SMITHS INDUSTRIES

Aerospace & Defence Systems

PRODUCT SUPPORT
Hounslow TW6 2LW

Northolt Road, Heathrow Airport–London,
Telephone: 01-759 9121 Telex 25662

GROUND EQUIPMENT MANUAL

for

4001KTQ-1 SPEED, TEMPERATURE AND BLEED VALVE TEST SET

4002KTQ-1 SPEED AND TEMPERATURE TEST SET

Failure to follow the applicable instructions given in this publication as amended from time to time by SMITHS INDUSTRIES revisions may endanger safety.

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SMITHS INDUSTRIES

AEROSPACE & DEFENCE SYSTEMS COMPANY

GROUND EQUIPMENT MANUAL

4000KTQ Series

TEST SET

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CHAPTER 1

GENERAL INFORMATION AND OPERATING INSTRUCTIONS

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MODIFICATIONS

1. General

When modifications are introduced on units covered by this manual, the text will be revised to cover the latest modification state. The modifications will be listed below together with a statement on whether the overhaul information is affected when any modification is not embodied. When overhaul is affected, the list will cross-refer to details.

Modification No	Service Bulletin or Modification Sheet No	Codes Effected	Brief Description of Modification
BRS 248	-	4001KTQ-1	Change of function of BV Indicators
01	-	4001KTQ-1	
02	4000KTQ-SER-02	4001KTQ-1 4002KTQ-1	Ruggedisation of chassis
03	4000KTQ-SER-03	4001KTQ-1 4002KTQ-2	Noise immunity improvement

NOTE: The Basingstoke Repair Scheme is abbreviated BRS

CHAPTER 1

GENERAL INFORMATION AND OPERATING INSTRUCTIONS

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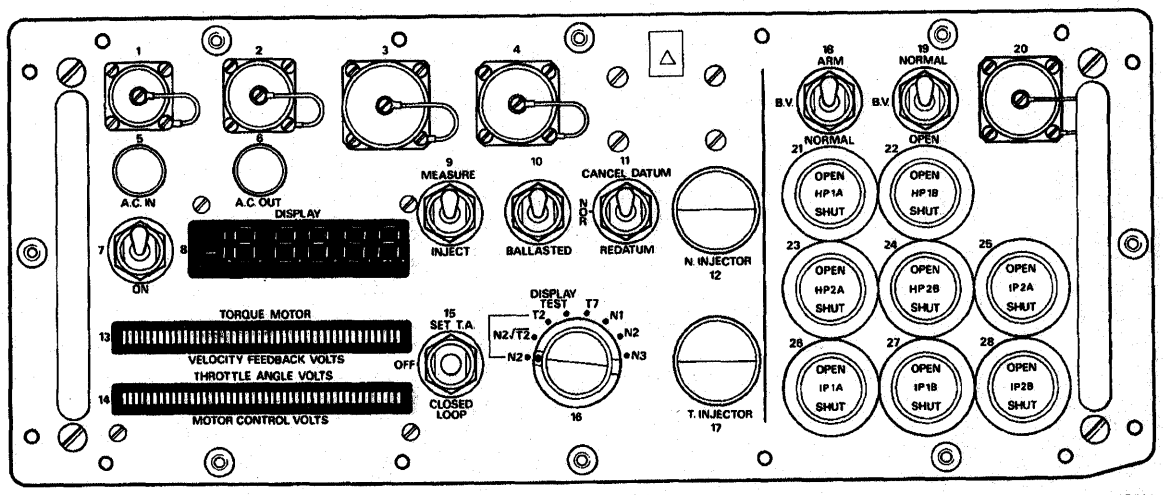
DESCRIPTION

1. General

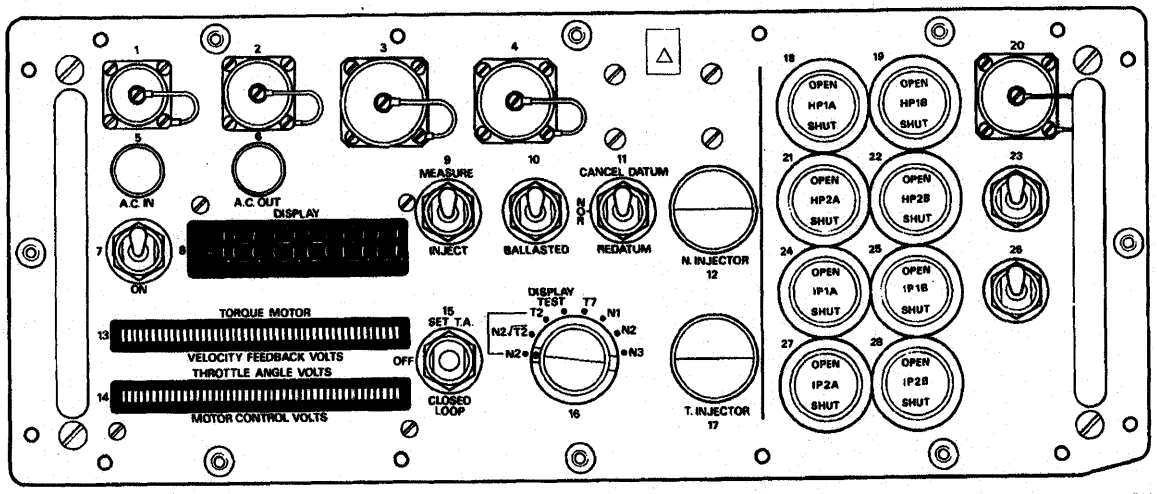
The Test Sets covered by this manual provide for high accuracy testing of various functions of Rolls Royce RB211 engines under static or running conditions. The 4001 KTQ-1 test sets incorporating BRS 248, (Figure 1 refers) and the 4001 KTQ-1 test sets at Mod 01, shown in Figure 2, accurately test speed, temperature and fuel control unit functions of the RB211-22, RB211-524 and RB211-535 engines. The Test Sets also incorporate controls to facilitate the checking of the bleed valve control unit fitted to the RB211-535 engine.



Front Panel 4001 KTQ-1 to BRS 248
Figure 1

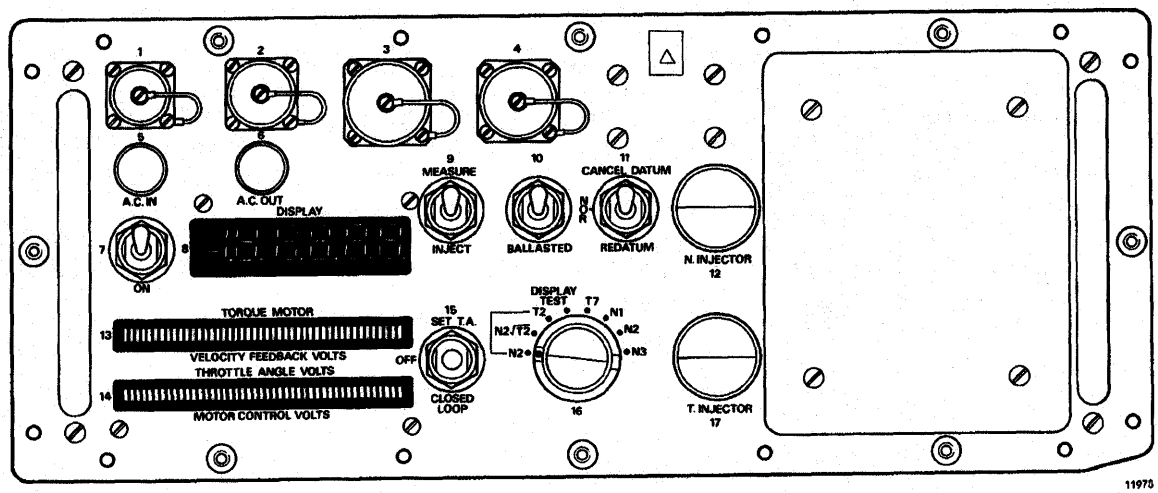
The 4002 KTQ-1, referred to in Figure 3, accurately tests speed, temperature and fuel control unit functions of the RB211-22 and RB211-524 engines.

Since the Test Sets are completely portable, testing may be performed under in-situ or engine test bed conditions provided that a 115 V 400 Hz single phase supply with an earth is available.



Front Panel 4001-1 to Mod 01
Figure 2

Interconnecting cables and carrying cases for the cables are provided as accessories for the Test Sets. Table 1 gives the quantity and type of cables and carrying case used on the Test Sets for various engine applications. When carrying out tests ensure that the correct cables are used for each engine application as the cables re-configure the Test Set, displays the aircraft type on the digital indicator and gives the correct voltage readout on the bar displays. The main test cables for the RB211-22 and RB211-524 engines cause the bar displays to read velocity feedback volts and motor control volts. The main test cables for the RB211-535 engine causes the bar displays to read torque motor volts and throttle angle volts.



Front Panel 4002 KTQ-1
Figure 3

The Test Sets may be used in conjunction with Smiths EPR Test Sets 3204 KTQ-1 or 3205 KTQ-1 to provide comprehensive engine parameter testing.

TABLE 1
Test Set Accessories

TYPE	CABLE DESCRIPTION	TEST SET/ENGINE	
		4001 KTQ-1	4002 KTQ-1
		RB211-22/-524, RB211-535	RB211-22/-524
0101 KCQ-20	POWER SUPPLY	1	
0101 KCQ-40	POWER SUPPLY	1	1
0103 KCQ-20 (Mod 01)	MAIN TEST	1	
0106 KCQ-40	MAIN TEST	1	1
0104 KCQ-20	THERMOCOUPLE	1	
0107 KCQ-40	THERMOCOUPLE	1	1
0105 KCQ-20	BVCU	1	
BTE 3167	CARRYING CASE	1	
BTE 3168	CARRYING CASE	1	1

2. Detailed

The front panels of the Test Sets, shown in Figures 1, 2, and 3, carry all the controls and indicator equipment, the identification and functions are shown in Table 2. The front panel and all connectors, switches, controls and meters mounted on it are sealed to prevent ingress of moisture. Each item/control on the panel is referenced with a number marked in red for ease of identification. The descriptions in this chapter include the panel reference number in parenthesis. The functions detailed in Table 2 apply to both Test Sets for all three RB211 engine applications unless otherwise stated.

Wiring diagrams for both the 4001 KTQ-1 and 4002 KTQ-1 are provided in Figures 6 and 7 respectively.

TABLE 2
Front Panel Components

Panel Ref.	Identification	Function
1.	Power Connector	Connector, 6-way, permitting 115 V 400 Hz power supply input.
2.	Auxiliary Power	Connector, 3-way, permitting power to be taken via the test set to power EPR test sets.
3.	Test Connector	Connector, 26-way, permitting inputs from aircraft for fuel flow regulator torque motor and throttle lever angle voltages and inspection of simulated engine speed signals, except N2. Function applicable to 4001 KTQ-1 for RB211-535 engine.
3.	Test Connector	Connector, 26-way, permitting inputs from aircraft for engine speed velocity feed back and motor control voltages and inspection of simulated engine speed signals. Function applicable to 4001 KTQ-1 and 4002 KTQ-1 for RB211-22/-524 engines.
4.	Thermocouple Connector	Connector, 19-way, allows for monitoring of engine thermocouple inputs and inspection of simulated temperature signals.
5.	AC IN	Fuse 1A, power input.
6.	AC OUT	Fuse 1A, power output.
7.	Power Switch	Switch, 2 position, controlling power supply input.
8.	Display	Digital indicator having a five digit readout. Display function selected by switch 16.

Continued ...

Panel Ref.	Identification	Function
9.	Test Mode	Switch, 2 position, selecting mode of operation of function selected on function switch (16) to either inject or measure.
10.	Ballasted (TGT)	Switch, 2 position, permits selection of ballasted TGT.
11.	Datum Select	Switch, 3 position, providing datum select/reset for fuel control system.
12.	Speed Signal Injector	Potentiometer controlling frequency of N1 and N2 inject oscillator.
13.	Torque Motor	D.C. voltmeter monitoring fuel flow regulator torque motor voltage. Function applicable to 4001 KTQ-1 for RB211-535 engine.
13.	Velocity Feedback Volts	D.C. voltmeter monitoring fuel flow regulator tachometer voltage. Function applicable to 4001 KTQ-1 and 4002 KTQ-1 for RB211-22/-524 engines.
14.	Throttle Angle Volts	A.C. voltmeter for monitoring the throttle lever angle voltage. Function applicable to 4001 KTQ-1 for RB211-535 engine.
14.	Motor Control Volts	A.C. voltmeter for monitoring fuel flow regulator motor voltage and phase sense. Function applicable to 4001 KTQ-1 and 4002 KTQ-1 for RB211-22/-524 engines.
15.	Throttle Angle/ Closed Loop	Switch, 3 position, used on 4001 KTQ-1 to: (i) Enable datum to be set for Throttle Lever Angle, and (ii) Allow closed loop testing to be carried out on the engine. Not operative on 4002 KTQ-1.

Continued ...

