified by the full-wave diode bridge D4-D7. The +30V and −30V supplies for the instrument are smoothed by D1-C1 and D3-C3 respectively, and a separate +30V (R) supply for external relays is additionally smoothed by D2-C2 to prevent relay chatter.

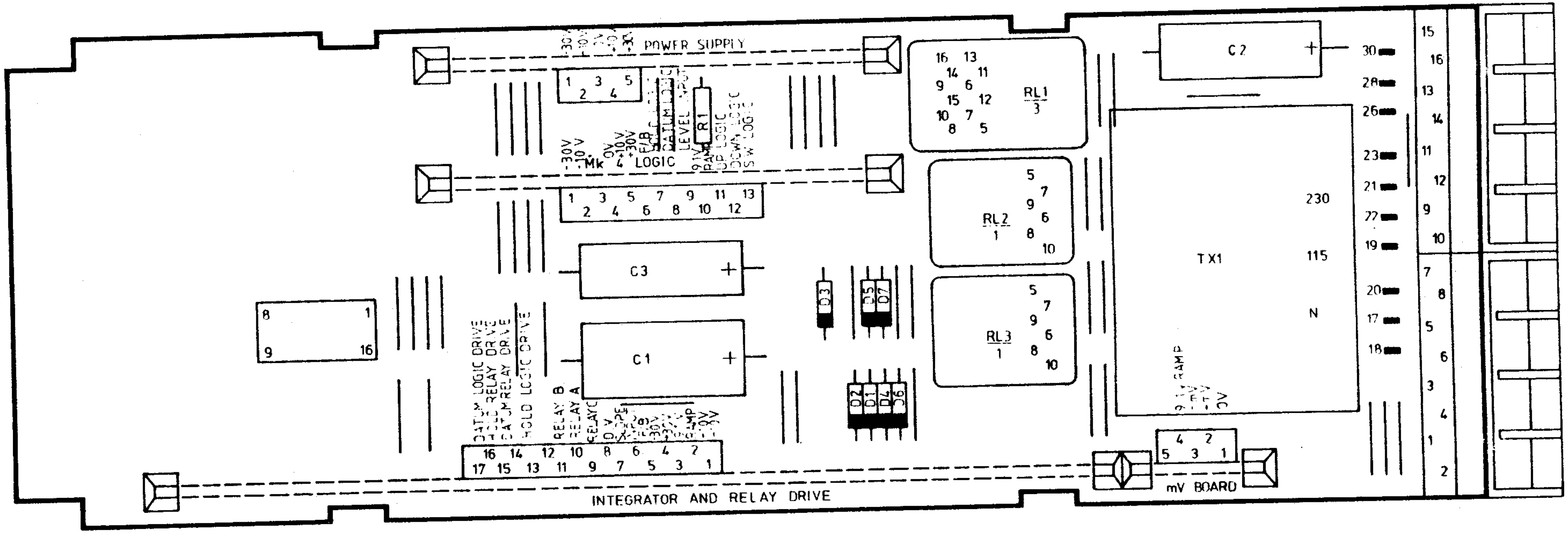
Relays

Relay $\frac{RL1}{3}$ is energized when the UP/DOWN switch is pressed for a ramp to zero. Contact RL1(1) changes over to disconnect the level digit switch from the input to the comparator on the logic board, and replaces it with a 39 Kilohm resistor R1, to provide the correct source impedance for zero signal input. Contact RL1(2) reverses the polarity of the ramp voltage and contact RL1(3) inverts the sense of the logic control circuit. Relay $\frac{RL2}{1}$ is energized by a switching signal from the logic board when zero or a hold after ramping towards zero is reached and contact RL2(1) closes across rear terminals 21 and 23. Similarly, relay $\frac{RL3}{1}$ is energized when a desired hold level after ramping away from zero is reached, and contact RL3(1) closes across terminal 17 and 19.

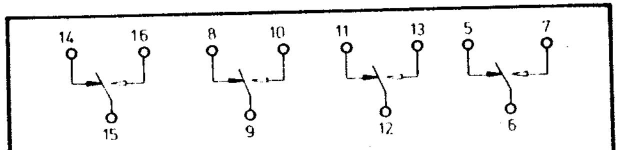


CIRCUIT DIAGRAM
PROGRAMMER MOTHER BD.

Drg No E995[illegible]



FOR CIRCUIT DIAGRAM SEE DRG I 99527



RELAY PIN IDENTS

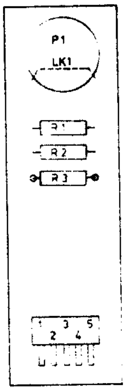
P.C.B. ASSEMBLY
PROGRAMMER MOTHER BOARD

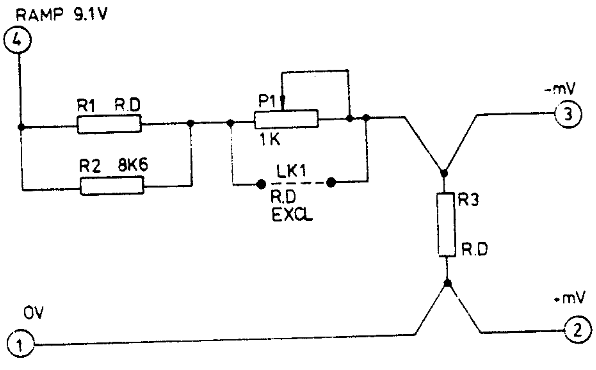
Millivolt Board
for Programmer 125, 127
Assembly C99534 — Circuit C99535

The Millivolt Board converts the high-level ramp voltage into an output signal in the millivolt range suitable for simulating a temperature sensor or similar device.

The ramp voltage at pin 4 is applied across a potential divider R2-P1-R3 with a total value of 9.6K, and potentiometer P1 is adjusted to pass a current of 1mA when the applied voltage is 9.1V. Consequently, the low value resistor R3 will provide a source resistance of one ohm per millivolt, and its value can be directly selected for the output range required. For example, if the value of R3 is nominally 10 ohms, the maximum output will be 10 millivolt. Any discrepancy due to the manufacturing tolerance of R3 can be corrected by a minor readjustment of potentiometer P1.

Link LK1 is used only when potentiometer adjustment is impractical for mechanical or temperature reasons, and the output signal is then calibrated by selecting a suitable value of R1 in parallel with R2.





NOTE
R1 AND LK1 NOT NORMALLY USED
○ Denotes P.C.B Connector

CIRCUIT DIAGRAM
PROGRAMMER mV BOARD

Automatic Sequence

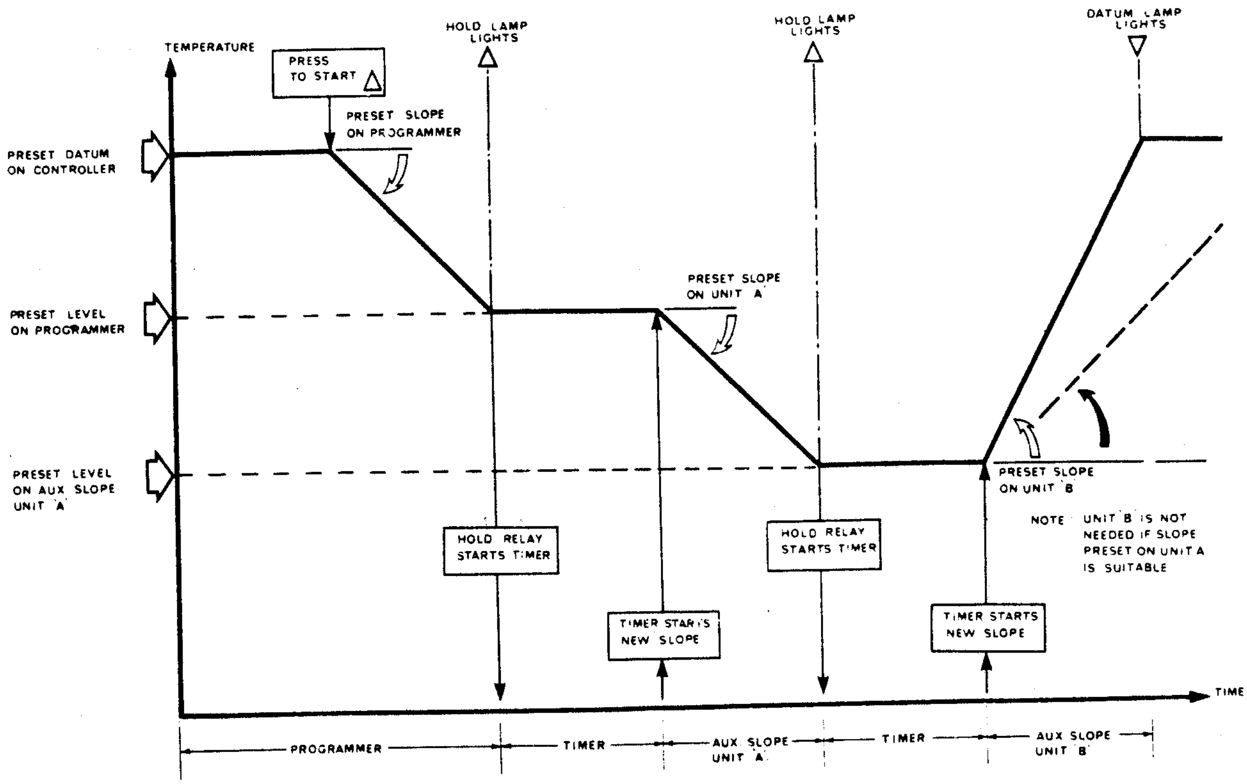


FIG.4 TYPICAL PROGRAMME PROFILE

Integrator & Relay Drive Board for Programmer 125, 127 Assembly E99530 – Circuit D99531

Integrator

The slope input at pin 7 is buffered by amplifier IC and calibrated by a potential divider network before being applied to the integrator. A second input from the logic board is provided at pin 6 to clamp the output of the buffer amplifier when the integrator has reached the desired level. Since the values of the input resistors R1 and R2 are 10K and 100 ohms respectively, the second input can easily over-ride the first.

The buffer amplifier ICI derives stable 15V supplies from zener diodes Z1 and Z2 and accepts slope input voltages up to ±10V from a source impedance of approx. 91 kilohms. The output of the amplifier is calibrated by potential divider R10-R13 and applied to the integrator R16-C7. An uncalibrated fast ramp for re-setting the programmer is obtained when reed relay RL1/1 is energized by the range switch and contact RL1(1) closes to connect R19 in parallel with R16 and reduces the time constant of the integrator.

Two other calibrated ranges are optionally available, with megistors R17 and R18 separately switched in parallel with R16 by reed relay contacts RL3(1) and RL2(1) respectively. These ranges are individually calibrated by dividers R11-R14 and R12-R15, and the calibration procedure will be described in greater detail after a brief description of the integrator circuit.

The resistance-capacitance integrator R16-C7 provides a linear ramp output voltage with capacitor C7 included in the feedback loop of a high-stability operational amplifier. The integrating amplifier consists of three symmetrically-coupled long-tail pairs T1-T2, T3-T4 and T5-T6, with an active load T7 in the output of T6.

The inverted output of the buffer amplifier is applied to an insulated gate field-effect transistor T1 which has a very high input impedance and ensures a very low virtual-earth operating current. The input off-set voltage is nulled by adjusting potentiometer P1, and the offset is also temperature-compensated to maintain balance between the dissimilar input devices T1 and T2. The base of T2 is connected via R29 to the temperature-dependent voltage at the junction of Thermistor R30 and resistor R31. The magnitude of the compensating current is determined by the empirically selected value of R29, and the voltage can be positive or negative as selected by link LK2 or LK1 depending on whether the temperature characteristic of T1 is negative or positive.

The output at T7 collector is a negative-going linear ramp voltage with a maximum value of 9.1V. A high proportion of the output voltage is also returned as negative feedback to the integrator capacitor C7 via a temperature-compensating divider network formed by R33 and R37 with thermistor R38 and capacitor C9 in parallel. Thus the integrator R16-C7 is fully compensated for extraneous influences: the input is buffered by ICI, and the high input impedance of T1 ensures that there is negligible loading on the circuit.