Panel Ref.	Identification	Function
16.	Function Switch	Switch, 8 position, permitting selection of test facilities.
17.	T Injector	Potentiometer controlling simulated temperature signal to engine system.
	The following panel references items 18 to 28 apply to Test Set 4001 KTG-1 incorporating BRS 248 only	
18. and 19.	Toggle Switches	These two switches have no function but are present to fulfil any future technical requirement.
20.	Bleed Valve Connector	Connector, 19 way, permitting inputs from the engine bleed valve circuits, and the simulated engine speed signal (N2), to the test set.
21. to 28.	Indicator/Switch	Bleed valve solenoid state indicators combined with switches to energise the specific bleed valve, the reference of which is engraved on the cap of each Indicator/Switch.
	The following panel references 18 to 28 apply to Test Set 4001 KTQ-1, Mod 01 only.	
18., 19., 21., 22., 24., 25., 27. and 28.	Indicator/Switch	Bleed valve solenoid state indicators combined with switches to energise the specific bleed valve, the reference of which is engraved on the cap of each Indicator/Switch.
20.	Bleed Valve Connector	Connector, 19 way, permitting inputs from engine bleed valve circuits, and the simulated engine speed signal (N2) to the Test Set.
23 and 26		These two toggle switches have no function, but are present to fulfil any future technical requirements
	Panel references 18 and 28 functions are applicable to Test Set 4001 KTQ-1 for RB211-S35 engines.	

Inside the Test Set is mounted the processor board, solar cell panel, display board, compensation assembly, bleed valve control unit board (4001 KTQ-1 only) and the associated power supplies to perform the Test Set functions shown in Tables 3 and 4. The functions include measurement of selected engine parameters and injection of voltages into aircraft systems to simulate turbine speed probes and thermocouple exhaust gas signals. In addition, the 4001 KTQ-1 Test Set for the RB211-535 engine application will display compressor inlet temperature, IP shaft speed in RPM (N2) and will compute and display the ratio $N2\sqrt{T2}$. Also for this application the state of the IP and HP bleed valve solenoid are displayed on individual split indicators, which provide the facility of switching the individual solenoids from de-energised to the energised state. The Test Set can also be used to de-energise all six IP solenoids simultaneously and provides a switching facility to inhibit the Bleed Valve Control Unit (BVCU) safety circuit.

TABLE 3
Functions and Ranges applicable to 4001 KTQ-1 for RB211-535 Engines

Function	Measurement in terms of	Adjustment	Range
Torque Motor Volts	Volts d.c.	-	0 - 4
Throttle Angle Volts	Volts a.c.	-	0 - 4
Inject N1	Percentage Speed	N Injector (12)	15 - 115
Inject N2	Percentage Speed	N Injector (12)	50 - 120
Inject N2	R.P.M.	-	1750 - 8400
Measure N1	Percentage Speed	-	15 - 115
Measure N2	Percentage Speed	-	25 - 120
Measure N2	R.P.M.	-	1750 - 8400
Measure N3	Percentage Speed	-	50 - 110
Measure T7	Degrees Celsius (°C)	-	350 - 1000
Measure T2	Degrees Celsius (°C)	-	-54 - +120
Inject T7	Degrees Celsius (°C)	T Injector (17)	350 - 1000
Inject T2	Degrees Celsius (°C)	T Injector (17)	-54 - +120

TABLE 4
Functions and Ranges applicable to 4001 KTQ-1 and 4002 KTQ-1 for RB211-22 and RB211-524 Engines

Function	Measurement in terms of	Adjustment	Range
Velocity Feedback Volts	Volts d.c.	-	4 - 0 - 4
Motor Control Volts	Volts a.c.	-	120 - 0 - 120
Inject N1	Percentage Speed	N Injector (12)	50 - 110
Inject N2	Percentage Speed	N Injector (12)	60 - 120
Measure N1	Percentage Speed	-	15 - 110
Measure N2	Percentage Speed	-	25 - 120
Measure N3	Percentage Speed	-	50 - 110
Measure T7	Degrees Celsius (°C)	-	350 - 1000
Inject T7	Degrees Celsius (°C)	T Injector (17)	350 - 1000

Readout of test parameters, except torque motor voltage/velocity feedback volts and throttle angle volts/motor control volts, are by means of the digital display (8) which displays in actual terms so that no errors can be incurred as a result of conversion or decimal point estimation. TORQUE MOTOR/VELOCITY FEEDBACK VOLTS (13) and THROTTLE ANGLE/MOTOR CONTROL VOLTS (14) are displayed on analogue LED bar displays.

3. Method of Operation

A programmable oscillator is used to provide the simulated speed signals, their nominal frequency being determined by the setting of the Functional Switch (16) and the specific frequency being set by Speed Signal Injector (12).

The signals are received from and supplied to the Limiter Amplifier via an isolation transformer. The measurement of the speed signals is achieved by a pulse counting technique.

The simulated temperature signal is generated from a stable d.c. source, cold junction temperature compensated and characterised to match the thermocouple law. These signals are isolated from the speed signals and the power input supply.

The temperature measuring circuit uses a high input impedance d.c. amplifier, a D to A converter and comparator circuit.

Cold junction compensation is achieved by a temperature sensing circuit which develops a voltage proportional to the temperature of the 'cold junction'.

The speed and temperature parameters that can be monitored by the Test Sets are those determined by the position of the Function Switch (16). The N2 adjacent to N2$\sqrt{T2}$ and T2 positions of Function Switch (16) are only used on the 4001 KTQ-1 Test Set for RB211-535 engine applications. The remaining positions apply to both Test Sets for all three RB211 engine applications.

The functions performed by the Test Sets for each position of Function Switch (16) are as follows:

N2

In the first position of N2, adjacent to N2$\sqrt{T2}$ position, with the Test Mode switch (9) in the MEASURE position, the IP compressor shaft speed N2 is displayed in RPM by the panel meter (8). With the Test Mode switch (9) in the INJECT position, a simulated N2 signal is generated across pins T and U of the Test Connector (20) and the simulated speed is displayed in RPM by the panel meter (8). The frequency of the signal is adjusted by the N INJECTOR (12).

N2$\sqrt{T2}$

In this position the ratio of N2$\sqrt{T2}$ is computed and displayed by the panel meter (8). With the Test Mode switch (9) in the INJECT position, the ratio can be changed by adjusting the frequency of the simulated N2 signal using the N INJECTOR (12) or by adjusting the simulated T2 signal using the T INJECTOR (17).

T2

In this position, with the Test Mode switch (9) in the MEASURE position, the IP compressor inlet temperature T2 is displayed in degrees celsius (sonic corrected) by the panel meter (8). With the Test Mode switch (9) in the INJECT position, a simulated T2 signal is generated across pins A and B of Thermocouple Connector (4) and the simulated temperature is displayed in degrees celsius by the panel meter (8). The magnitude of the signal is adjusted by using the T INJECTOR (17).

Display Test

When switched to this position the displays of the panel meter (8) and the bar display meters (13) and (14) are energised to demonstrate they are functioning. Switching from this position, a limited self check is carried out and, in the event of a fault, the panel meter (8) will display an error message.

T7

In this position, with the Test Mode switch (9) in the MEASURE position, the turbine gas temperature T7 is displayed in degrees celsius by the panel meter (8). With the Test Mode switch in the INJECT position a simulated T7 signal is generated across pins D and E of the Thermocouple Connector (4) and the simulated temperature displayed in degrees celsius by the panel meter (8). The magnitude of the simulated signal is adjusted by the use of the T INJECTOR (17).

N1

In this position, with the Test Mode switch (9) in the MEASURE position, the LP compressor shaft speed N1 is displayed as a percentage by panel meter (8). With the Test Mode switch (9) in the INJECT position a simulated N1 signal is generated across pins a and b of the Test Connector (3) and the simulated speed displayed as a percentage by panel meter (8). The frequency of the signal is adjusted by the N INJECTOR (12).

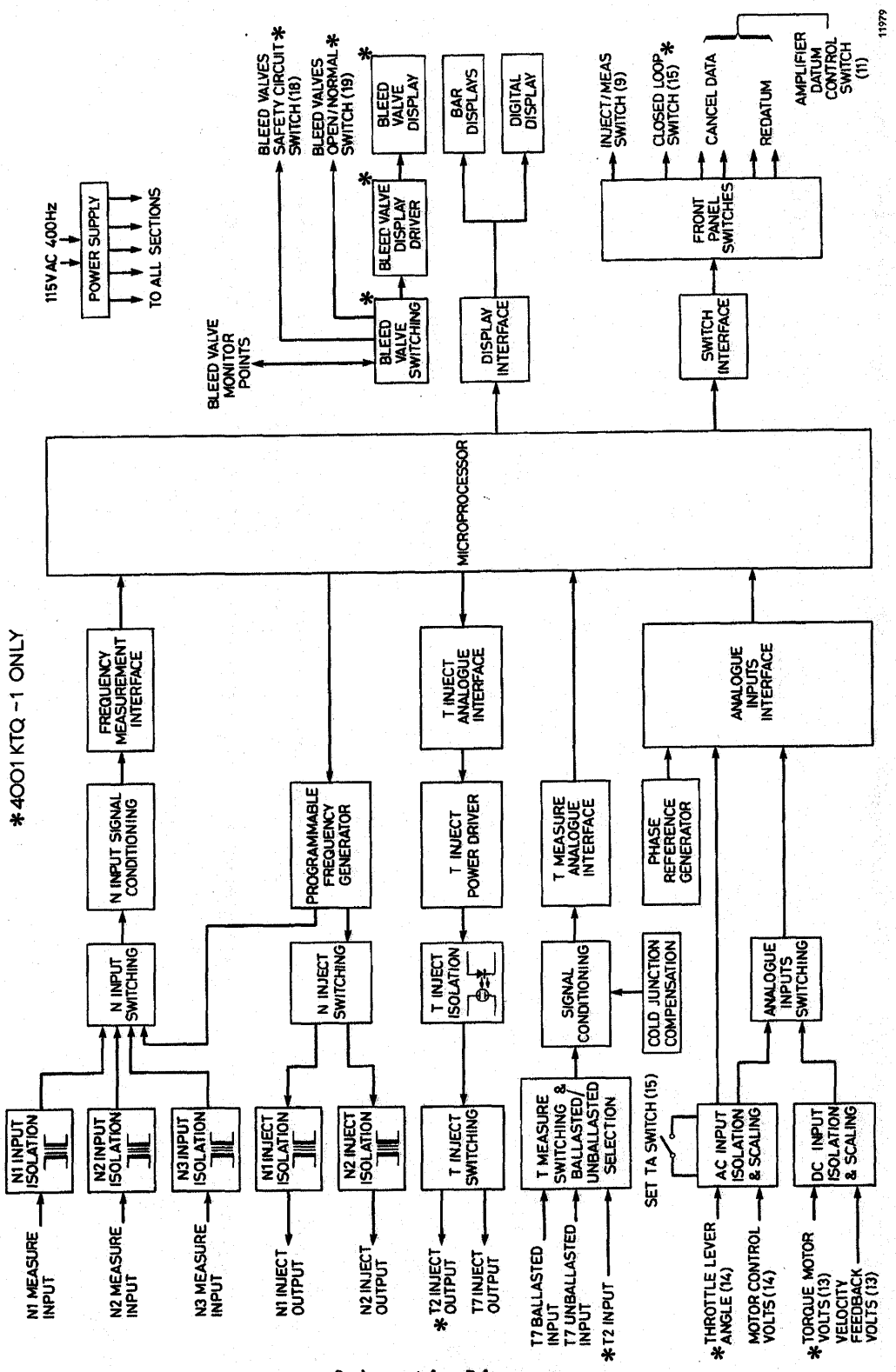
N2

In this position, with the Test Mode switch (9) in the MEASURE position, the IP compressor shaft speed N2 is displayed as a percentage by the panel meter (8). With the Test Mode switch (9) in the INJECT position a simulated N2 signal is generated across pins D and E of the Test Connector (3) and the simulated speed displayed as a percentage by panel meter (8). The frequency of the signal is adjusted by the N INJECTOR (12).

N3

In this position, with the Test Mode switch (9) in the MEASURE position, the HP compressor shaft speed N3 is displayed as a percentage by the panel meter (8).

Figure 4 shows the schematic layout of the Test Sets and Figure 5 shows a typical link up of the Test Set to the Engine Systems.