The time constant of the integrator is given by the product of the resistance and capacitance. However high-value resistors or megistors are used to obtain the long time constants needed for most heat treatment processes, and these component values are subject to a manufacturing tolerance of 10%. The nominal value of C7 is also subject to a tolerance of 5%, so the time constant could have a tolerance of up to 15% in practice. Consequently, when nominal component values have been selected to give a suitable time constant for a particular range, the ramp rate is calibrated by adjusting the applied voltage to compensate for variations in both components. Resistors R10 and R13 have nominal values of 27K and 150K respectively, so the divider can provide up to 15% variation in the nominal output voltage of the buffer amplifier. The ramp rate is directly proportional to the voltage at the junction of R10, R13 and R16, and the value of R10 is empirically selected to correct any discrepancy in the time constant. Thus the time constant of R16-C7 can be calculated from the formula: –

$$RC = \frac{8.5}{9.1} T = 0.93T$$

where T is the time in seconds taken for the ramp to attain 9.1V when the slope input is at its maximum nominal value of 10V.

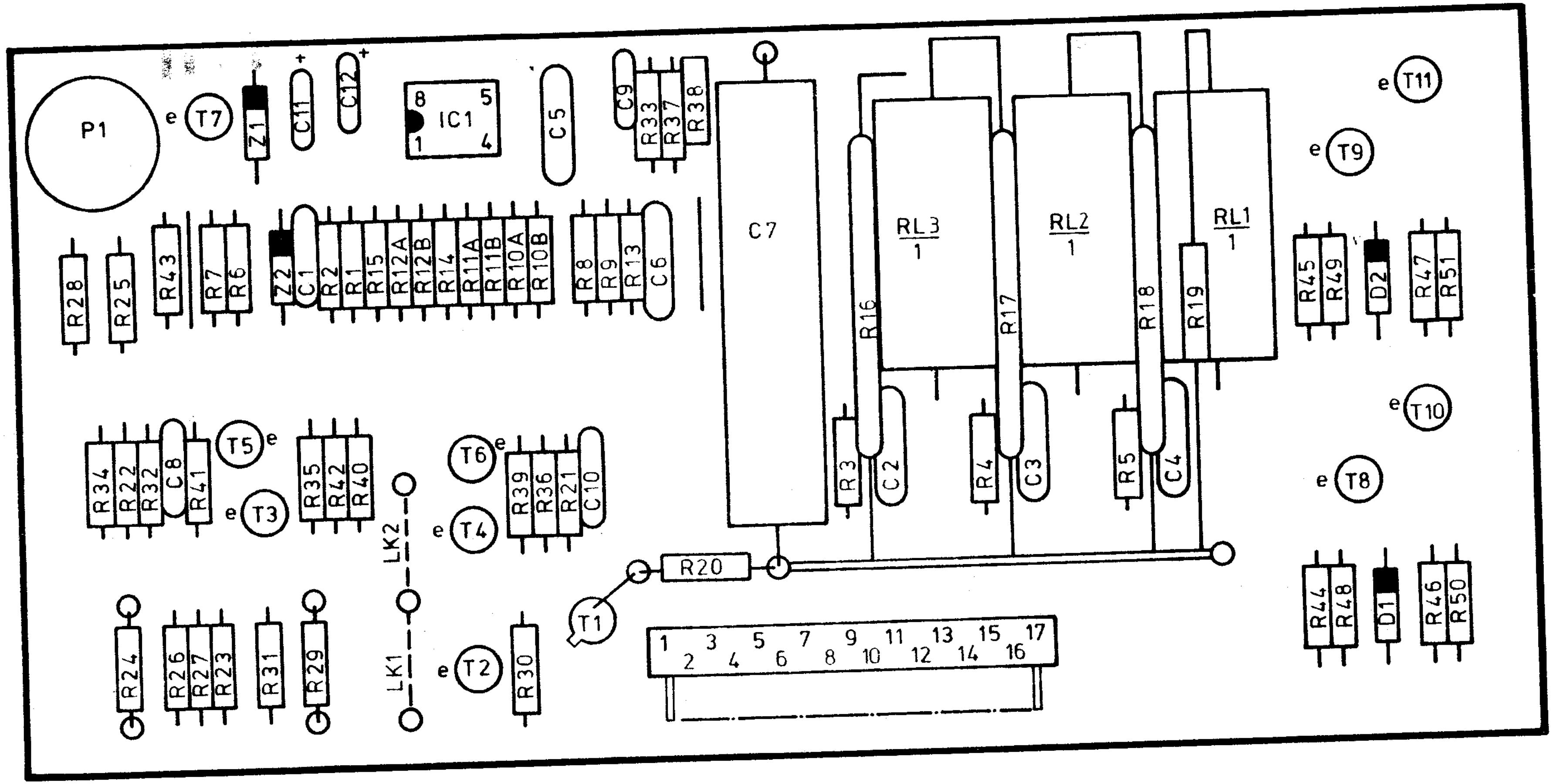
If the integrator board is fitted with more than one calibrated range, the slowest ramp rate is calibrated first, followed by the others in ascending order. The low range is calibrated by empirically selecting the value of R10 to give the correct time constant. The medium range is calibrated by energizing relay RL3/1 and selecting the correct value of R11 in the same way as R10. The high range is calibrated by energizing relay RL2/1 and similarly selecting the correct value of R12.

Relay contact RL3(1) connects R17 in parallel with R16 to reduce the time constant of the integrator and obtain a tenfold increase in ramp rate for the medium range. Relay contact RL2(1) connects R18 in parallel with R16 to give a hundredfold increase in ramp rate for the high range. There is thus a constant contribution from R10-R13 through R16 which represents 10% of the total charging current in the medium range, and 1% of the total in the high range. Consequently, the ramp rate in these two ranges is not strictly proportional to the respective voltages at R11-R14 and R12-R15. However, if R10 is calibrated first, the calibration of R11 and R12 will not be affected. As a general guide, if the nominal value of R10 is 27K, the nominal value of R11 will be 47K. A lower voltage is applied to R17 because the nominal values of the megistors are selected in decade multiples and there is a 10% contribution via R16 in the medium range. The contribution is only 1% in the high range, so the nominal value of R12 will be roughly the same as R10.

The high-impedance input circuit of T1 must be treated with great care. The input megistors are carried on p.t.f.e. stand-off mountings for maximum leakage resistance, and it is important not to touch these or other components in the integrator circuit because even minute traces of oil from the fingers could alter the circuit impedance and affect the calibration. It is especially important not to touch the input terminal of T1 because the static charge carried on the fingers is sufficient to damage the IGFET itself. Indeed, unless full facilities are available for testing and calibrating the instrument, it would be advisable not to touch the circuit at all, but to return the board to Eurotherm for re-calibration when necessary. It should also be borne in mind that temperature-cycling facilities will be needed to null the input offset voltage.

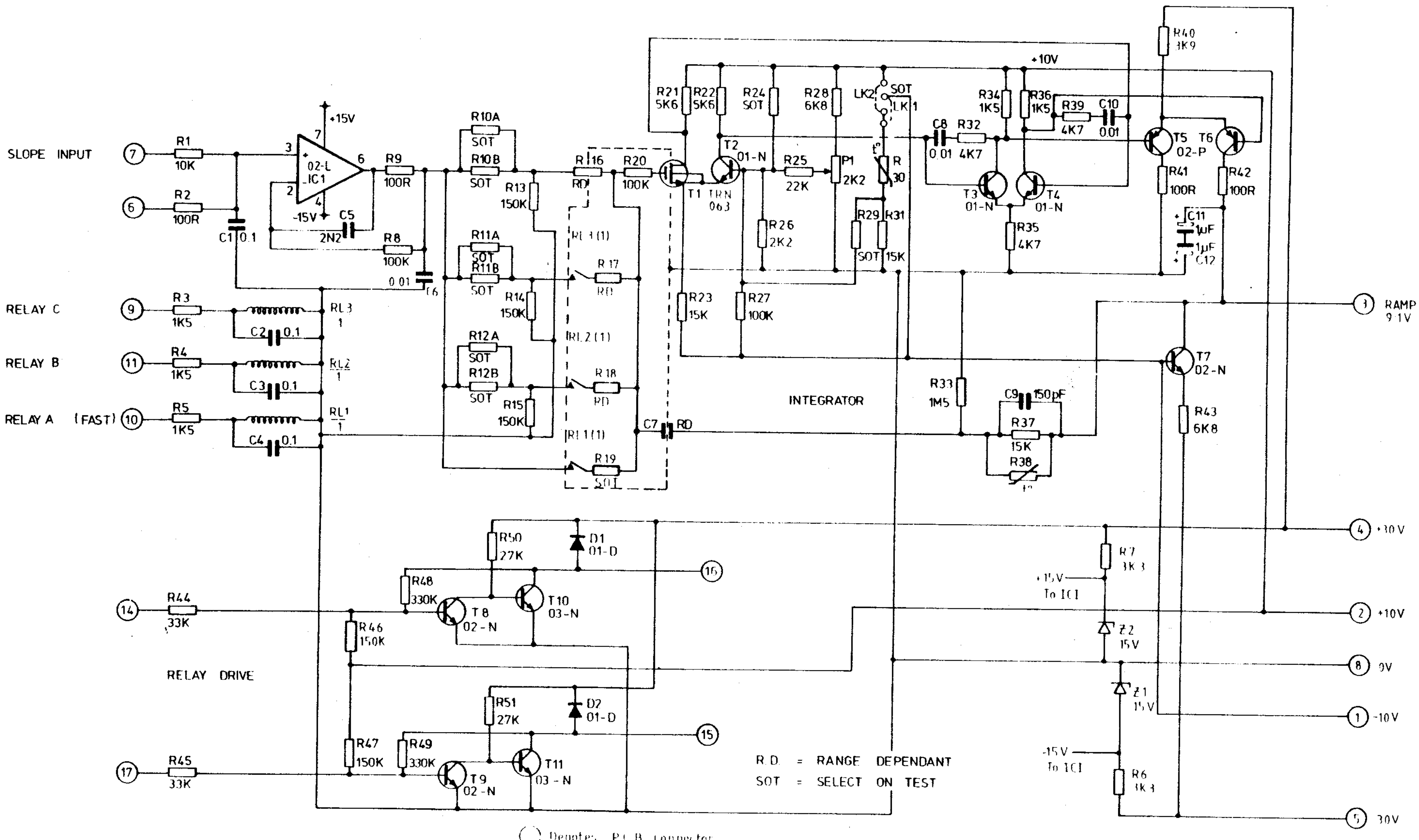
Relay Drive

The Integrator Board carries two separate transistor switching circuits to drive relays RL2/1 and RL3/1 respectively mounted on the motherboard. Each drive circuit consists of a pair of transistors, T8-T10 and T9-T11, in cascade with positive feedback via R48 and R49 respectively to hold T10 or T11 fully conducting when an input signal from the logic board is applied at pin 14 or pin 17. The respective outputs at pins 16 and 15 are switched to zero volts when T10 or T11 conducts, the 'freewheeling' diodes D1 and D2 damp the turn off transient when the relay is released.