Schematic Diagram
Figure 4

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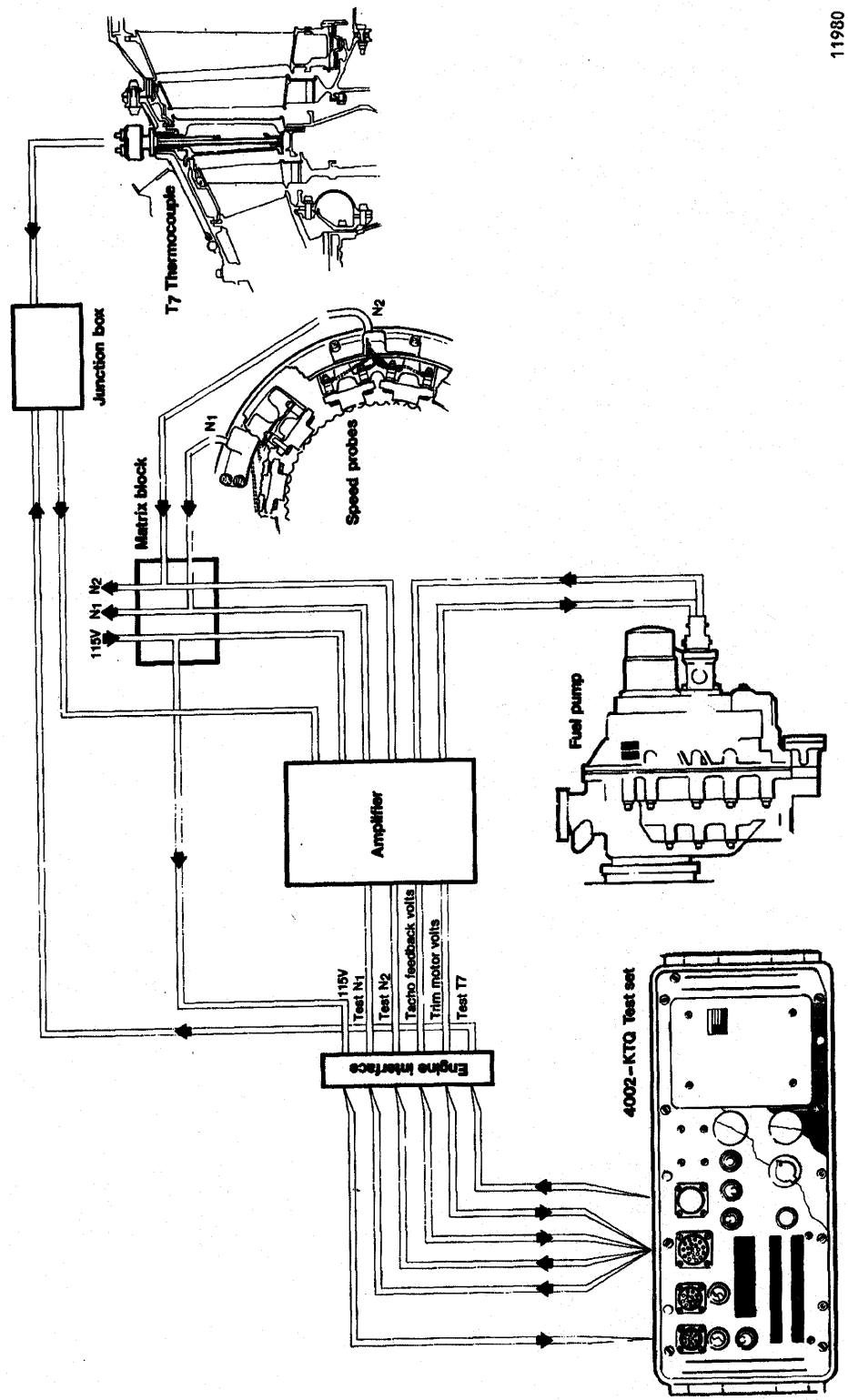


Typical Link-up to Engine Systems
Figure 5

4. Circuit Description

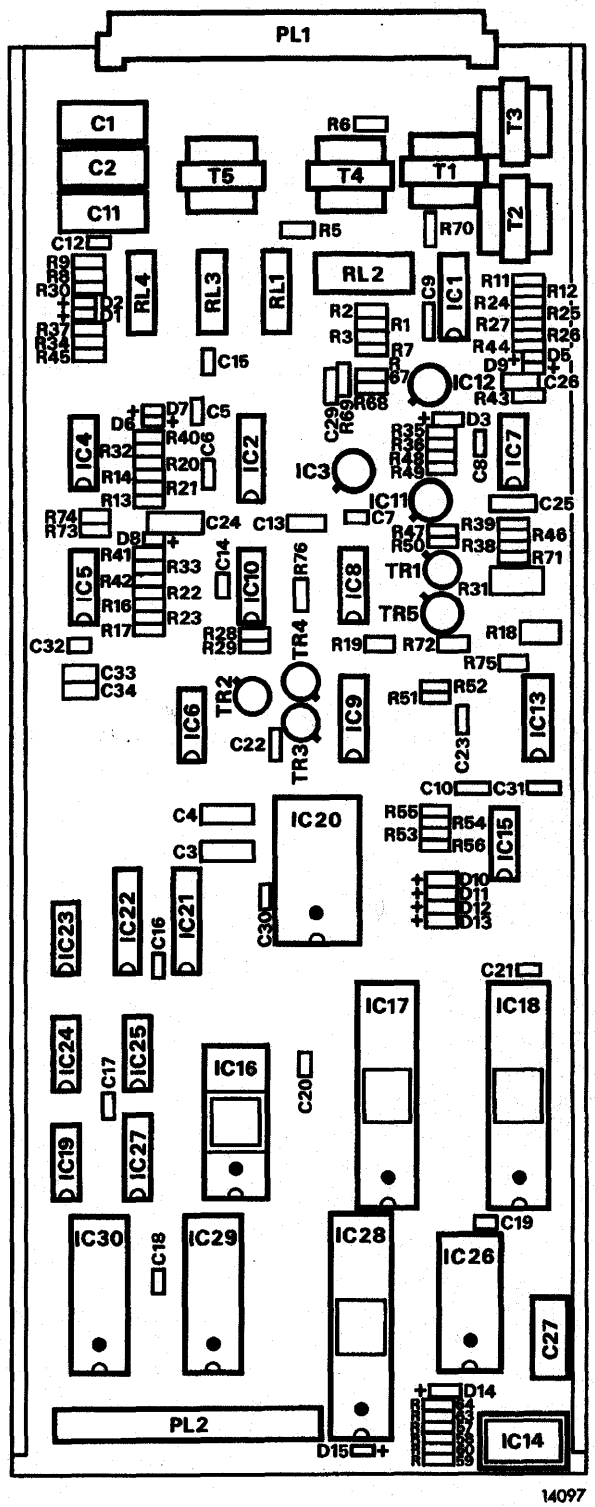
A. General

With the exception of the circuitry on the processor board, the general circuit of the test set is considered to be self explanatory. In the following paragraphs the description of the circuit is broken down into specific functions and illustrated. The circuit drawn will be found on the processor board, but where circuitry which is not on this board is required to explain the function, this will be identified. Where the circuit is different for different test sets covered by this manual, the appropriate unit part number will be identified. Figure 8 shows the component layout of the processor board to enable identification of the components shown in the circuits. Where an item on the front panel is referred to, the actual engraving (if present) will be written in capital letters and the number on the panel adjacent to the item given in parenthesis.

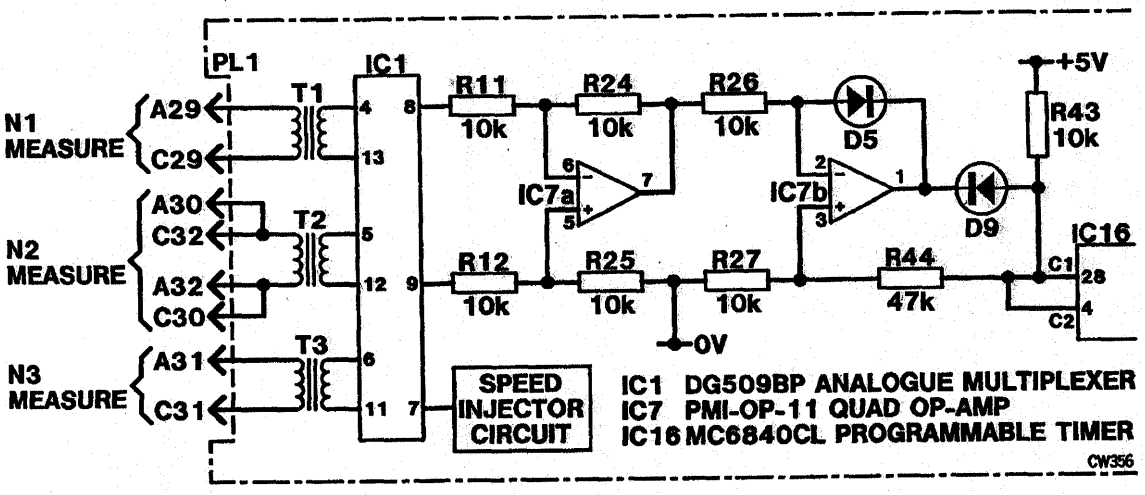
The processor board contains the circuitry to inject and measure speed signals, inject and measure thermocouple signals with cold junction compensation, measure one a.c. and one d.c. analogue input, and drive one digital and two bar type LED displays. A phase signal is also produced from the a.c. signal which can be used to determine the phase of the input. All functions are controlled by the software program for the microprocessor. The program can also modify the injected temperature or speed via the analogue output channels. In this way, the closed loop function can be performed where the engine amplifier output is controlled by adjusting the injected input so as to hold the output at constant value.

B. Speed Measurement (See Figure 9)

The three speed inputs are each coupled to multiplexer IC1 via isolation transformers T1, T2 and T3. A fourth input from the speed injector oscillator is directly connected to IC1 to allow it to be monitored. The desired input is selected by setting the front panel selector switch SW6 (16) to N_1, N_2 or N_3 and setting the toggle switch (9) to MEASURE. The microprocessor IC17 outputs data to the select inputs of IC1 via interface adaptor IC16, which causes IC1 to switch the desired input to buffer amplifier IC7a which is a unity gain differential amplifier whose output is converted to a rectangular waveform with TTL levels 0V to +5V by amplifier IC7b. For negative inputs, IC7b is open loop and its output will saturate to a positive voltage, diode D9 will be cut off and the output pulled up to the +5V rail by R43. For positive inputs, D5 and D9 both conduct, pulling the output down to a virtual 0V. Positive feedback via R44 provides hysteresis to prevent oscillation at the cross over point.



P.C.B. Layout
Figure 8

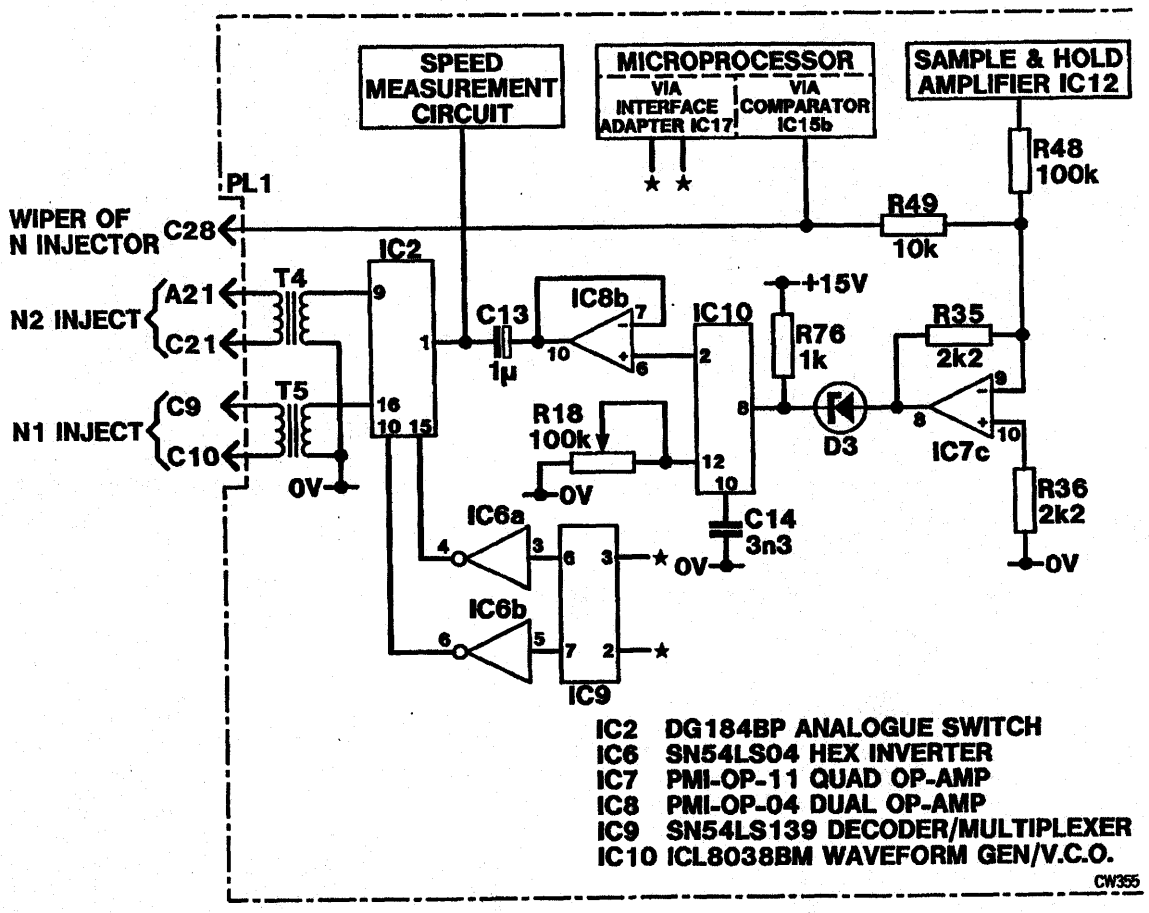


Speed Measurement Circuit
Figure 9

The frequency of the speed signal is measured using programmable timer IC16. One counter (counter 2) counts the number of cycles and another (counter 1) measures the time in clock pulses. Measurement is initiated by clearing counter 1 and setting counter 2 to count the number of cycles to be measured. The output of counter 2 goes active on the next active edge of the output from IC7b and starts counter 1. When the output of counter 2 goes inactive after the pre-determined number of cycles, counter 1 is stopped and the time period is read from IC16 by the microprocessor and processed before being output to DISPLAY (8) on the front panel.

C. Speed injector (See Figure 10)

The frequency of the speed injector is set by the N INJECTOR(12) potentiometer R3 mounted on the front panel and operating between 0V and -15V. The voltage picked off by the wiper is input via R49 to amplifier IC7c (which is configured as a summing amplifier) with the other input via R48 from sample and hold amplifier IC12. The output of IC7c is level shifted by zener diode D3 and drives the voltage input of voltage controlled oscillator IC10. The frequency range of the oscillator is determined by C14 and the symmetry of the waveform optimised by variable resistor R18.



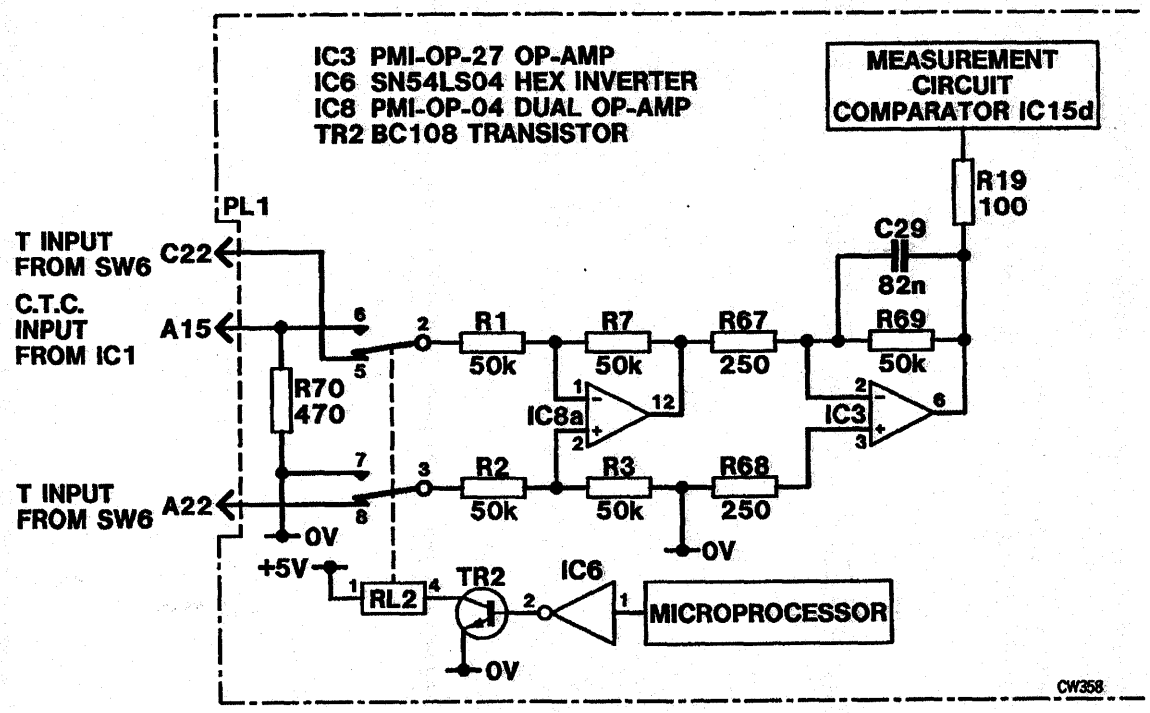
Speed Injector Circuit
Figure 10

The output of IC10 is buffered by amplifier IC8b and switched by multiplexer IC2 to the output via isolation transformer T4 or T5 as appropriate. The output is selected by setting the front panel selector switch SW6 (16) to N1 or N2 and setting the toggle switch (9) to INJECT. The output port of the microprocessor provides a channel select and an output enable via multiplexer IC9 and inverter IC6 to select the appropriate output of multiplexer IC2.

D. Thermocouple Input Measurement (See Figure 11)

Thermocouple inputs from the connector mounted on the front panel pass to the cold junction compensation (CJC) block via nickel chromium and nickel aluminium wires. The CJC contains a terminal block, at which the thermocouple signal is transferred to copper wires, with solid state temperature sensor IC1 in close thermal contact. IC1 passes a

current proportional to absolute temperature, this current being scaled by R70 to be of the same scaling as the thermocouple input.



Thermocouple Input Measurement Circuit
Figure 11

Toggle switch SW3 (10) and selector SW6 (16) on the front panel select the appropriate pair of input wires for T2 or T7 measurement. In the case of T7, SW3 selects ballasted (in the BALLASTED position) or non-ballasted connections of the nickel aluminium wire from the aircraft engine.

The input from the microprocessor input/output port controls transister TR2 via inverter IC6 to energise or de-energise relay RL2. This switches between the selected inputs and the output of IC1. This signal is buffered by amplifier IC8a, which is configured as a unity gain differential amplifier, and amplified by amplifier IC3, which has its gain set at 200. C29 is connected across IC3 to provide low pass filtering and the output from IC3 is passed to the measurement circuit via R19.

E. Thermocouple Injector

(1) 4001 KTQ Test Sets only (See Figure 12)

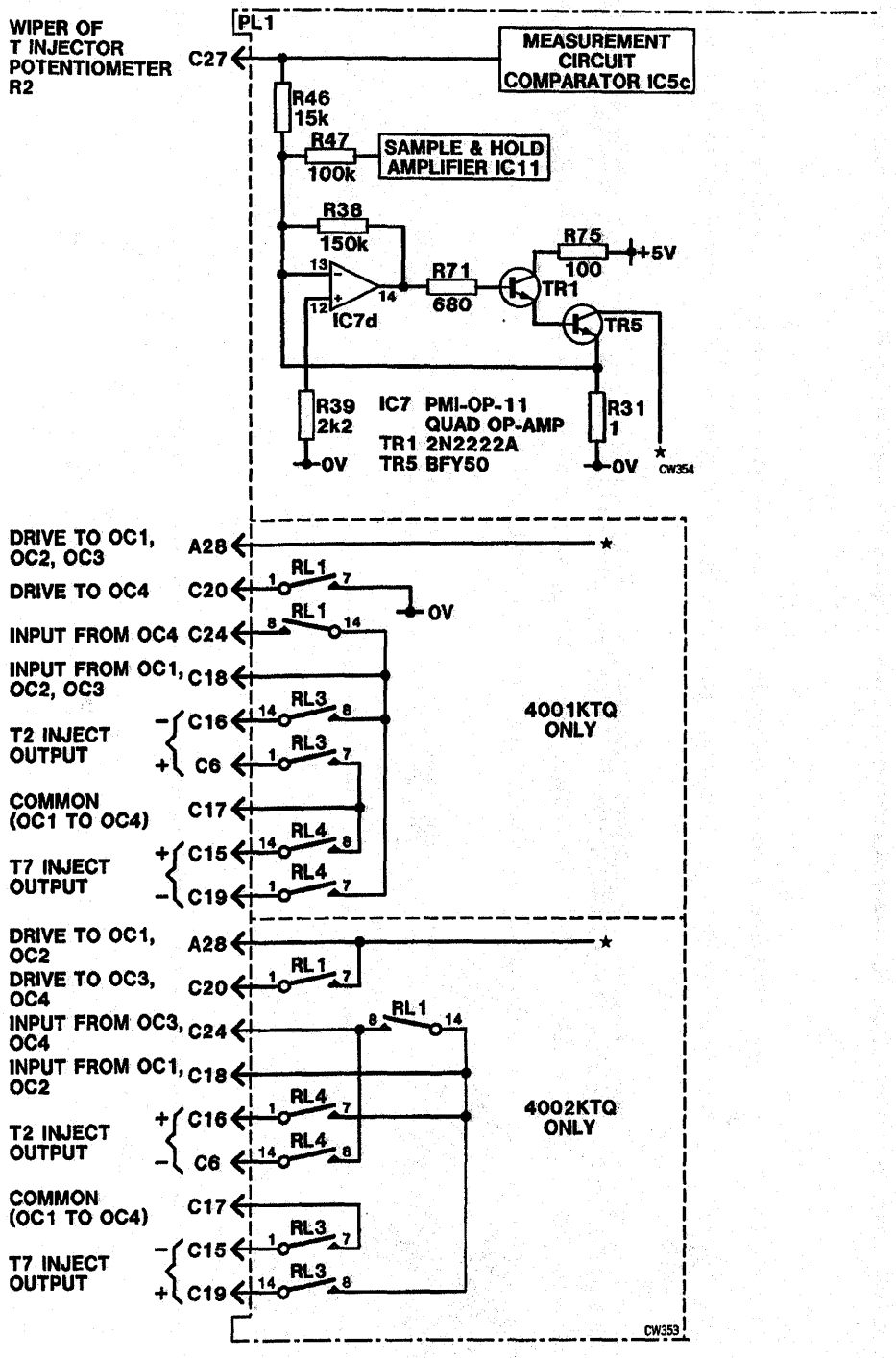
The temperature injector is set by T INJECTOR(17) potentiometer R2 on the front panel which operates between 0V and -15V. The voltage picked off by the wiper is input via R46 to amplifier IC7d which is configured as a summing amplifier. The other inputs to IC7d are the microprocessor controlled analogue output from D-A converter IC20 via R50, sample and hold amplifier IC11 and R47, and feedback via R72 to control the output drive current of IC7d. This output current drives TR1 and hence TR5, which in turn drives three solar cells (OC1, OC2, OC3), the outputs of which provide unipolar drive for the T2 inject signal. When T2 inject is selected by selector switch SW6 (16) and toggle switch SW3 (9) on the front panel, relay RL4 is energised to connect the T2 inject signal to the connector (3) on the front panel.

When T7 inject is selected, relays RL1 and RL3 are energised, connecting the output of solar cell OC4 in parallel with the parallel combination OC1,)C2 and OC3 to provide bipolar drive for the T7 inject signal to connector (3).

(2) 4002KTQ Test Sets only (See Figure 12)

The temperature injector is set by T INJECTOR (17) potentiometer R2 on the front panel which operates between 0V and -15V. The voltage picked off by the wiper is input via R46 to amplifier IC7d which is configured as a summing amplifier. The other inputs to IC7d are the microprocessor controlled analogue output from D-A converter IC20 via R47 and feedback via R72 to control the output drive current of IC7d. This output current drives TR1 and hence TR5, which in turn drives two solar cells (OC1, OC2) connected in parallel, the output of which provides unipolar drive for the T2 inject signal. When T2 inject is selected by selector switch SW6 (16) and toggle switch SW3 (9) on the front panel, relay RL4 is energised to connect the T2 inject signal to the connector (3) on the front panel.

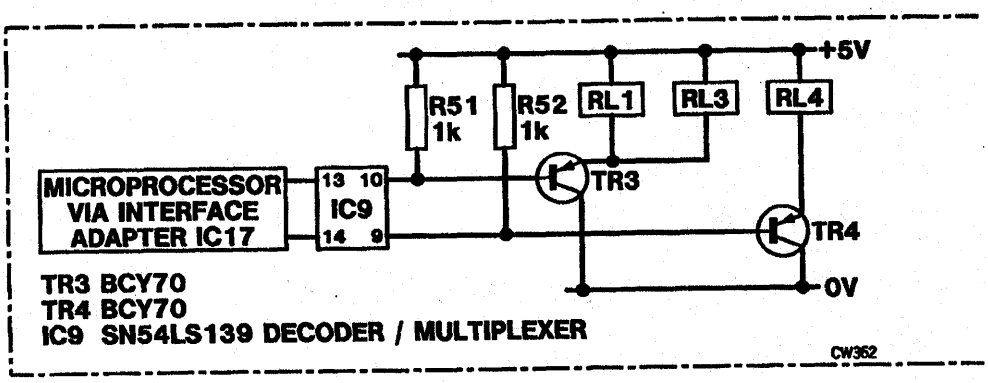
When T7 inject is selected, relays RL1 and RL3 are energised, connecting the output of parallel solar cells OC3 and OC4 in parallel with parallel solar cells OC1 and OC2 to provide bipolar drive for the T7 inject signal to connector (3).