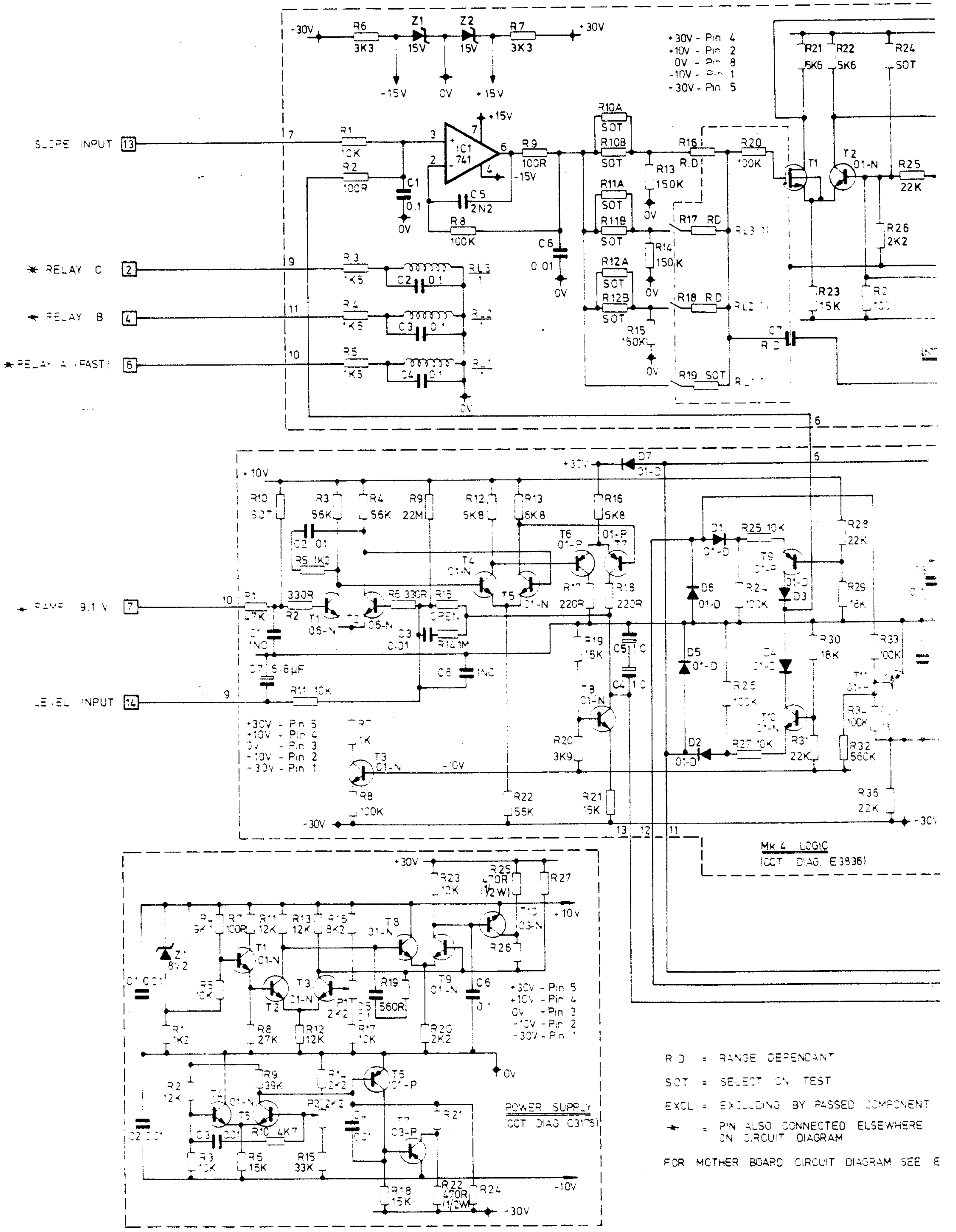


P. C. B. ASSEMBLY

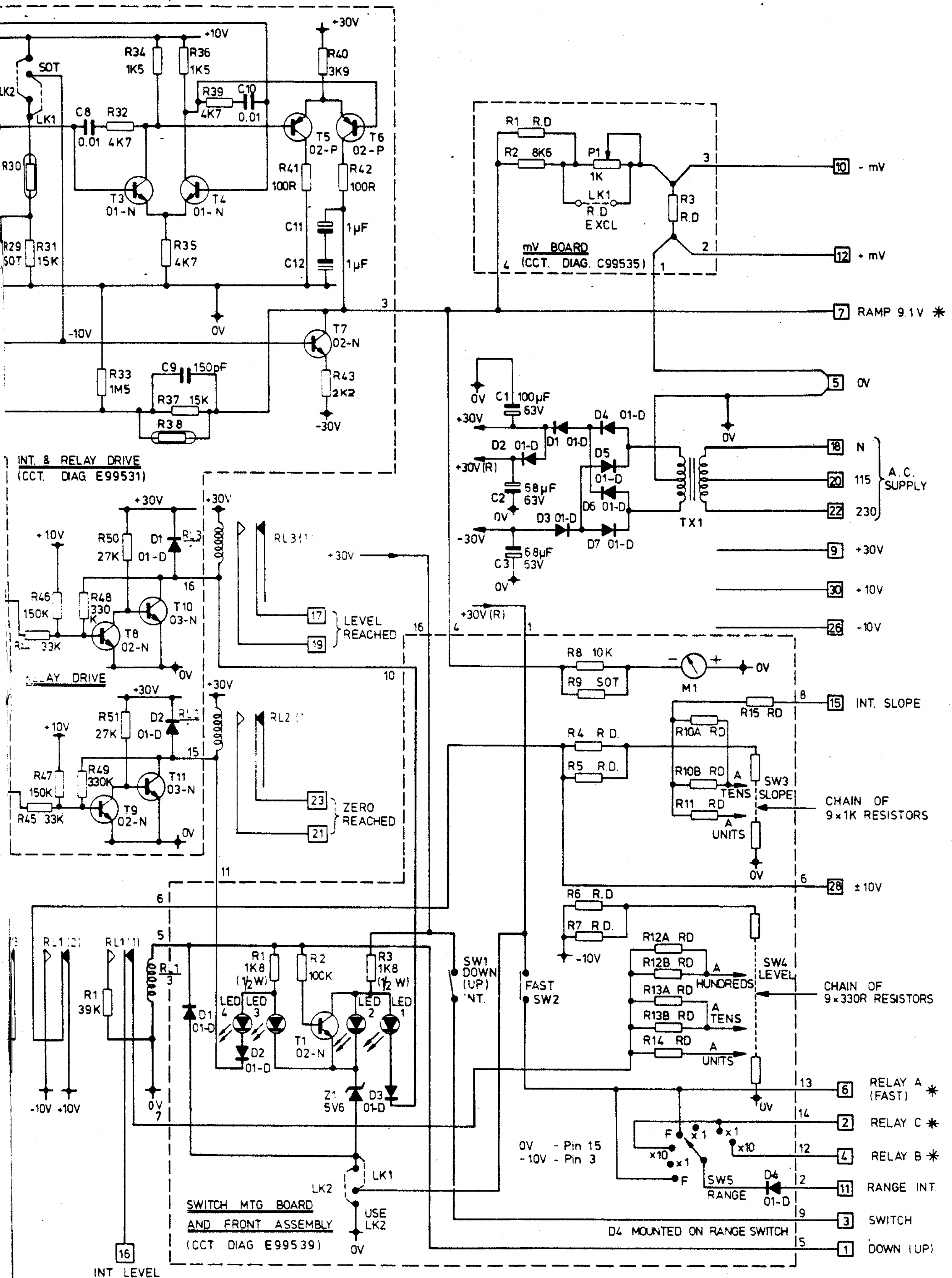
INTEGRATOR & RELAY DRIVE



CIRCUIT DIAGRAM
INTEGRATOR & RELAY DRIVE



Drg. No. F910641



CIRCUIT DIAGRAM
MULTIRANGE DIGITAL
PROGRAMMER

MK4 Logic Board for Programmer 125, 127 Assembly 93835 — Circuit 93836

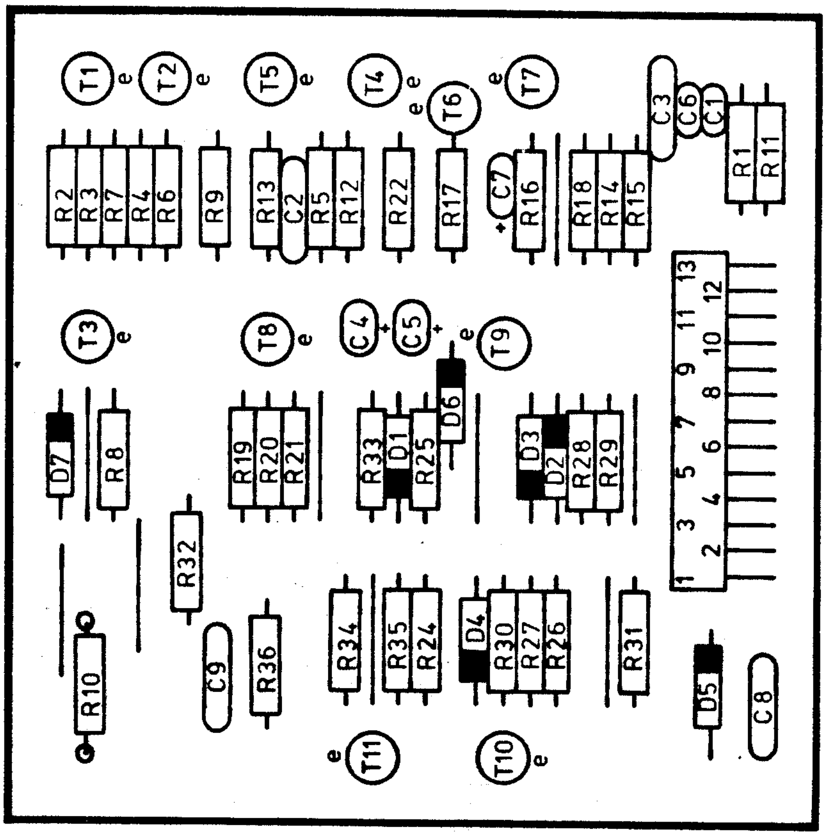
Briefly, the logic board carries a high-accuracy comparator circuit to monitor the ramp output voltage from the integrator. The ramp voltage is compared with the level input voltage from the level digit switch or zero volts and a logic switching circuit provides a signal to clamp the integrator output when the desired level or setpoint is reached. At the same time, a separate signal operates either relay RL3/1 or relay RL2/1 on the motherboard and also lights either the hold after a ramp away from zero lamp or the zero or hold after a ramp towards zero, as appropriate, on the front panel.

The comparator consists of three symmetrically-coupled long-tail pairs T1-T2, T4-T5 and T6-T7. The base-emitter voltage of the input pair T1-T2 is matched with the value of R10 selected-on-test to balance the bias current under zero limit conditions, and the constant current source T3 ensures effective common mode rejection. The negative-going ramp voltage at pin 10 is applied to the base of T1 via R1 and R2, while the level input voltage at pin 9 is applied to the base of T2 via R11 and R6. The ramp voltage can attain a maximum value of 9.1V and the level input voltage is preset by the level digit switch between 4% and 100% of the 9.1V span. Consequently, the comparator is held saturated until the ramp voltage matches the level input voltage. Overall a.c. negative feedback from T8 collector via C3-R14 to the base of T2 ensures that the comparator remains stable under these conditions.

The voltage step at T8 collector is taken via changeover contact RL1(3) on the motherboard, and applied to either T9 or T10 collector to obtain an output signal at pin 6 in correct sense to clamp the integrator. The voltage at T8 is also directly applied to the drive circuit for relay RL3/1 via pin 7, but is inverted by T11 to give appropriate polarity for the drive circuit for relay RL2/1 via pin 8.

Thus the control logic is UP & ABOVE LEVEL, or DOWN & BELOW ZERO. The ramp output is clamped at the appropriate voltage in each case and alternative outputs are obtained to operate either relay RL3/1 or RL2/1 and to light either the hold lamp or zero lamp as appropriate.