Thermocouple Injector Circuit
Figure 12

F. Thermocouple Injector Relay Drivers (See Figure 13)

The two inputs to multiplexer IC9 from microprocessor interface adaptor IC17 effectively provide an inject enable signal and a channel select signal. When T2 inject is selected by selector switch SW6 (16) and toggle switch SW3 (9) on the front panel, the appropriate output of IC9 goes low, turning on TR4 and thus energising relay RL4 which outputs the T2 inject signal to connector (3) on the front panel. Similarly when T7 inject is selected, the appropriate output of IC9 goes low, turning on TR3 and thus energising relays RL1 and RL3 which outputs the T7 inject signal to connector (3) on the front panel.



Thermocouple Injector Relay Drive Circuit
Figure 13

G. Analogue Inputs

(1) D.C. Input (See Figure 14)

The floating d.c. input is buffered by an instrumentation amplifier comprising amplifiers IC4a and IC4b. The output is applied to amplifier IC4c, which is configured as a differential amplifier with unity gain. In 4002 KTQ test sets, C33 and C34 are fitted to filter out spurious noise at this point. The output from IC4c is then input to comparator IC15 via analogue switch IC13 for measurement by the microprocessor using interface adaptor IC28 and D-A converter IC20.

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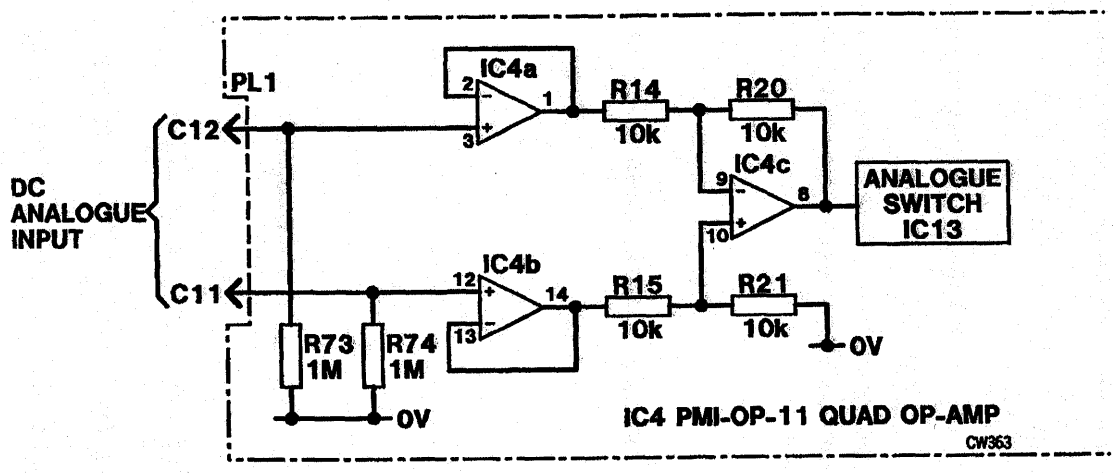


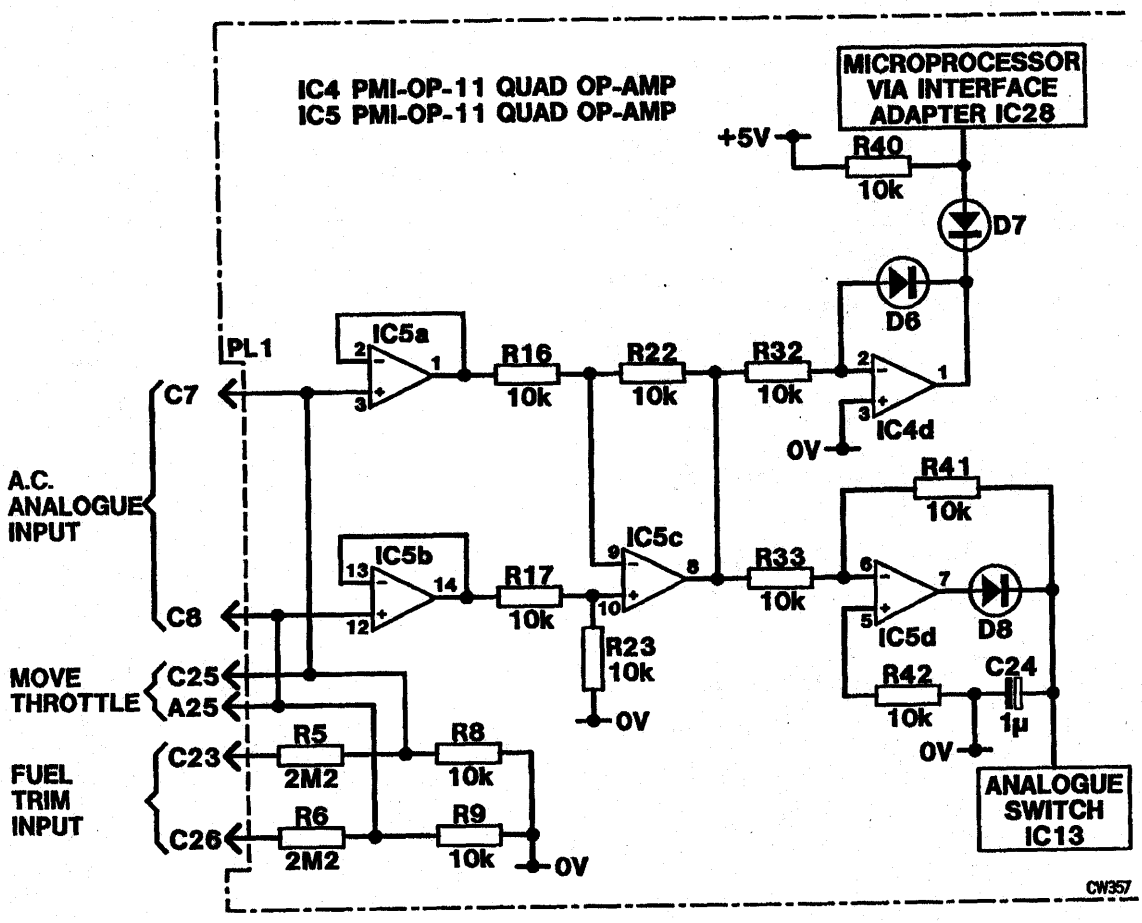
D.C. Analogue Input Circuit
Figure 14

(2) A.C. Input (See Figure 15)

A.C. inputs are either applied directly to the buffer instrumentation amplifier comprising IC5a and IC5b, or applied via potential dividers R6/R9 and R5/R8. The voltage is divided by 23 when applied via the potential dividers. The output is applied to amplifier IC5c which is configured as a differential amplifier with unity gain.

The output from IC5c is rectified by IC5d and diode D8. By including D8 in the feedback path, the effect of the diode voltage chop is removed from the output and the peak of the input waveform is stored in C24. The output from IC5d is then input to comparator IC15 via analogue switch IC13 for measuement by the microprocessor using interface adapter IC28 and D-A converter IC20. Since the a.c. input signals may not be truly sinusoidal, the indicated voltage should be regarded as an indication of amplitude rather than a true r.m.s. value.

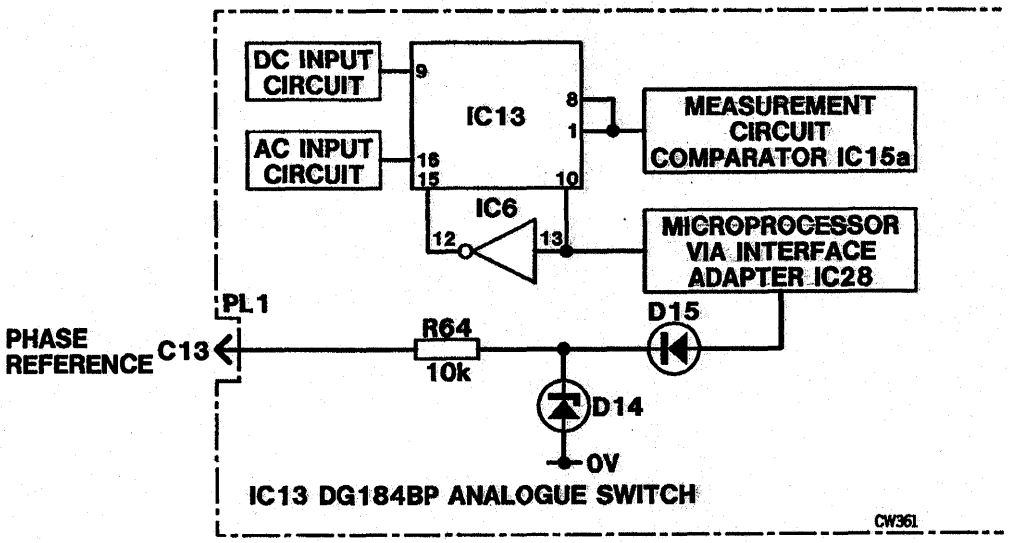
The output from IC5c is also passed to IC4d which produces a rectangular waveform of 5V amplitude giving an indication of the phase of the input. The output of IC4d is passed to the microprocessor via interface adapter IC28 for comparison with the phase reference signal derived from R64, D14 and D15.



A.C. Analogue Input Circuit
Figure 15

(3) Analogue Input Switching (See Figure 16)

Analogue switch IC13 comprises two independent switches each controlled by its own control signal. One control input receives its control signal directly from the microprocessor input/output, the other control input receiving the same input signal in anti-phase via inverter IC6. The selected signal is out put to the measurement circuit.



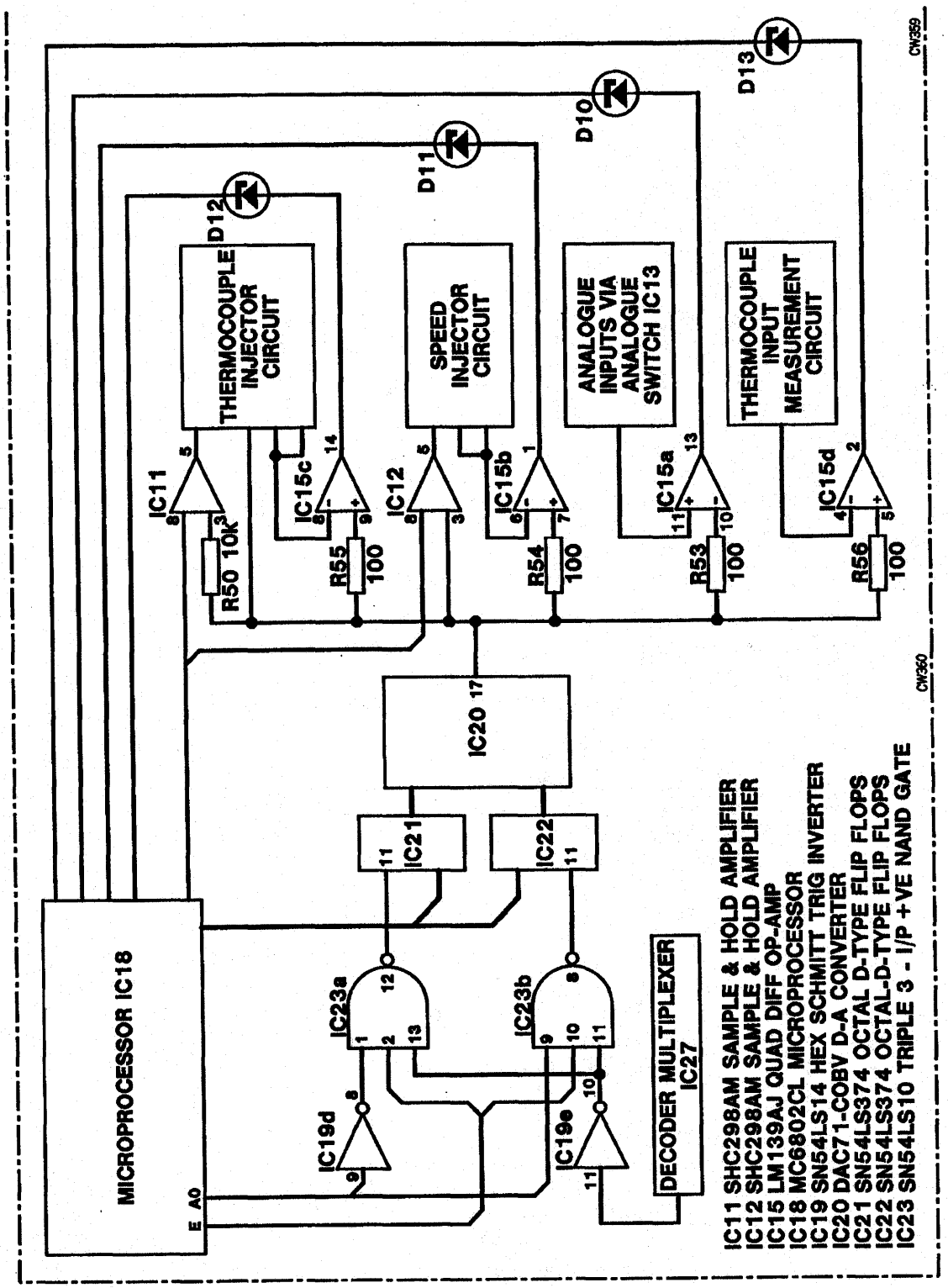
Analogue Input Switching
Figure 16

An input derived from the 400 Hz transformer is converted by R64, D14 and D15 into a 5V rectangular waveform to be used as the phase reference. This signal is passed to the microprocessor via interface adapter IC28 for comparison with the a.c. input signal, to determine the phase relationship.

H. Microprocessor Analogue Interface (See Figure 17)

Data is passed over the microprocessor databus and held in latches IC21 and IC22. The microprocessor timing signal E is combined with the address enable signal and either A0 or its complement to select one latch or the other. The latch outputs from IC21 or IC22 are input to D-A converter IC20, which produces a continuous conversion from the input data.

The output from IC20 is input to four differential comparators IC15a, b, c and d and to two sample and hold amplifiers IC11 and IC12. The comparators can be used to measure analogue inputs by finding the threshold between a voltage greater than and less than the input voltage. the sample and hold amplifiers are used as analogue outputs by setting the D-A output to the required voltage and switching the amplifier to sample. The amplifier can then be switched to hold and thus provide the required voltage while the D-A converter performs some other function.



Microprocessor Analogue Interface Circuit
Figure 17

The analogue inputs are measured and displayed in two different ways. Temperature measurements are made by successive approximation, with each bit of the D-A converter being set in turn to establish whether or not this makes the output greater than the input to be measured. In this way the output of the D-A converter gets nearer to the input with each approximation, the result being displayed on the digital display. Where a measurement is to be displayed on the bar display, the output from the D-A converter is sequentially incremented by a step equivalent to one step on the display until the comparator changes state. This halts the increment and holds the display until the input is changed or removed.

The comparator outputs pass to the input/output port of the microprocessor via level shifting zener diodes, D10, D11, D12 and D13. The sample and hold amplifiers are controlled by two output lines from the input/output port of the microprocessor.

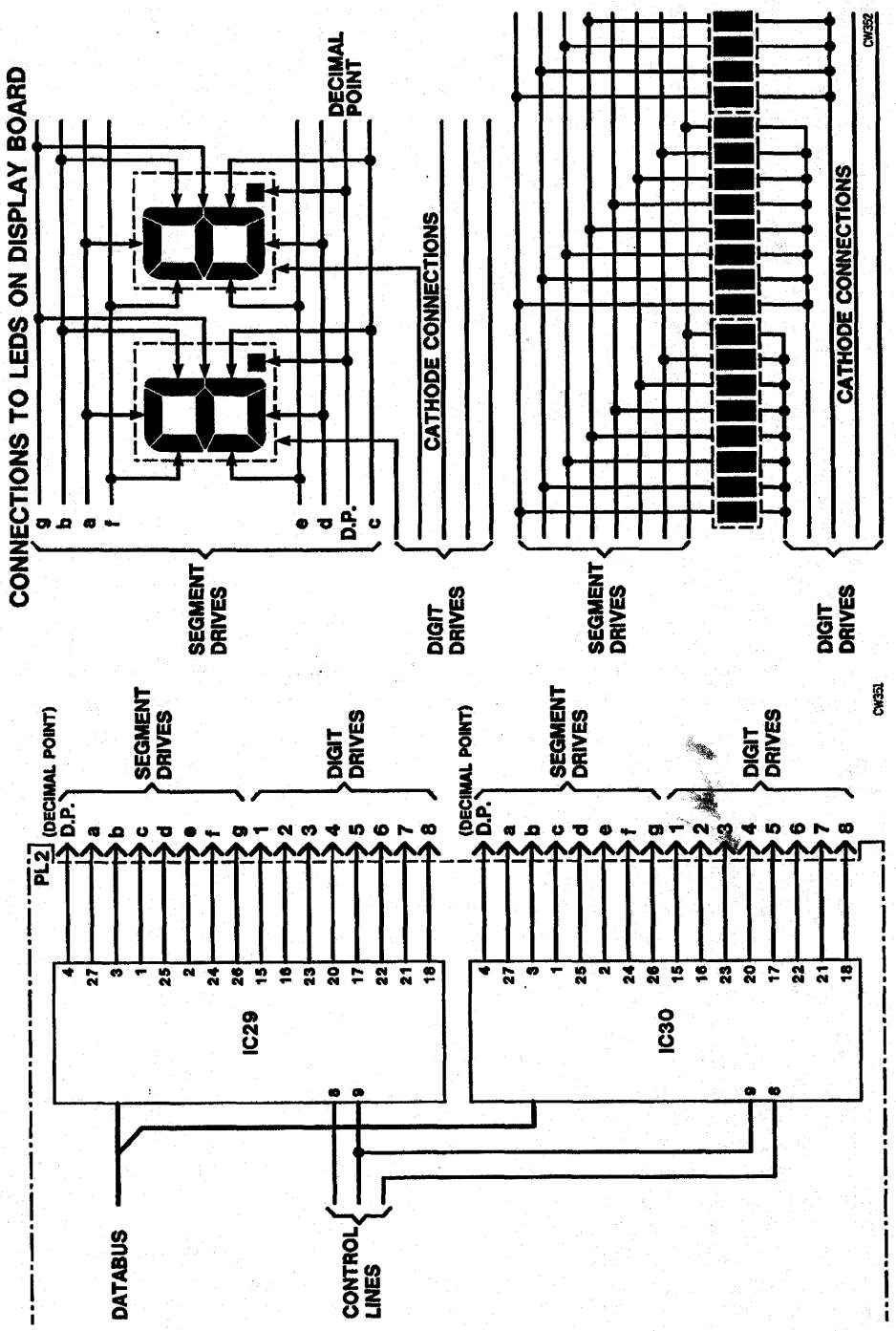
J. Display Drivers (See Figure 18)

The LED digital and bar displays are driven by display drivers IC29 and IC30. These drivers each have 16 outputs and are each configured to drive 64 LEDSs. Each of the six digits may be regarded as a group of eight LEDs (seven segments plus decimal point) and the bar display (two sets of 40 LEDs) as ten groups of eight LEDs. The equivalent segments of each digit are connected to each other and to the appropriate segment drive on the driver IC, with each cathode driven by a separate digit drive. For the bar display, the cathodes of all LEDs in a group of eight are connected together and to a separate digit drive, while the anodes of equivalent LEDs from each group are connected together and to a separate segment drive

The data for display is output from the microprocessor on eight arallel lines plus two control lines via interface adapter IC28 to the drivers. Once the data is stored in the internal memory of the drivers, they generate all the waveforms required to drive the displays to show the stored data.

K. Microprocessor, Memory and Address Decoding

Microprocessor IC18 is the heart of the unit and is controlled by its operating program which is stored in EPROM IC26. Variables are stored in the internal memory of IC18. All the devices connected to the microprocessor databus have a unique address, carried by the address bus, which connects the device to the microprocessor bus when its address is decoded. Address decoding for IC26 is carried out by NAND gate IC24b and inverter IC19f, giving an address range of 7000 to 7FFF ($7000 to $7FFF) and $F000 to $FFFF. Address decoding for all other devices on the address bus is carried out by multiplexer IC27 which is selected for addresses in the range $0 to $FF as decoded by NAND gates IC23 and IC24 and NOR gate IC25.



Display Driver Circuit
Figure 18

OPERATION

1. General

The Test Set when operated within the ranges given in Specifications and Capabilities, Chapter 1-3, will provide for high accuracy testing of various functions of Rolls Royce RB211 engines. The numbers in parenthesis are the front panel references.

2. Procedures

A. Preparation for Use

(1) Set the Power Switch (7) to OFF.

(2) Remove the protective cap from the Power Connector (1).

(3) Connect a single phase, 115 V, 400 Hz supply with earth to the Power Connector (1) using the appropriate power supply lead (refer to Chapter 1-1, Table 1).

(4) Remove the protective cap from the Test Connector (3).

(5) Using the appropriate test lead (refer to Chapter 1-1, Table 1) connect between the Test Connector (3) and the associated connector on the engine.

(6) Remove the protective cap from the Thermocouple Connector (4).

(7) Using the appropriate thermocouple test lead (refer to Chapter 1-1, Table 1) connect between the Thermocouple Connector (3) and the associated connector on the engine.

(8) Remove the protective cap from the Bleed Valve Control Unit (BVCU) Connector (20).

(9) Using the BVCU cable connect between the BVCU Connector (20) and the associated connector on the engine.

NOTE: Paragraph 2.A.(8) and (9) apply only when using the 4001 KTQ-1 Test Set on the RB211-535 engine.

(10) Set Power Switch (7) to ON.

(11) Set Function Switch (16) to DISPLAY TEST.

(12) Check that display (8) indicates a readout of 00000, each digit should then increment by 1 simultaneously until a readout of 99999 is displayed.

(13) Check that the Torque Motor/Velocity Feedback Volts (13) and Throttle Angle Volts/Motor Control Volts (14) displays increment by one LED bar until all LEDs are lit.

NOTE: The display test, paragraph 2.A.(12) and (13), will repeat while Function Switch (16) remains in the DISPLAY TEST position.

B. Percentage Speed Measurement

(1) Set Test Mode switch (9) to MEASURE and Function Switch (16) to N1, N2 or N3, according to the requirements laid down in the engine maintenance manual.

(2) Check that the percentage speed indicated by display (8) is within the limits given in the engine maintenance manual.

C. Inject N Facility

(1) Set Test Mode switch (9) to INJECT and Function Switch (16) to N1 or N2 depending on the function required.

(2) Set Datum Select switch (11) according to the setting given in the engine maintenance manual.

(3) Set N INJECTOR (12) so that the readout on display (8) complies with the requirements given in the engine maintenance manual. Adjustment of N INJECTOR (12) knob clockwise increases the simulated percentage speed readout on display (8).

D. T7 Thermocouple Check

(1) Set Function Switch (16) to T7 and Test Mode switch (9) to MEASURE.

(2) Check that the display (8) readout is within the limits given in the engine maintenance manual.

E. Inject T7 Facility

(1) Set Test Mode switch (9) to INJECT.

(2) Set T INJECTOR (17) so that the display (8) and corresponding engine thermometer indications are in accordance with the requirements given in the engine maintenance manual. Adjustment of T INJECTOR (17) knob clockwise increases the simulated temperature readout on display (8).

NOTE: Paragraphs 2.F. to 2.K. apply only when using the 4001 KTQ-1 Test Set on the RB211-535 engine.

F. T2 Temperature Check

(1) Set Function Switch (16) to T2 and Test Mode switch (9) to MEASURE.

(2) Check that the display (8) readout is within the limits given in the engine maintenance manual.

G. Inject T2 Facility

(1) Set Test Mode switch (9) to INJECT.

(2) Set T INJECTOR (17) so that the display (8) and corresponding engine thermometer indications are in accordance with the requirements given in the engine maintenance manual. Adjustment of T INJECTOR (17) knob clockwise increases the simulated temperature readout on display (8).

H. $N2\sqrt{T2}$ Ratio Check

(1) Set Function Switch (16) to $N2\sqrt{T2}$ and Test Mode switch (9) to INJECT.

(2) Set the T INJECTOR (17) and N INJECTOR (12) until the ratio on display (8) is within the limits given in the engine maintenance manual.

NOTE: The $N2\sqrt{T2}$ Ratio Check may also be carried out with the Test Mode switch (9) in the MEASURE position.

J. N2 MEASURE (RPM)

(1) Set the Function Switch (16) to the first N2 position, adjacent to the $N2\sqrt{T2}$ position, and the Test Mode switch (9) to the MEASURE position.

(2) Check that the display (8) readout is within the limits given in the engine maintenance manual.

K. Limiter Amplifier Checks

(1) The displays for TORQUE MOTOR/VELOCITY FEEDBACK VOLTS (13) and THROTTLE ANGLE VOLTS/MOTOR CONTROL VOLTS (14) must read in accordance with the information given in the engine maintenance manual.

L. Limiter Amplifier Datum Select

(1) Set the Datum Select switch (11) according to the requirements of the engine maintenance manual.

M. Ballasted Turbine Gas Temperature (TGT)

(1) Set the BALLASTED (TGT) (10) switch in accordance with the instructions given in the engine maintenance manual.

(2) Monitor the display (8) readout, which should be within the limits given in the engine maintenance manual.