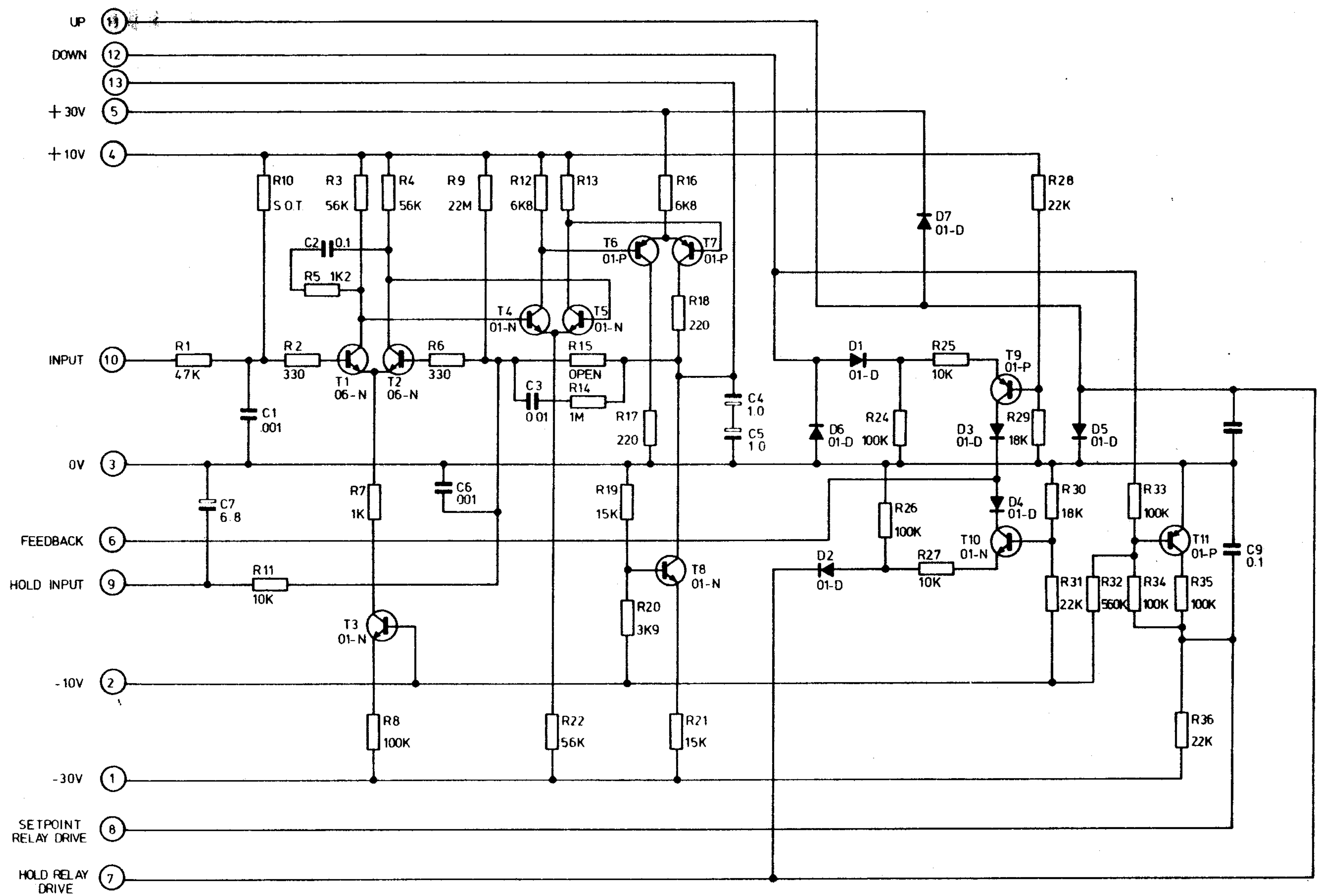
Stabilized ±10V power supplies for the comparator amplifier are obtained from the Power Supply Board via pins 4 and 2 respectively.



FOR CIRCUIT DIAGRAM SEE DRG. NO. E 93836.

P.C.B. ASSEMBLY
MK 4 LOGIC

Drg. No. D93835



Denotes P.C.B. Connector

CIRCUIT DIAGRAM
MK 4 LOGIC

Power Supply Board for Programmer 125, 127 Assembly 92667 — Circuit 3176

The power supply board provides separate +10V and −10V stabilized supplies for the programmer and auxiliary slope units, when fitted. The +10V supply is derived from the +30V line via limiting resistor R25 and series stabilizer T10. The output voltage at T10 emitter is continuously compared with a reference voltage derived from an 8.2V zener diode Z1, and the collector/emitter voltage is varied to maintain a constant output voltage regardless of load. The +10v supply in turn provides a stable reference voltage for controlling the −10v stabilized supply derived from the −30v line via limiting resistor R22 and series stabilizer T7.

Zener diode Z1 is connected in parallel with potential divider R4-R5 and in series with common resistor R1 across the +10V supply so that the potential at the junction of R4-R5 and the base of T1 is held constant at 6V with a temperature coefficient of about 2mV per degree C. Emitter-follower T1 is a buffer stage with a gain of less than unity, and has a temperature coefficient inverse to that of the zener diode. Thus the emitter potential of T1 is held stable at 4.5v with respect to the −10v line, the temperature coefficient being better than one part in 10,000 Deg.C.

This high-stability reference voltage is directly coupled to the input T2 of a comparator amplifier consisting of two directly-coupled long-tail pairs T2-T3 and T8-T9, with the output of T9 applied to the base of the series stabilizer T10. A portion of the output at T10 emitter is returned via a potential divider chain R16-P1-R17 to the second comparator input at the base of T3, and any difference between the two input voltages is amplified to vary the bias on T10 in appropriate sense to correct the error. The output voltage at T10 emitter is thus held constant, and can be precisely adjusted with potentiometer P1.

If extreme accuracy is required, mains compensation and load compensation can be provided by resistors R27 and R26. though the resistors are usually omitted since the effects are significantly less than one in a thousand. Capacitor C1 is connected across +10V supply to ensure low source impedance at high frequency, and the high-frequency stability of the comparator amplifier is improved by C5-R19, and with the base of T10 decoupled by C6.

The −10V stabilized supply is obtained in much the same way as the +10V supply, with a comparator amplifier controlling the bias on a series stabilizer T7 which is connected via limiting resistor R22 to the −30V line. A stable reference potential is obtained at the junction of potential divider R2-R3 across the +10V stabilized supply, and applied at the input T4 of a comparator amplifier consisting of a long-tail pair T4-T5 with a directly-coupled output stage T6 connected to the base of the series stabilizer T7.

A suitable proportion of the output from T7 emitter is returned via potential divider R14-P2-R15 to the second comparator input at the base of T5. Thus any difference between the two inputs is amplified to vary the bias on T7 to correct the error, and the output level can be adjusted with potentiometer P2.

Again, when extreme accuracy is needed, mains and load compensation can be provided by resistors R24 and R21. Capacitor C2 is connected across the −10v supply to achieve a low source impedance at high frequency, and the high frequency stability of the amplifier is improved with C3-R10 and the output decoupling via C4.

The stabilized supplies are preset precisely at +10.00V and −10.00V respectively, and potentiometers P1 and P2 are sealed during manufacture to ensure that the programmer will produce identical positive and negative slopes, and that the calibration of the instrument will not be affected if the power supply board is changed. Consequently, it is usually better to fit a new board than to attempt to re-adjust an existing board. However, a calibration procedure is provided in this manual for use in exceptional circumstances.

Front Assembly for Programmer 125, 127 and Auxiliary Unit 126, 128 Assembly C99538 — Circuit E99539

General

The front assembly carries the controls and indicators for the programmer. The controls consist of two thumbwheel digit switches and two press-button switches. The indicators consist of a ramp output meter and two LED lamps, and the press-buttons also have built-in LED lamps to show which press-button is activated.

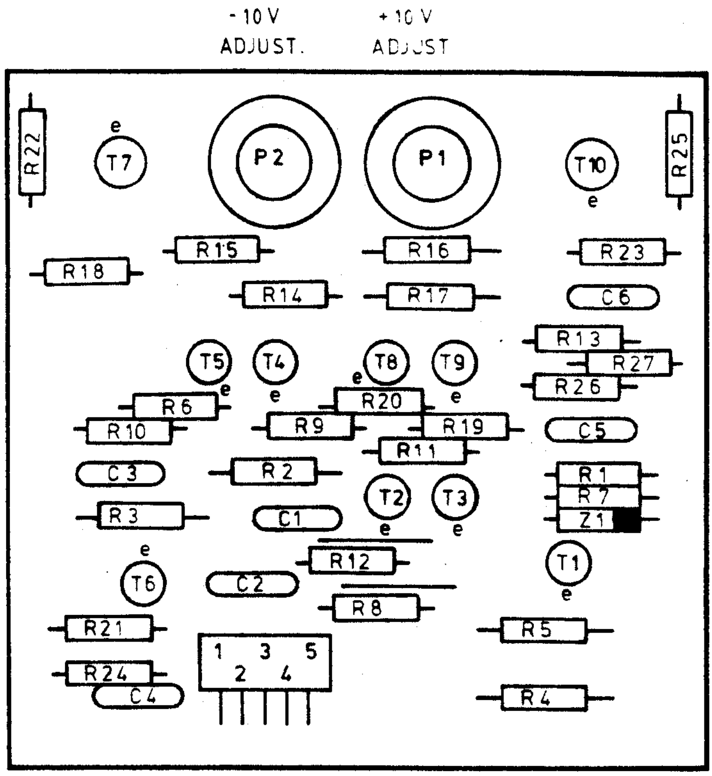
The main components are fitted in the front panel itself, while the push-button switches are fitted on a switch mounting board which also carries the LED lamps and various resistors for calibrating the slope and level switches described in the following paragraphs.

Slope Switch

The two-decade slope switch is available in three optional ranges 0-19, 0-39 and 0-99, to provide an analogue voltage output proportional to the desired ramp rate. The switch selects various tappings along a chain of nine 1k resistors in series with a parallel pair of range-dependent resistors R4 and R5 to form a potential divider across the stabilized +10V or −10V supply at pin 6. The polarity of the 10V supply is determined by the position of changeover contact RL1(2) on the motherboard, and proportionality between tens decade and the units decade is obtained with the values of R10 and R11 respectively in the inverse ratio of 1:10 in series with R15 to provide the correct output voltage at pin 8.

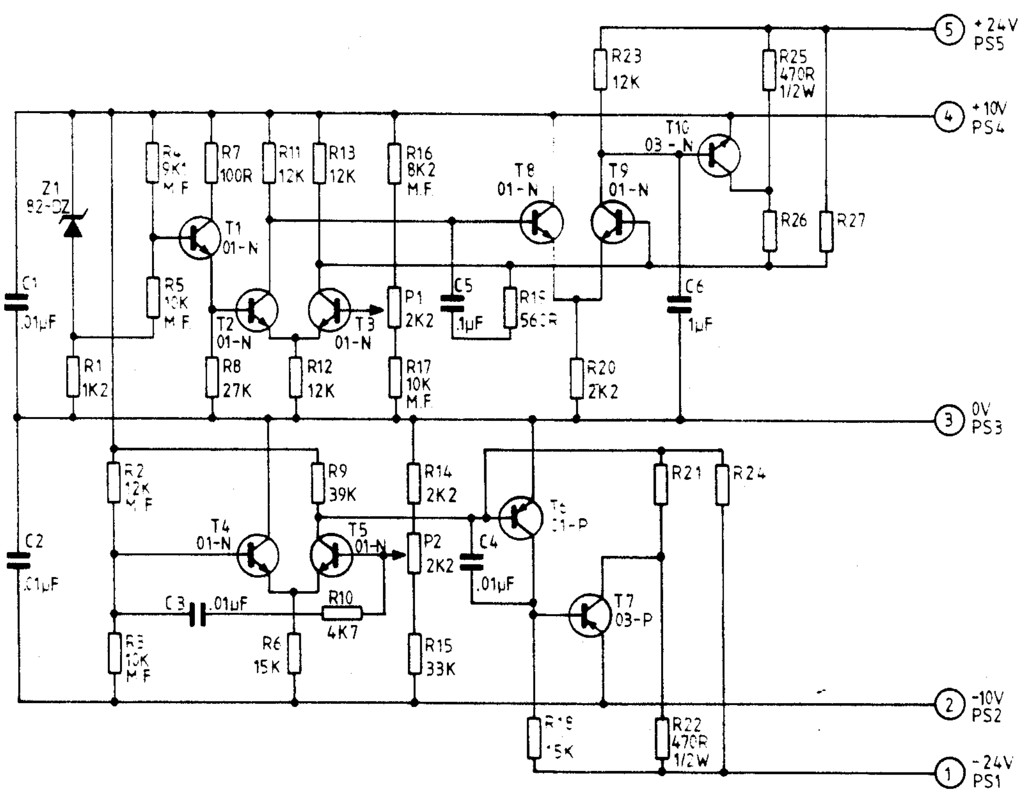
The source impedance at pin 8 should be approximately 90K ohms to match the input impedance of the buffer amplifier ICI on the integrator board. Consequently, the values of R10 and R11 must be calculated not only to give the correct summing ratio but also to have a parallel resistance below and as near to 90K ohms as possible. The value of R15 can then be selected to make up the small deficiency, if any. For example, with a 0-99 digit switch, the value of R10 and R11 would be 100K ohms and IM ohm respectively, and R15 would be a link. However, if either R10 or R11 has a slightly lower value in practice, R15 can be selected to make up the difference.

The values of the parallel pair of resistors R4 and R5 are

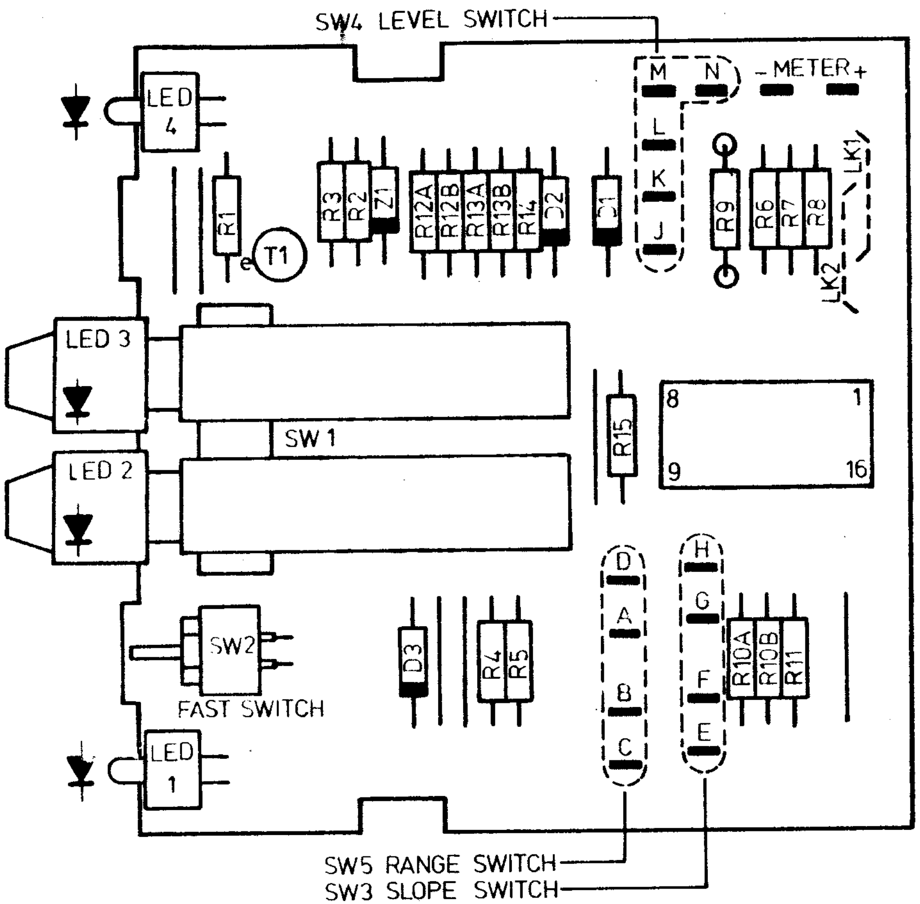


P.C.B. ASSEMBLY
POWER SUPPLY BOARD

FOR CIRCUIT DIAGRAM SEE DRG NO. D93176

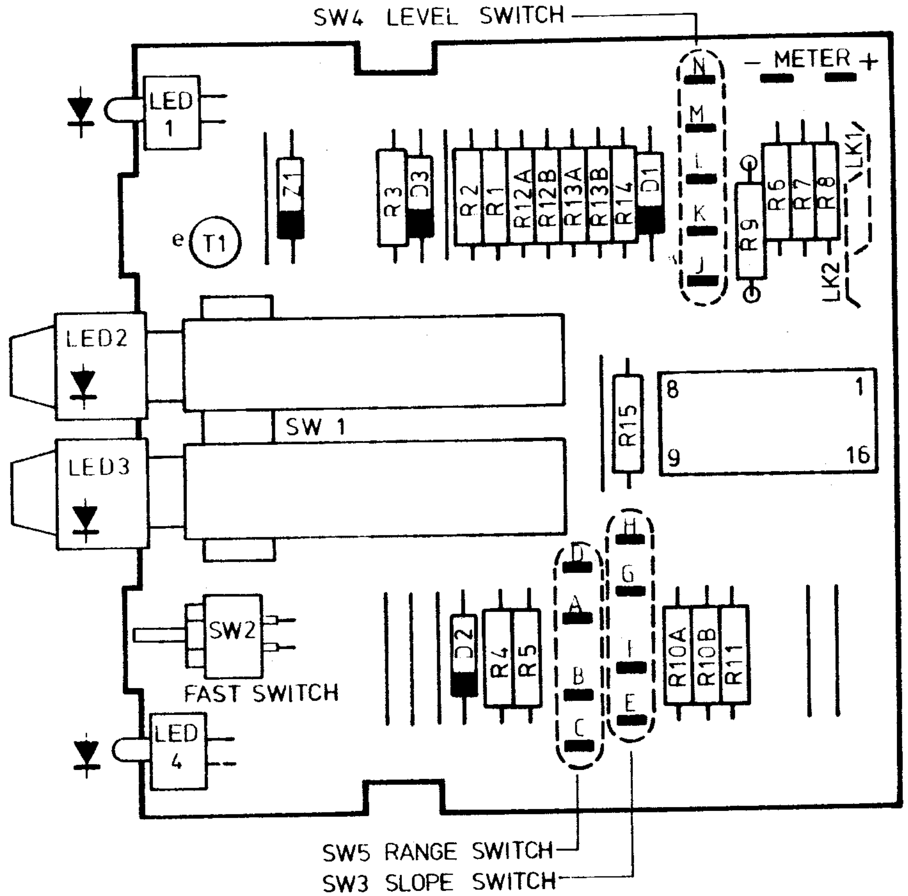


CIRCUIT DIAGRAM
PROGRAMMER Mk3
POWER SUPPLY



For circuit diagram see drg. no. E 99539

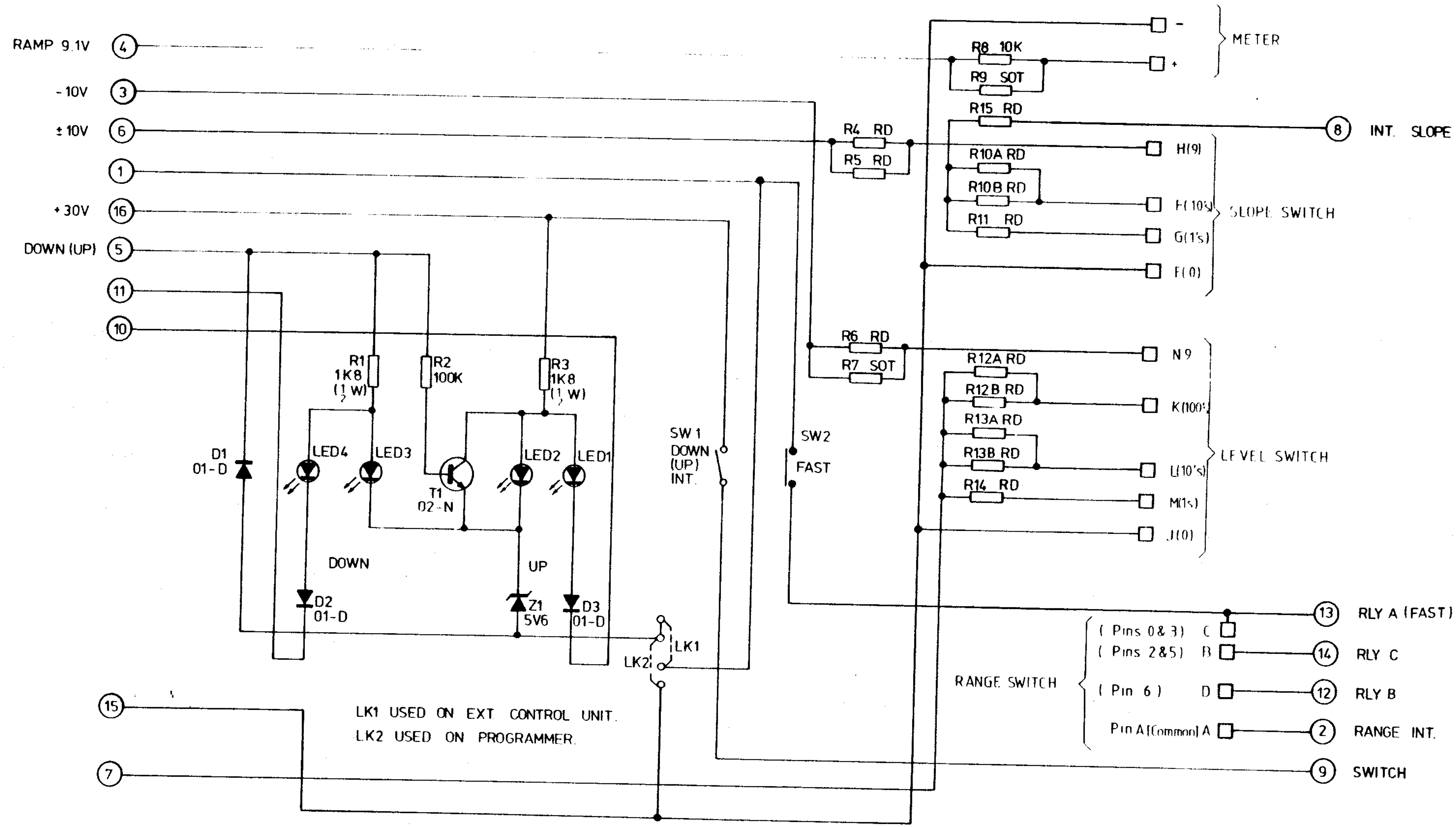
(OPTION 25)



For circuit diagram see drg no E 99539

(STANDARD)

P.C.B. ASSEMBLY SWITCH MOUNTING BD PROGRAMMER 125,



RD = RANGE DEPENDANT SEE TABLE PAGE 24

SOT = SELECT ON TEST

LED 1 & 4 ARE PART No. LAM 009

LED 2 & 3 ARE PART No. LAM 010

□ DENOTES FASTON STAKE

○ DENOTES DIL. SOCKET

Drg. No. E99539

CIRCUIT DIAGRAM
PROGRAMMER
SWITCH MOUNTING BD.

selected to provide the correct voltage Vc at the top of the digit switch chain. This voltage depends on which optional switch range is fitted, and is calculated as follows: —

$$Vc = \frac{10 \times \text{Maximum Switch Setting}}{\text{Maximum Switch Setting} + 1}$$

Thus, for the 0-99 range the maximum slope is 100, and

$$Vc = \frac{10 \times 99}{100} = 9.99V$$

Correspondingly, Vc is 9.75V for the 0-39 range, and 9.50V for the 0-19 range. Consequently the values of R4 and R5 must be selected from close-tolerance resistors to ensure that Vc is accurate to within a few millivolts.

Range Switch

The slope range selector is combined with the slope digit switch, and occupies the position that would otherwise accommodate the hundreds decade. It is available with two, three or four positions as tabulated below, and selects various ranges of ramp rate by switching the +30V (R) supply to energize appropriate reed relays on the integrator board. Up to three calibrated ranges are available together with an uncalibrated fast ramp rate for resetting the instrument.

NUMBER OF CALIBRATED RANGES	SWITCH POSITIONS	FUNCTION SELECTED
1	0 1	FAST X 1
2	3 4 5	Fast X 1 X 10
3	3 4 5 6	FAST ÷10 X1 X10

Note: An over-riding fast command for test purposes can also be obtained by pressing a small push switch on the switch mounting board. The push switch is concealed behind the facia of the instrument, and is not available for normal use.