SPECIFICATIONS AND CAPABILITIES

1. Specification and Capabilities

Power Supply required: 115 V $^{+4.5\ V}_{-7.5\ V}$, 400 Hz ±10 Hz, single phase

Weight:	4001 KTQ-1	11.25 kg (25 lb)
	4002 KTQ-1	10.35 kg (23 lb)
Dimensions:	Length	444.5 mm (17.5 in)
	Width	177.8 mm (7 in)
	Depth	254.0 mm (10 in)

Accuracies:

4001 KTQ-1 for RB211-535 engine applications

Torque Motor Volts range measurement	0 - 4 V d.c. ±2.5% FSD	
Throttle Angle Volts range measurement	0 - 4 V a.c. frequency 800 Hz, accuracy ±5% FSD	
N1 Measurement	15 ±0.50% 90 ±0.25% 105 ±0.25% 110 ±0.50% 115 ±0.50%	
N2 Measurement	25 ±0.50% 90 ±0.25% 105 ±0.25% 110 ±0.50% 120 ±0.50%	1750 ±4 RPM 3000 ±7 RPM 5000 ±12 RPM 7000 ±17 RPM 8400 ±21 RPM
N3 Measurement	50 ±0.50% 90 ±0.25% 105 ±0.25% 110 ±0.25%	
T2 Measurement (Sonic Corrected)	-54 to 120 ±2 °C	
T7 Measurement	350 to 450 ±3 °C 500 to 700 ±2 °C 750 to 1000 ±3 °C	
N1 Inject Signal Amplitude	6.0 V ±1.5 V peak to peak Accuracy ±0.2% FSD	
N2 Inject Signal Amplitude	6.0 V ±1.5 V peak to peak Accuracy ±0.1% FSD	

4001 KTQ-1 and 4002 KTQ-1 for RB211-22 and RB211-524 engine applications

Velocity Feedback Volts range	0 - 4 V d.c. ±5% FSD
Motor Control Volts range	0 - 120 V a.c. ±5% FSD
N1 Measurement	15 ±0.50% 90 ±0.25% 105 ±0.25% 110 ±0.50%
N2 Measurement	25 ±0.50% 90 ±0.25% 105 ±0.25% 110 ±0.50% 120 ±0.50%
N3 Measurement	50 ±0.50% 90 ±0.25% 105 ±0.25% 110 ±0.25%
T7 Measurement	350 to 450 ±3 °C 500 to 700 ±2 °C 750 to 1000 ±3 °C 4001 KTQ only 750 to 900 ±3 °C 4002 KTQ only
N1 Inject Signal Amplitude	6.0 V ±1.5 V peak to peak Accuracy ±0.2% FSD
N2 Inject Signal Amplitude	6.0 V ±1.5 V peak to peak Accuracy ±0.1% FSD

SHIPPING

1. Shipping

There are no special shipping instructions. The 4001 KTQ-1 and 4002 KTQ-1 Testers should be packed as described under STORAGE, Chapter 1-5 for transit purposes.

STORAGE

1. Procedure

A. General

These instructions are applicable to all climates. The packaging described is suitable for both storage and transit purposes.

B. Packaging

(1) Secure the lid to the case of the Test Set by the eight captive screws.

(2) Clean the Test Set and ensure that it is free from dust and corrosion.

(3) Cover the lid and edges of the Test Set with cellulose wadding encased in 0.005 inch thick polythene, size to suit.

(4) Wrap the Test Set in Kraft waxed paper and secure with adhesive tape.

(5) Place the Test Set in two polythene bags 24 inch x 40 inch x 0.010 inch thick, extract all excess air and heat seal.

(6) Overwrap the primary package with Kraft paper and secure the ears with gummed Kraft paper tape.

(7) Insert the package in the rubberized hair pads of the appropriate wooden crate and place the top rubberized hair pad in position.

(8) Secure the lid of the crate with the captive screws.

(9) Bind the complete package with three bands of steel tape drawn around the battens so that they are embedded in the wood.

(10) Add labels and identification.

C. Storage Conditions

(1) The unit should be stored in conditions which are clean, dry, of even temperature, well ventilated and free from corrosive fumes. It should remain in its packing described in paragraph B.

D. Storage Limiting Period

(1) Providing that the storage conditions are observed the Test Set may remain in storage for any period up to two years. After this time the Test Set must be removed from its pack and subjected to the full testing procedure detailed in this manual.

(2) If the Test Set passes these tests it may be repacked and returned to store for a second period of up to two years after which it must be retested as detailed in this manual.

(3) Any Test Set failing the test must be overhauled before being subjected to further storage or despatched for service.

CHAPTER 2

MAINTENANCE

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SERVICING

1. Procedures

A. General

(1) At periods not exceeding twelve months, or if the serviceability of the Test Set is suspect, carry out the tests specified in Chapter 3-8, TESTING.

(2) The relevant tests must also be applied on the completion of any servicing procedure which entails the renewal of parts.

B. Spare Parts

(1) The following parts are those necessary to be held to maintain the serviceability of the Test Set without removing the mechanism from the case.

(a) Fuse Link, 1A, Belling Lee Type L1427B/1A, Smiths Industries Part No. 40-615-139-14.

(b) Lamp filament, 28 V, 0.04 A (4001 KTQ-1 only), Smiths Industries Part No. 40-621-170-46.

C. Fuse Replacement

(1) Unscrew the cap on the fuse holder. Extract the unserviceable fuse and replace with a new fuse of the correct value. Refit the cap.

(2) Should the fuse blow again immediately the Test Set is switched on, check the supplies and, if correct, fit another fuse of the correct value. If after this action the fuse blows again return the Test Set for repair.

NOTE: On no account use other than the specified fuse value.

D. Lamp Replacement Indicator/Switch (4001 KTQ-1 only)

(1) Lift the light module from its housing.

(2) Extract the unserviceable lamp and replace with a new lamp.

(3) Replace light module in its housing.

TROUBLE SHOOTING

1. Trouble Shooting

A. General

(1) Trouble shooting at Maintenance Level is not practical. Trouble shooting charts are given in Chapter 3-1 in the event that a fault develops which needs to be diagnosed.

REMOVAL/INSTALLATION

1. Procedure

A. General

(1) The work should be carried out in a clean, dust-free atmosphere and absolute cleanliness of workbench, components and tools must be maintained throughout.

B. Removal

(1) Extract the twelve screws from around the periphery of the panel. Recover the sealing washers and, using the D shaped handles, lift the mechanism out of the case.

CAUTION: TAKE CARE WHEN LIFTING OUT THE MECHANISM THAT IT DOES NOT FOUL THE LIP ON THE CASE.

C. Installation

(1) Hold the mechanism by means of the D shaped handles and lower it carefully into the case.

NOTE: The panel is shaped to ensure that the mechanism can be fitted only one way.

(2) Secure the mechanism in the case with the twelve 2 BA x 1/2 in cheese head screws and sealing washers.

REPAIRS

1. Procedures

Remove the mechanism from its case as detailed in Chapter 2-3, REMOVAL/INSTALLATION, and apply the relevant procedures as follows:

A. Renewing Faulty Alpha Numeric and Bar Graph Displays

(1) Remove the 34-way connector from the display board assembly.

(2) Remove the four screws, nuts, pillars, plain and spring washers securing the display board assembly to the front panel and remove the display board assembly from the Tester.

(3) Remove the faulty display and replace with a new display.

(4) Replace the display board assembly in the Tester and secure to the front panel with the four screws, nuts, pillars, plain and spring washers.

(5) Refit the 34-way connector to the display board assembly.

B. Refit the mechanism to the case as described in Chapter 2-3, REMOVAL/INSTALLATION.

TROUBLE SHOOTING

1. General

Trouble shooting charts are not practical. However, sufficient circuit descriptions have been included in Chapter 1 to allow fault diagnosis by a competent technician.

CHAPTER 3

OVERHAUL

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TABLE OF CONTENTS (continued)

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TABLE OF CONTENTS (continued)

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TABLE OF CONTENTS (continued)

DISASSEMBLY

1. Procedures

A. General

(1) The detailed disassembly procedure provides a quick and logical method of removing the components. If the Tester is to be disassembled to renew a specific component or sub-assembly, the procedure may be modified to suit the particular cirucmstances. After any component has been renewed or repaired, the complete testing procedure detailed in Chapter 3-8, TESTING, must be applied.

(2) Protect the mechanism from accidental damage during overhaul by placing a rubber mat between the mechanism and the work bench.

(3) The work should be carried out in a clean, dust-free atmosphere and absolute cleanliness of workbench, components and tools must be maintained throughout.

(4) The processor board contains static sensitive devices (SSDs) which can be damaged or destroyed during handling by the discharge of static voltages into the device. Handling procedures for SSDs are defined in paragraph 2 of this Section. The method of indicating the presence of SSDs on the processor board is by the warning symbol being carried on the board.

SSDs are identified individually with a yellow spot.

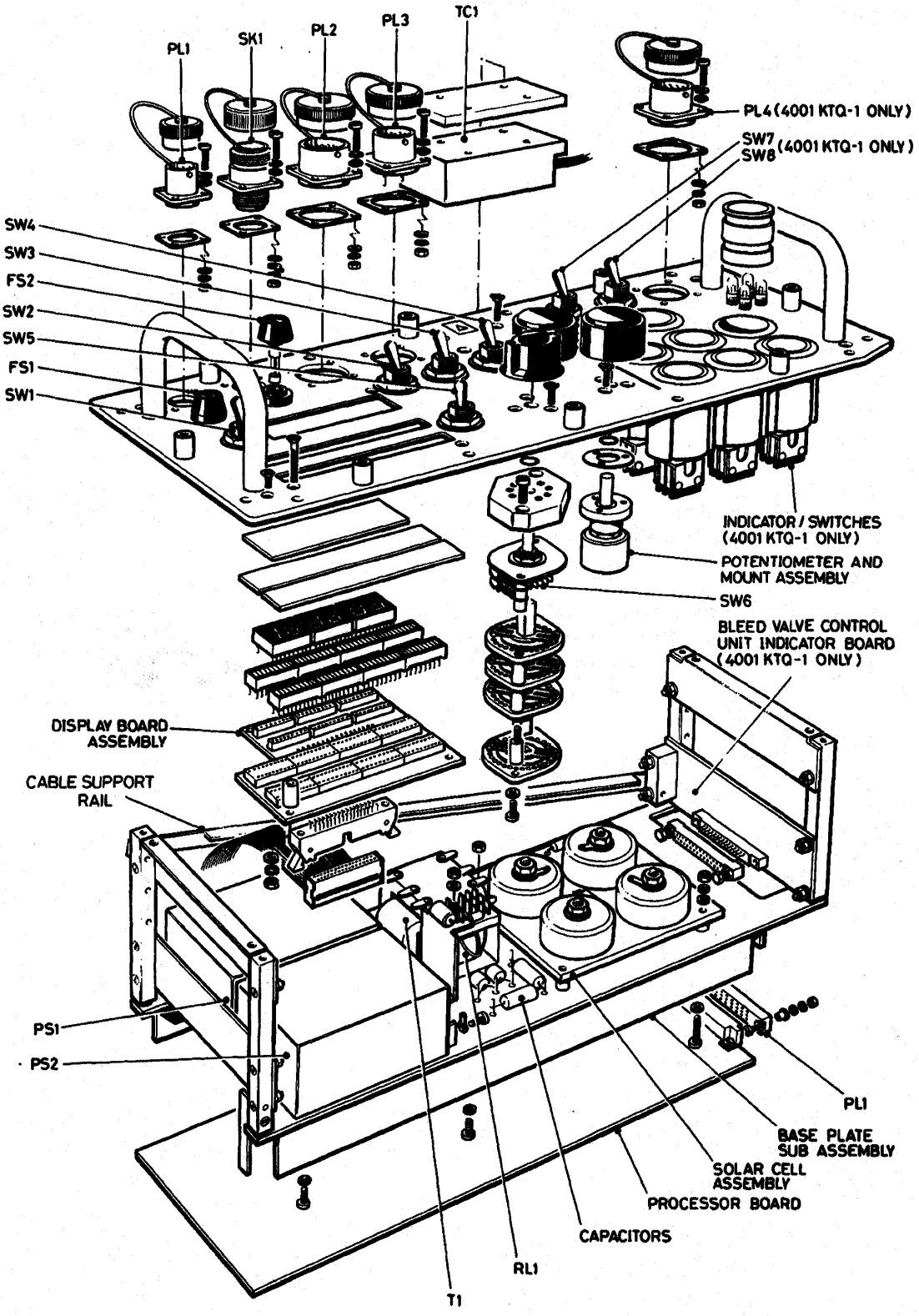
• - yellow spot, approximately 0.25 in dia.

 - 'Warning' symbol, black on yellow background.

The warning symbol is used to identify SSDs on the component location diagrams included in this manual.

(5) The layout of the front panel in Figure 1 gives the Bleed Valve Indicator/Switch arrangement for Test Set 4001 KTQ-1 incorporating BRS 248. For Test Sets 4002 KTQ-1 and 4001 KTQ-1 at Mod 01, their panel lay-outs are detailed in Figure 2 and 3 of Chapter 1-1.

(6) The cable support rail (not scheduled) fitted to Test Set 4001 KTQ-1 at modification 01 standard is mounted diagonally onto the chassis. Modification 02, for sets 4002 KTQ-1 introduces a more robust bracket (KTQ 2003) which forms part of the ruggedisation as well as providing a cable support. The ruggedisation provides strengthening plates and brackets for both



Disassembly of Testers
Figure 1

the 4001 KTQ-1 and 4002 KTQ-1 sets as well as introducing steel chassis pillars in lieu of light alloy.