Level switch, programmer 125 and auxiliary unit 126

The level switch is a three-decade switch available in three optional ranges 0-199, 0-399 and 0-999. It is similar in operation to the slope digit switch, and provides an analogue output voltage equivalent to the desired level. The output voltage is obtained by selecting various tappings along a chain of nine 330 ohm resistors in series with a parallel pair of range-dependent resistors R6 and R7 to form a potential divider chain across the −10V stabilized supply. Proportionality between the hundreds, tens and units decades is maintained by selecting values of R12, R13 and R14 in the corresponding inverse ratio. At the same time, the source impedance presented by the three resistors in parallel must be between 35k and 40k to match the input impedance of the comparator amplifier on the Mk4 logic board. However, the limits are reasonably wide and can be met without an extra series resistor since close-tolerance resistors are selected with nominal values of 4M, 0.4M and 40k respectively, or with slightly higher values if need be.

The values of the parallel pair of resistors R6 and R7 are selected to provide the correct voltage Vc at the top of the digit switch, depending on which optional switch range is fitted, calculated as follows: —

$$Vc = \frac{9.1 \times \text{Maximum Switch Setting}}{\text{Maximum Level Value}}$$

Thus for the 0-999 range the maximum level is 1000, and

$$Vc = \frac{9.1 \times 999}{1000} = 9.091V$$

Correspondingly, Vc will be 9.077V for the 0-399 range, and 9.055V for the 0-199 range. The voltage must be accurate to within a few millivolts, and the values of R4 and R5 are selected from close-tolerance resistors.

Level switch, programmer 127 and auxiliary unit 128

To linearise the settings of the hold level on this type of programmer and auxiliary unit which will always be in °C or °F, the resistance chain across the −10 volt supply is made up with resistors of differing values. As the hundred's digit switch is rotated the voltage across the appropriate resistor in the chain is applied across a second linear resistor chain and the ten's and unit's wipers on the switch pick off voltages on this second chain which are summed by R13 and R14 into the logic input.

Up/Down Switch

The up/down switch consists of a single make-or-break contact which is closed for a downward ramp. The switch is operated by two locking push-buttons; the lower button closes the contact and the upper button opens it. The push-buttons are mounted on a p.c.b. sub-assembly known as the switch mounting board, though it also carries various other components described below.

Switch Mounting Board

In addition to the up/down push-buttons, the switch mounting board carries parallel pairs of resistors R4-R5 and R6-R7 for adjusting the voltage applied to the slope and level switch chains respectively, together with meter calibration resistors R8 and R9, and the LED display.

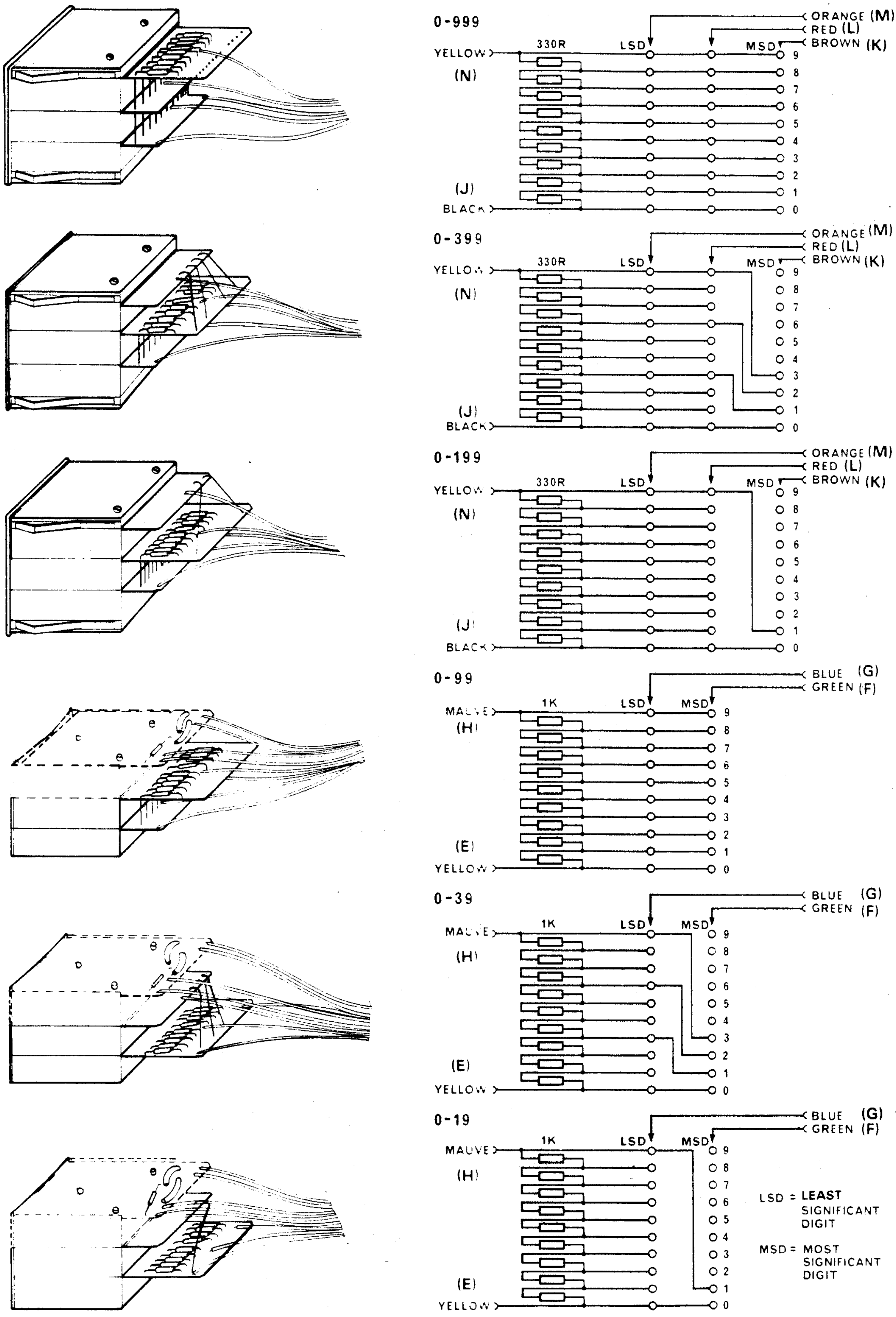
The LED display comprises four light-emitting diodes which indicate programmer functions at various stages of a programme. LED1 lights when the desired level is reached; LED2 lights when an upward ramp is in progress; LED3 lights when a downward ramp is in progress; and LED4 lights when zero or level is reached. The diodes light one at a time, with circuit interlocks to inhibit the others.

LED1 and LED2 are directly supplied from the +30V line, while LED3 and LED4 are supplied via the up/down switch. Thus LED1 and LED2 are associated with upward ramps, while LED3 and LED4 are associated with downward ramps.

At the same time, the switched +30V line to LED3 and LED4 is also taken via a series resistor R2 to the base of transistor switch T1 connected across LED2, so that LED2 will be inhibited when the up/down switch is closed.

LED1 and LED4 are separately returned to 0V via relay drivers T10 and T11 respectively, so that each diode can conduct only when the appropriate relay is energized. LED2 and LED3 share a common return to 0V via zener diode Z1 and link LK2, so that each diode can conduct only when LED1 and LED4 respectively are not conducting, and when the appropriate push-button is pressed, bearing in mind that the voltage which lights LED3 also inhibits LED2.

The operation of the circuit can best be explained by describing a typical sequence of events, as illustrated in Fig. 4. For example, if the programmer output is ramping upwards, there will be no supply to LED3 and LED4, and T1 will not be conducting. Pin 10 will remain at +30V until the desired level is reached, and only LED2 will light.



HOLD AND SLOPE SWITCH LAYOUT AND CIRCUIT DIAGRAM, PROGRAMMER 125, 127 AND AUXILIARY UNIT 126, 128 (NON KELVIN VARLEY)

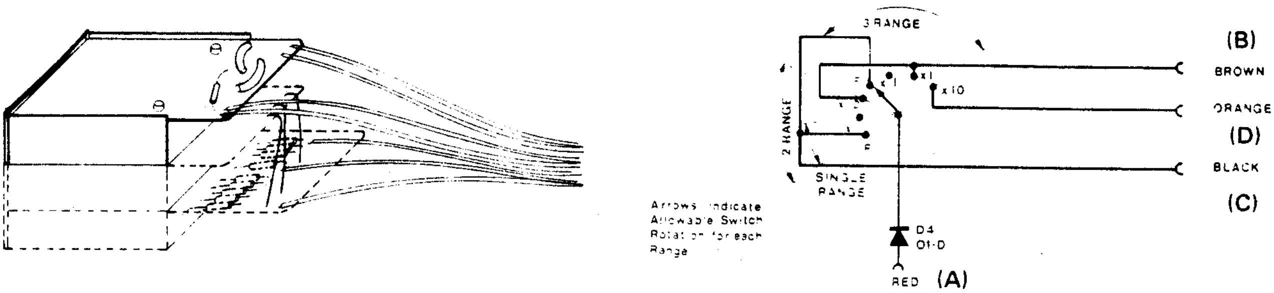
When the desired level is reached, pin 10 will fall abruptly to 0V and LED1 will conduct, producing an increased voltage drop across the common resistor R3. Consequently, the voltage across the zener diode Z1 falls below the zener threshold, and both Z1 and LED2 cease conducting, to leave only LED1 alight.

Again, when the programmer output is ramping down, the Up/down switch is closed to extend the +30V supply to LED3 and LED4, and T1 conducts to shunt LED2. Pin 11 will remain at +30V until zero is reached, and only LED3 will light.

When zero is reached, pin 11 falls abruptly to 0V, and LED4 conducts to increase the voltage drop across the common resistor R1. In consequence the voltage across the zener diode Z1 again falls below the zener threshold, and both Z1 and LED3 cease conducting to leave only LED4 alight.

Ramp Output Meter

The instantaneous ramp voltage up to a nominal maximum of 9.1V is indicated by an output meter on the front panel. The meter movement is nominally 1mA fsd, with the meter current defined by the value of R8 trimmed by R9. The meter is mechanically zeroed with zero signal input, and then calibrated at 80% of full scale deflection by selecting R9.



RANGE SELECTOR SWITCH, LAYOUT AND CIRCUIT DIAGRAM

RANGE DEPENDENT COMPONENTS FOR SLOPE SWITCHES

SWITCH RANGE	R 4 RES 030	R5 RES 030	R 10 A RES 030	R 10 B RES 030	R 11 RES 030	R 15 RES 030
1 - 19	470	OC	330K	330K	180K	4K7
2 - 39	270	1K5	150 K	560 K	390K	SC
4 - 99	100	1K	100 K	OC	IM	SC

RANGE DEPENDENT COMPONENTS FOR LEVEL SWITCH, PROGRAMMER 125 AND AUXILIARY UNIT 126.

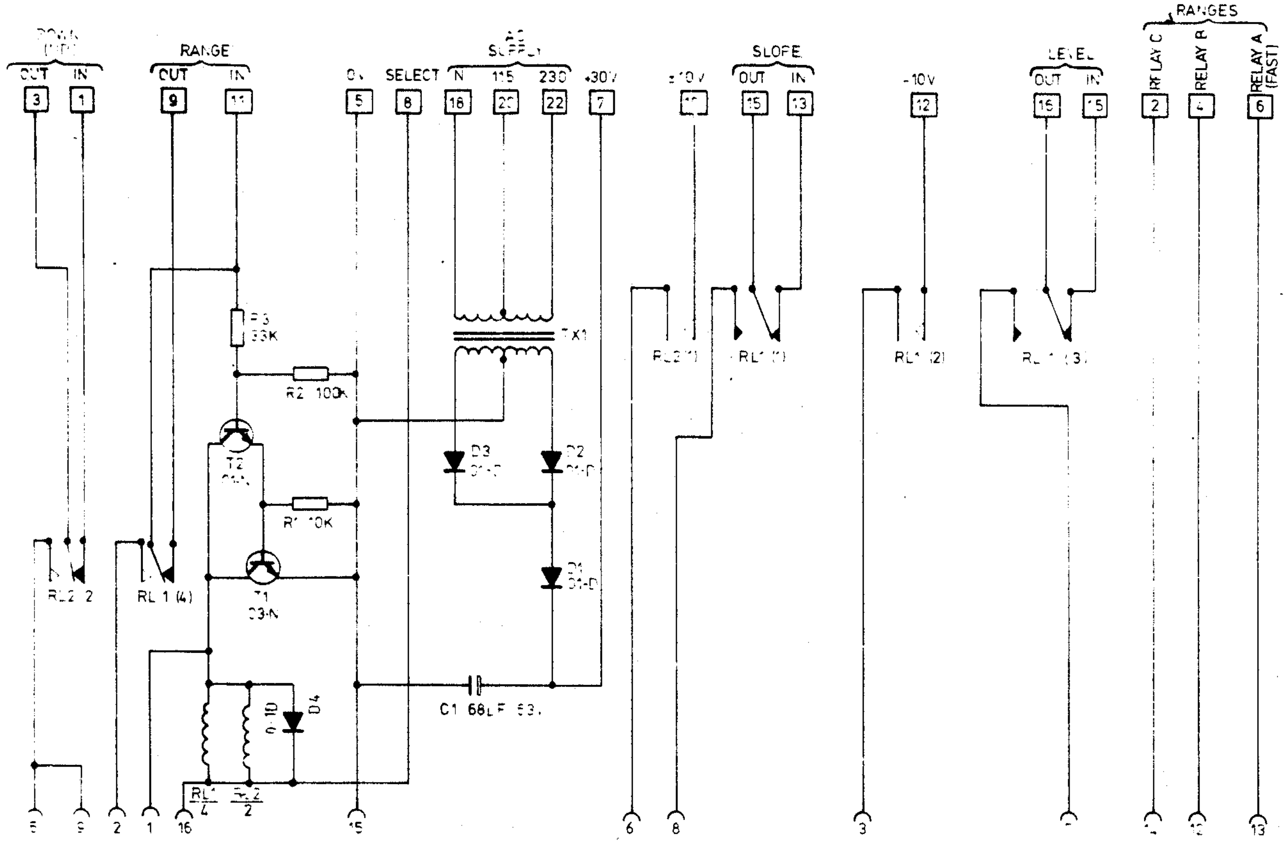
SWITCH RANGE	R 6 RES 030	R7 RES 030	R 12 A RES 030	R 12 B RES 030	R 13 A RES 030	R 13 B RES 030	R 14 RES 020
0 - 199	330	4K7	82K	680K	82 K	OC	820 K
0 - 399	330	2K	47K	IM	150K	OC	1M5
0 - 999	330	3K	39K	OC	390K	OC	3M9

Motherboard for Auxiliary Unit 126, 128. Assembly D99584—Circuit HB012834D

This board provides the relay logic circuitry for selecting the desired set point. To select this unit a 30 volt address signal is applied to terminal 8 which takes one side of both relays $\frac{RL1}{4}$ and $\frac{RL2}{2}$ to + 30 volts. To energize these relays transistors T1 and T2 must be conducting, this will only occur if there is +30 volts on terminal 11. Relay contacts RL1(4) interrupt the 30 volt ring energized from the programmer on terminal 9 and circulated through each auxiliary unit via terminals 11 and 9 to return to the programmer on terminal 11, therefore energizing the relays in any auxiliary unit inhibits any earlier unit in the chain from being addressed and likewise if another auxiliary unit further down the chain is addressed, the relay in this particular unit will be de-energized.

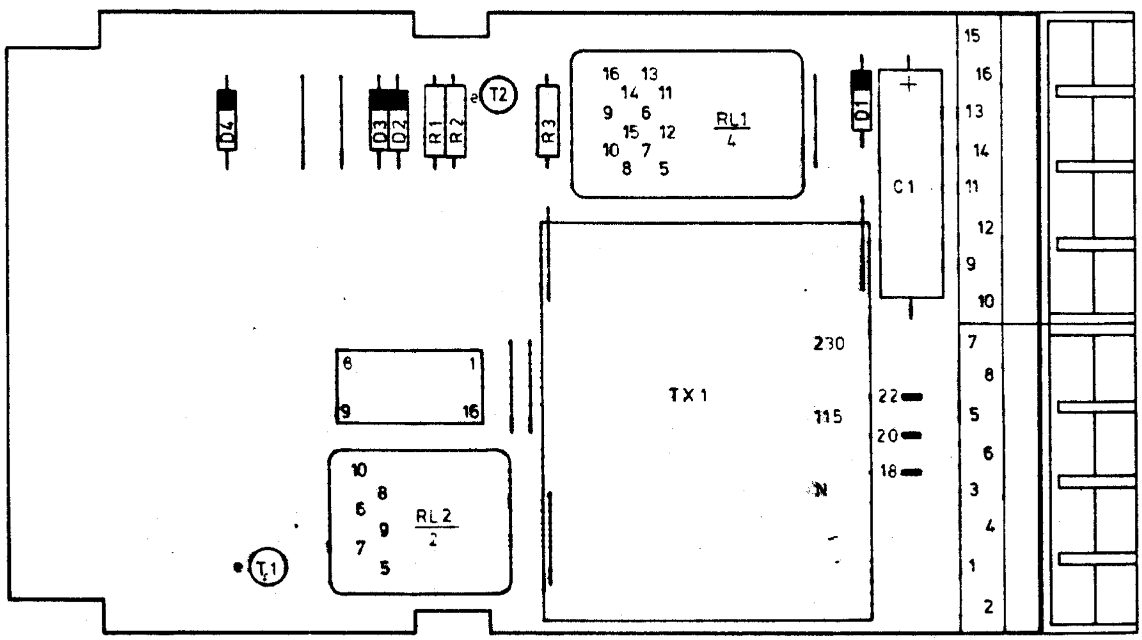
The relay contacts in the auxiliary unit connect the switches in that unit into the programmer circuits. Relay contacts RL1(4) energize the range switch in the auxiliary unit and relay contacts RL2(2) de-activates the UP/DOWN switch in the programmer and energizes the UP/DOWN switch in the auxiliary unit. Relay contacts RL2(1) supplies the correct polarity voltage to the top of the slope switch. The output from the slope switch is fed via relay contacts RL1(1) into the programmer at the same time disconnecting the output of the slope switch in the programmer. Likewise the −10 volt supply is fed via the relay contacts RL1(2) to the level switch and the output from the level switch is fed via relay contacts RL1(3) to the programmer logic input at the same time disconnecting the programmer level switch from the logic input.

Transformer TX1, diodes D1, D2, D3 and capacitor C1 are only fitted if option 78 is specified. With a.c. mains connected to the primary, the secondary of transformer TX1 provides a nominal output of 30-0-30 volts which is rectified by a full wave diode rectifier D2 and D3. The −30 volt supply is smoothed by D1-C1 and the output appears at rear terminal 7 to give an additional 30 volt relay supply if the 30 volt supply from the programmer is insufficient.



CIRCUIT DIAGRAM
AUXILIARY UNIT
MOTHERBOARD.

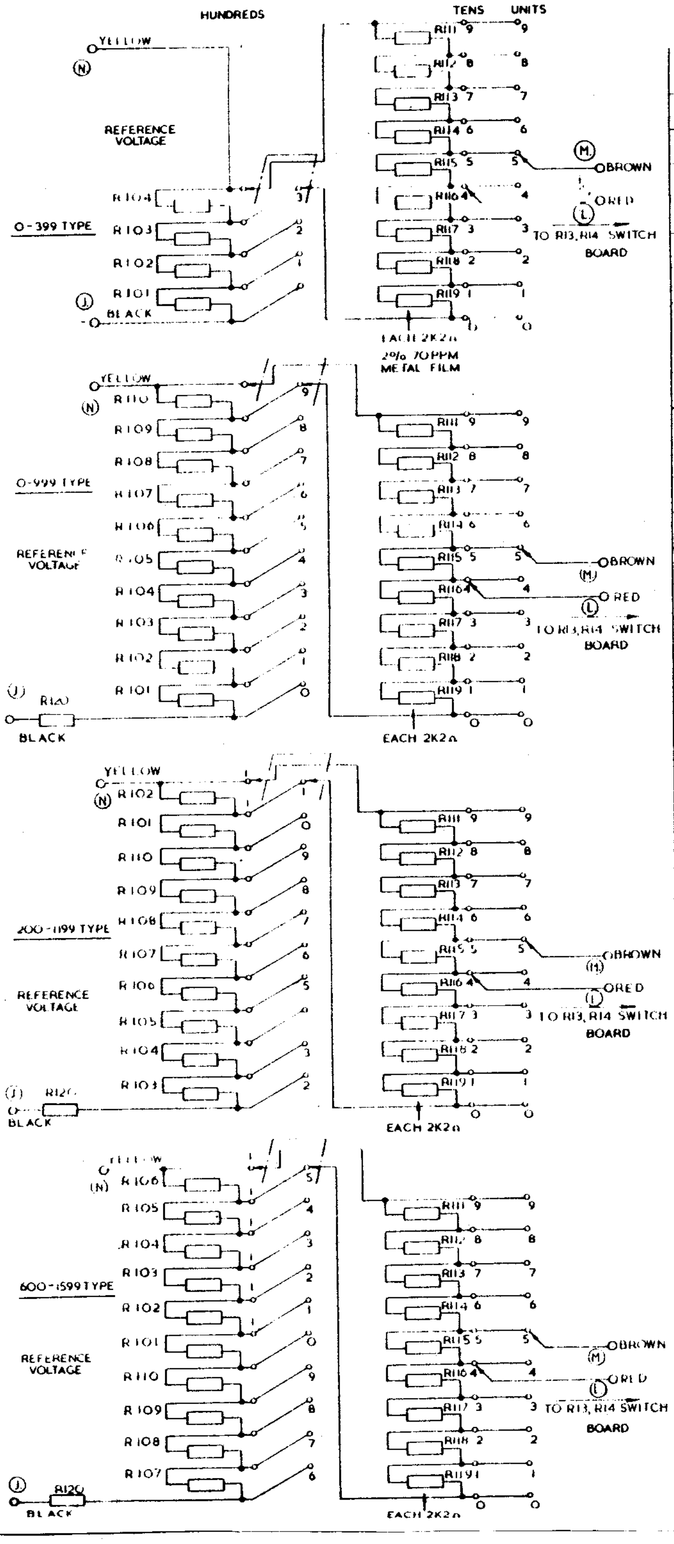
HB C12834 D



FOR CIRCUIT DIAGRAM SEE DRG E99585

P.C.B. ASSEMBLY
AUXILIARY UNIT
MOTHER BOARD

Drg. No. D99584



SENSOR & RANGE	RANGE CODE	R101	R102	R103	R104	R105	R106	R107	R108	R109	R110	CAL. BOARD RESISTORS 50PPM METAL FILM R1/0 BTM
		SWITCH RESISTORS (0·2% METAL FILM 50PPM)										
0-199°C I/C J	01-271	165·1Ω E22	172·9Ω E19	173·8Ω E18	172·9Ω E19	HUNDREDS STOPPED AT 1						LINK
0-399°C I/C J	01-272	165·1Ω E22	172·9Ω E19	173·8Ω E18	172·9Ω E19	HUNDREDS STOPPED AT 3						LINK
0-499°C I/C J	01-274	165·1Ω E22	172·9Ω E19	173·8Ω E18	172·9Ω E19	173·8Ω E18	180·7Ω E15	189·2Ω E10	199·8Ω E01	199·8Ω E01	188Ω E11	LINK
						HUNDREDS STOPPED AT 4						
0-599°C I/C J	01-275	165·1Ω E22	172·9Ω E19	173·8Ω E18	172·9Ω E19	173·8Ω E18	180·7Ω E15	189·2Ω E10	199·8Ω E01	199·8Ω E01	188Ω E11	LINK
						HUNDREDS STOPPED AT 5						
0-999°C I/C J	01-276	165·1Ω E22	172·9Ω E19	173·8Ω E18	172·9Ω E19	173·8Ω E18	180·7Ω E15	189·2Ω E10	199·8Ω E01	199·8Ω E01	188Ω E11	LINK
0-599°F I/C J	01-280	181·6Ω E14	190·6Ω E09	194·7Ω E06	198·5Ω E02	198·5Ω E02	196·7Ω E04	197·6Ω E03	196·7Ω E04	197·6Ω E03	199·8Ω E01	LINK
						HUNDREDS STOPPED AT 5						
0-999°F I/C J	01-282	181·6Ω E14	190·6Ω E09	194·7Ω E06	198·5Ω E02	198·5Ω E02	196·7Ω E04	197·6Ω E03	196·7Ω E04	197·6Ω E03	199·8Ω E01	LINK
200-1199°F I/C J	01-281	196·7Ω E04	199·8Ω E01	185·3Ω E12	189·2Ω E10	189·2Ω E10	188Ω E11	189·2Ω E10	188Ω E11	189·2Ω E10	191·4Ω E8	E40
600-1599°F I/C J	01-284	180·7Ω E15	185·3Ω E12	191·4Ω E08	197·6Ω E03	199·8Ω E01	194·7Ω E06	172·9Ω E19	170·7Ω E20	172·9Ω E19	175·1Ω E17	E40
0-399°C C/A K	03-272	192·6Ω E07	189·2Ω E10	191·4Ω E08	196·7Ω E04	HUNDREDS STOPPED AT 3						LINK
0-599°C C/A K	03-275	192·6Ω E07	189·2Ω E10	191·4Ω E08	196·7Ω E04	199·8Ω E01	199·8Ω E01	198·2Ω E02	195·5Ω E05	190·6Ω E09	185·3Ω E12	LINK
								HUNDREDS STOPPED AT 5				
0-999°C C/A K	03-276	192·6Ω E07	189·2Ω E10	191·4Ω E08	196·7Ω E04	199·8Ω E01	199·8Ω E01	198·2Ω E02	195·5Ω E05	190·6Ω E09	185·3Ω E12	LINK
200-1199°C C/A K	03-169	180·7Ω E15	175·1Ω E17	191·4Ω E08	196·7Ω E04	199·8Ω E01	199·8Ω E01	198·5Ω E02	195·5Ω E05	190·6Ω E09	185·3Ω E12	E34
0-399°K C/A K	03-273	199·8/168Ω E01	130·3Ω E31	185·3Ω E12	199·8Ω E01	HUNDREDS STOPPED AT 3						LINK
0-999°F C/A K	03-282	185·3Ω E12	194·7Ω E06	191·4Ω E08	188Ω E11	190·6Ω E09	192·6Ω E07	195·5Ω E05	198·5Ω E02	198·5Ω E02	199·8Ω E01	LINK
0-399°C Cu/Const T	04-272	144·1Ω E29	166·7Ω E21	185·3Ω E12	199·8Ω E01	HUNDREDS STOPPED AT 3						LINK
0-699°F Cu/Const T	04-281	130·3Ω E31	149·3Ω E27	159·3Ω E24	172·9Ω E19	182·7Ω E13	192·6Ω E07	199·8Ω E01	HUNDREDS STOPPED AT 6			LINK
0-999°C Pt 10% Rh - Pt S	06-276	166·7/354Ω E21/E40	141·1Ω E30	156·0Ω E25	165·1Ω E22	170·7Ω E20	176·4Ω E16	182·7Ω E13	189·2Ω E10	195·5Ω E05	199·8Ω E01	LINK
200-1199°C Pt 10% Rh - Pt S	06-169	191·4Ω E08	195·5Ω E05	144·2Ω E28	153·4Ω E26	159·3Ω E24	165·1Ω E22	170·7Ω E20	176·4Ω E16	181·6Ω E14	188Ω E11	E33
600-1599°C Pt 10% Rh - Pt S	06-170	191·4Ω E08	195·5Ω E05	199·8Ω E01	199·8Ω E01	198·5Ω E02	195·5Ω E05	170·7Ω E20	176·4Ω E16	181·6Ω E14	188Ω E11	E36
0-999°C Pt 13% Rh - Pt R	05-276	100R	388/189·2Ω E38/E10	144·2Ω E28	156·0Ω E25	165·1Ω E22	172·9Ω E19	180·7Ω E15	188Ω E11	194·7Ω E06	199·8Ω E01	LINK
200-1199°C Pt 13% Rh - Pt R	05-169	188Ω E11	192·6Ω E07	130·3Ω E31	141·1Ω E30	149·3Ω E27	156·0Ω E25	163·5Ω E23	170·7Ω E20	176·4Ω E16	182·7Ω E13	E32
600-1599°C Pt 13% Rh - Pt R	05-170	188Ω E11	192·6Ω E07	195·5Ω E05	199·8Ω E01	199·8Ω E01	195·5Ω E05	163·5Ω E23	170·7Ω E20	176·4Ω E16	182·7Ω E13	E35
600-1599°C Pt 20% Rh - Pt 5% Rh (JMC)	07-170	172·9Ω E19	181·6Ω E14	190·6Ω E09	196·7Ω E04	199·8Ω E01	199·8Ω E01	130·3Ω E31	141·1Ω E30	149·3Ω E27	163·5Ω E23	E37
600-1599°C Pt 30% Rh - Pt 6% Rh B	08-170	163·5Ω E23	175·1Ω E17	185·3Ω E12	191·4Ω E08	196·7Ω E04	199·8Ω E01	144·2Ω E28	149·3Ω E27	198·5Ω E02	153·4Ω E26	O/C
800-1799°C Pt 30% Rh - Pt 6% Rh B	08-277	163·5Ω E23	173·5Ω E18	182·7Ω E13	190·6Ω E09	195·5Ω E05	198·5Ω E02	199·8Ω E01	198·5Ω E02	141·1Ω E30	153·4Ω E26	560K
1000-1999°C W W 26% Re (ENGELHARD)	11-192	199·8Ω E01	195·5Ω E05	185·3Ω E12	176·4Ω E16	170·7Ω E20	163·5Ω E23	159·3Ω E24	153·4Ω E26	149·3Ω E27	144·2Ω E28	7K
0-99·9°C RT	70-270	199·8Ω E01	199·8Ω E01	198·5Ω E02	198·5Ω E02	197·6Ω E03	196·7Ω E04	196·7Ω E04	195·5Ω E05	195·5Ω E05	194·7Ω E06	LINK
0-199°C RT	70-271	400Ω E37	388Ω E38	376Ω E39	354Ω E40	HUNDREDS STOPPED AT 1						LINK
0-399°C RT	70-272	400Ω E37	388Ω E38	376Ω E39	354Ω E40	HUNDREDS STOPPED AT 3						LINK
0-999°C RT	70-276	199·8Ω E01	194·7Ω E06	188Ω E11	181·6Ω E14	176·4Ω E16	170·7Ω E20	163·5Ω E23	159·3Ω E24	153·4Ω E26	144·2Ω E28	LINK
0-999°F RT	70-282	199·8Ω E01	196·7Ω E04	192·6Ω E07	189·2Ω E10	188Ω E11	182·7Ω E13	180·7Ω E15	176·4Ω E16	172·9Ω E19	170·7Ω E20	LINK
0-399°C RT 130Ω AT 0°C	71-272	400Ω E37	388Ω E38	376Ω E39	354Ω E40	HUNDREDS STOPPED AT 3						LINK

NOTE:
R/T'S ARE ALL 100Ω AT 0°C TO B.S. 1904 AND DIN 43760 UNLESS NOTED

Hold switch circuit (Kelvin Varley), programmer 127 and auxiliary unit 128

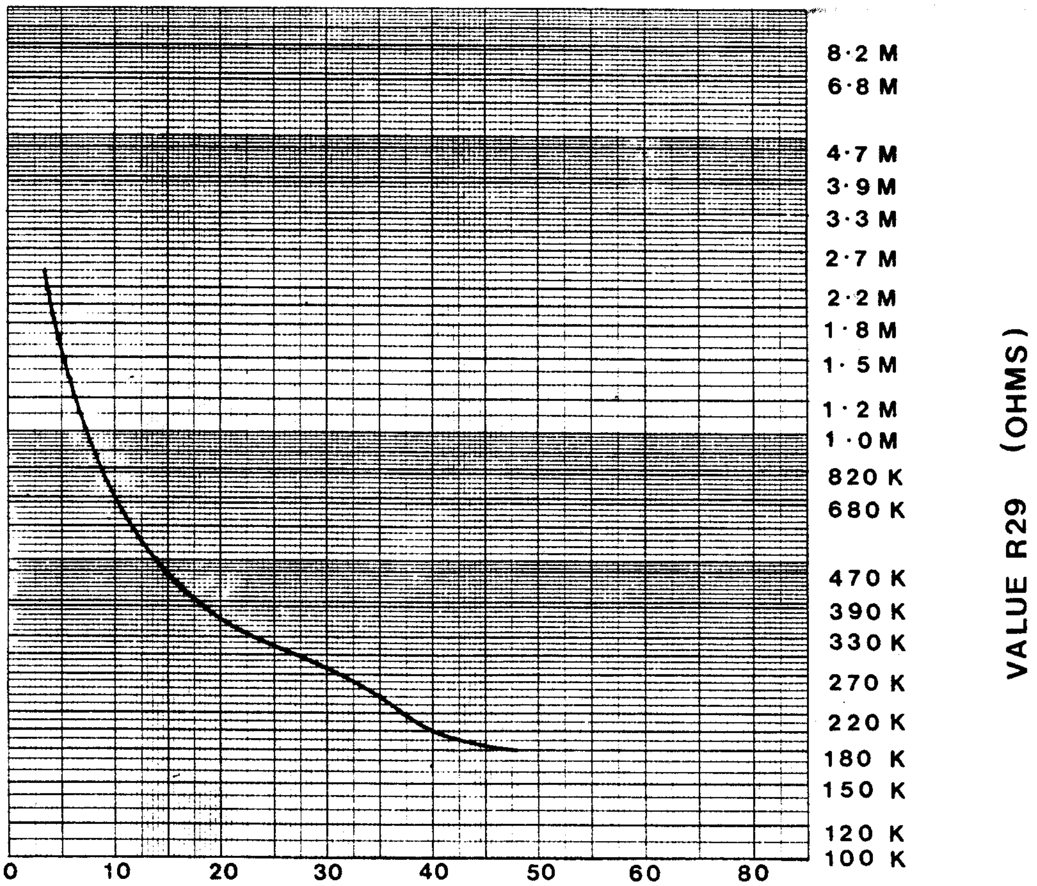


Fig. 5. Value of R29 to Null Voltage Drift

Calibration Procedures

Integrator and Relay Drive Board

Caution

Components associated with the high-impedance input to the integrating amplifier must be treated with care, and handled with tweezers not the fingers. Before changing any component, a short jumper with crocodile clips should be connected from the 0V line to the junction of R16-R20 to prevent any static charge on the fingers from damaging IGFET T1. No attempt should be made to change T1, unless full test facilities are available, the board should be returned to Eurotherm for recalibration if necessary. Indeed, even when suitable test facilities are available, to work on this sensitive part of the circuit, it would probably be more satisfactory to return the board to Eurotherm.

Offset Adjustment on Integrator Board

Extension leads should be made up with sufficient length to permit the Integrator Board to be placed in an oven while operationally connected to the instrument. A digital voltmeter with the L.S.D. in millivolts and with a span greater then 50 millivolts is required to measure the drift.

Connect a 10 ohm resistor across the integrator capacitor C7, joining the connection to the junction of R33, R37, R38 and C9 first. Connect the digital voltmeter onto the 9.1 volt ramp output, pin 3 on the integrator board and the 0 volt line, pin 8 on the integrator board. R.29 must be left open circuit.

1) Set the range selection to FAST, press the Datum and wait until the ramp voltage is stable.

2) Null any offset voltage that exists with potentiometer P1.
   Note: In exceptional circumstances the range of P1 can be altered by changing the value of R24.

3) Place the board in an oven set at 20°C above ambient temperature. Note the direction and amount of any drift that occurs while the board remains in the oven for one hour.

4) Allow the board to cool to ambient temperature.

5) For drifts in a positive direction make link LK1 and for drifts in a negative direction make link LK2. Insert a resistor in the position of R29, its value can be determined from Fig.5 knowing the amount of drift.

6) After 1 hour at ambient temperature readjust P1 then repeat 3 to 5 until there is negligible drift.

7) Remove the 10 ohm resistor from across C7 removing the connection to the junction of R16, R17, R18, R19 and R20 first.