B. Removal of Case

(1) Extract the twelve screws and sealing washers from around the periphery of the panel and, using the D-shaped handles, lift the mechanism out of the case. Invert the mechanism and stand it on the two handles.

C. Removal of Processor Board

(1) Remove the connector assembly from PL2 of the processor board and PL1 of the display board assembly, and remove from the Tester.

(2) Remove the screw, nut and washer securing the stop plate, loosen the remaining screw and let the stop plate swivel to allow the board to be removed.

(3) Ease the processor board from the 96-way connector (PL1) and withdraw the processor board.

D. Removal of Base Plate Sub-Assembly

(1) Remove the four screws and washers securing the base plate sub-assembly to the tester.

(2) Support the base plate sub-assembly to prevent strain on the wires while components are removed from the base plate sub-assembly.

E. Removal of Components from the Base Plate Sub-Assembly

(1) Power Supplies PS1 and PS2

(a) Disconnect the wires from each of the two power supplies.

(b) Remove the four pan head screws and plain washers securing the power supplies to the base plate sub-assembly. Remove the power supplies.

(2) Transformer T1

(a) Cut the wires as close to the soldered connections on the transformer as possible.

(b) Remove the four pan head screws, nuts and plain washers securing the transformer to the base plate sub-assembly. Remove the transformer.

(3) Relay RL1, Capacitor C5 and Diode D1

(a) Cut the wires as close to the soldered connections on the relay as possible. Remove the capacitor and diode.

(b) Remove the two pan head screws, nuts, plain and spring washers securing the relay bracket and relay to the base plate sub-assembly. Remove the relay and bracket.

(c) Remove the nut and washer securing the relay to the bracket, if the relay is to be replaced, and retain the bracket for fitting to the replacement relay.

(4) Capacitors C1, C2, C3 and C4

(a) Cut the lead-outs from the capacitors as close to the terminal pins as possible.

(b) Cut the tape securing the capacitors to the base plate sub-assembly. Remove the capacitors.

(5) Solar Cell Assembly

(a) Cut the wires as close to the terminal pins on the solar cell assembly as possible.

(b) Remove the four screws, nuts, spring washers, pillars and the eight plain washers securing the solar cell assembly to the base plate sub-assembly. Remove the solar cell assembly.

F. Removal of Bleed Valve Control Unit Indicator Board Assembly (4001 KTQ-1 only)

(1) Remove the connector from PL1 of the board assembly.

(2) Remove the four csk head screws, nuts, plain and spring washers securing the board assembly to the pillars. Remove the board assembly.

G. Removal of Components from the Front Panel

(1) Connectors SK1, PL1, PL2, PL3 and on 4001 KTQ-1 only PL4

(a) Cut the wires as close as possible to the crimped joints on the connector.

(b) Remove the four pan head screws, nuts, spring washers and the eight plain washers securing each connector to the front panel.

(c) Withdraw the connectors and gaskets from the front panel.

(2) Fuses FS1 and FS2

(a) Slide back the sleeves and cut the wires as close to the soldered connections on the fuses as possible.

(b) Remove the hexagon nuts securing the fuses to the front panel and withdraw the fuses.

(3) Switches SW1, to SW5 inclusive, and switches SW7 and SW8 on 4001 KTQ-1 only

NOTE: Switches SW7 and SW8 have no wires connected.

(a) Slide back the sleeves, SW1 only, and cut the wires as close to the soldered connections on the switches as possible.

(b) Remove the hexagon nuts securing the switches to the front panel and withdraw the switches.

(4) Compensation Assembly TC1

(a) With reference to the point to point wiring table in Chapter 3-5 identify the destinations of the flying leads from the compensation assembly.

(b) Slide back the sleeves, if applicable, and disconnect the wire from the power supply PS1 positive terminal. The remaining wires should be cut as close to the soldered connections at their destinations as possible. Carefully remove the wires from the cable form.

(c) Remove the four csk head screws securing the compensation assembly to the front panel. Remove the compensation assembly and insulating plate.

(5) Display Board Assembly

(a) Remove the four csk head screws, nuts, plain and spring washers securing the display board to the front panel. Remove the display board and the four pillars.

(b) Remove any faulty alpha numeric or bar graphic displays.

(6) Switch SW6

(a) Cut the wires as close to the soldered connections on the switch as possible.

(b) Prise off the cap from the top of the switch knob. Remove the nut that is exposed and remove the knob.

(c) Remove the three csk head screws that secure the switch to the front panel. Remove the switch and 'O' ring.

(7) Potentiometer and Mount Assemblies R2 and R3

(a) Cut the wires as close to the soldered connections on the potentiometer as possible.

(b) Prise off the cap from the top of each potentiometer knob. Remove the nut that is exposed and remove the knob.

(c) Remove the three csk head screws that secure the potentiometers to the front panel. Remove the potentiometers, gaskets and 'O' rings.

(6) Indicator/Switches SW11 to SW18 (4001 KTQ-1 only)

(a) Cut the wires as close to the soldered connections on the indicator/switches as possible.

(b) Remove the indicator inserts from the indicator/switches.

(c) Remove the two screws from inside the housing of the indicator/switches.

(d) Slide off retaining sleeve and remove the indicator/switches from the front panel.

2. General Handling Requirements for SSD's

A. General

Static electricity is generated in many everyday ways, for example, general movement of the body and associated clothing, movement of clothing against chair seats and benches or the movement of conventional packaging materials, i.e. paper, cardboard, plastics or polystyrene. Static electricity generated in this way is contained as an electrical energy charge on individual objects and people. The contact of two such charged bodies can result in the transfer or equalisation of the electrical energy between the two bodies, it is sometimes noticed as a mild electric shock, but more generally is completely unnoticed. The transfer of this energy into certain sensitive electronic devices (SSDs), which can occur during normal handling, is sufficient to damage or destroy the device even though the transfer will be unnoticed by the operator.

The objective of Static Handling Procedures is to ensure that SSDs are not subject at any time to circumstances which could give rise to a discharge of static electricity into their terminals, case, or associated circuitry.

B. Operator Disciplines

Personnel who are required to handle SSDs shall implement the following precautions before commencing any operation including the unpacking of any device, or assembly, from its conductive protective packaging.

(1) Change into an anti-static overall

(2) Attach a wrist strap and grounding lead, ensure that the wrist strap is in firm contact with the wrist and that it is connected via a wrist quick release attachment and lead to a "Static Ground Point".

(3) Check that the conductive working surface is connected to the "Static Ground Point".

(4) Ensure that all tools, devices and work pieces are situated on the conductive work surface.

(5) Observe these precautions throughout all operations involving SSDs until the SSDs are either; safely repacked in conductive packaging or; completely assembled in an assembly which is declared safe by its assembly instructions and packed in an approved conductive container.

NOTE: If SSDs or PCB assemblies containing SSDs are inadvertently handled without the requirements described in paragraphs B.(1) to B.(3) being observed, or if they come into contact with alien items as described in paragraph C.(1)(a), the occurrence should be reported to the appropriate supervisory authority before any further work on the SSD/assembly is progressed.

C. General Handling Rules

(1) The following general rules shall be observed during all operations with SSDs:-

(a) Avoid having any items, particularly non-conductive items, for example, plastic trays or bags, packaging material, handbags or personal effects, or drawings within the confines of the Special Handling Area (S.H.A.), which are not essential for the immediate work. Drawings which are required shall be securely attached to the rail provided to ensure that they cannot encroach into the work area.

(b) Operators shall not wear gloves or finger stalls when handling SSDs.

(c) Before removing a device or assembly from its conductive packing the operator shall first touch the conductive packing, similarly when repacking. The conductive packing shall be touched by hand before it is placed in contact with the device. Care should also be taken that the device terminals do not come into contact with any plastic or paper outer containers.

(d) If it should become necessary to lay a device on the work bench without its terminals being otherwise protectively shorted, it should be placed with its terminals in contact with the conductive work surface.

(e) Operators are reminded that SSDs can be destroyed by only momentary contact of any part of the device, including its body or case with any non-conducting or ungrounded object and that the damage is inflicted at the moment of contact.

The disciplines prescribed in these paragraphs must therefore, be observed at all times.

(f) Operators and supervision should be aware that the use of conductive surfaces in an S.H.A. departs from the normal practice of providing electrically insulated work surfaces. Care should be taken, therefore, that unauthorised electrical equipment is not taken into S.H.A.s and that covers are not removed from any "live" equipment.

CLEANING

1. Procedures

A. Case and Lid

(1) Clean the case and lid, both inside and outside, with lint-free cloth moistened with trichloroethane.

(2) Finally polish with dry lint-free cloth.

B. Front Panel

(1) Polish the panel, including the display windows, with a chamois leather.

NOTE: The windows are easily scratched so care must be taken when cleaning.

(2) Clean off all traces of old gasket and jointing compound from the underside of the panel using lint-free cloth moistened with trichloroethane.

C. Electrical Components

CAUTION: INDISCRIMINATE USE OF THE AIR JET MAY ONLY REDISTRIBUTE DUST AND DIRT, DIRECT AIR JET TO THE OUTSIDE OF THE MECHANISM.

(1) Use a soft brush and a dry, low pressure air jet to remove dust and dirt particles, taking care to avoid damage to the protective coating on the printed circuit boards and the connector assembly.

CHECK

1. Procedures

A. General

The procedure detailed in paragraph B applies when inspecting both overhauled and new components. Any additional checks necessary are detailed in paragraphs C to F.

B. All Components

(1) Ensure all components are clean. Recommended cleaning methods are given in Chapter 3-3, CLEANING.

(2) Check visually for cracks or other damage. Reject cracked or damaged components.

(3) Examine for corrosion. Any component showing signs of corrosion must be renewed.

(4) Examine all electrical components and wiring for evidence of overheating and for damage or deterioration of insulation. Reject any components whose performance could be impaired and renew defective wiring by reference to Chapter 3-5, REPAIRS.

(5) Item 1 of the list in Chapter 3-10, SPECIAL TOOLS, FIXTURES AND EQUIPMENT, will be required.

C. Case and Lid

(1) The condition of the paintwork will have no adverse effect on the operation of the Tester. Both minor defects, i.e. surface scratches and scores which penetrate the protective coating, may be treated in accordance with the procedure detailed in 3-5, REPAIRS.

D. Front Panel

(1) Examine the paintwork on the front panel to ensure legibility of panel references. Touch-up worn or damaged paintwork in accordance with the procedure detailed in Chapter 3-5, REPAIRS.

E. Electrical Connectors

(1) Examine connector pins for straightness and the body for chips and cracks.

(2) Ensure that soldered and crimped connections are satisfactory and are covered by rubber sleeving, if applicable.

(3) If a connector is damaged, fit a new one as detailed in Chapter 3-5, REPAIRS.

F. Wiring

(1) With reference to the point to point wiring, see Chapter 3-5, Table 1, use the multimeter set to ohms to carry out an electrical point to point check of the wiring. If necessary, renew the wires as described in Chapter 3-5, REPAIRS.

REPAIRS

1. Procedures

A. Introduction

(1) This chapter details the procedures required to repair those sub-assemblies which are considered repairable. Repairs to other sub-assemblies are confined to replacement of parts, except for the processor board, which requires special techniques and test equipment and must be returned to the manufacturer for overhaul.

(2) Faulty parts must be replaced by approved spares.

(3) Items 1 and 2 on the list in SPECIAL TOOLS, FIXTURES AND EQUIPMENT, Chapter 3-10, will be required.

B. Painting

NOTE: The condition of the paintwork will have no adverse effect on the operation of the Tester. If required, surface scratches may be rubbed out using metal polish or other fine abrasive. Scratches or scores which penetrate the protective coating may be treated in the following manner.

(1) Case, Lid and Panel

(a) Degrease the area to be painted using trichlorethylene and allow to dry in a dust free atmosphere.

(b) Apply one coat of epoxy primer and allow four hours (minimum) to dry in a dust free atmosphere.

(c) If necessary, apply primer filler to rectify surface defects. Allow four hours drying time between coats and eight hours after the final coat.

(d) Smooth down with the specified wet abrasive paper and dry with a lint free cloth.

(e) Apply two uniform coats of epoxy finish allowing eight hours (minimum) between coats.

(f) Blend edges of new paint with fine abrasive paste and finish off with metal polish. Finally, polish with a lint-free cloth.

(2) Panel References

(a) Clean the area on which the reference is to be printed using trichlorethylene.

(b) Mix the polyscreen Part 1 and catalyst Part 2 in accordance with the manufacturer's instructions.

(c) Using a standard Uno pen, with light strokes, carefully print the reference.

(d) Allow to air dry in a dust-free atmosphere for four hours.

C. Bleed Valve Control Unit Indicator Board Assembly 4001 KTQ-1 Only

Refer to Figure 1.

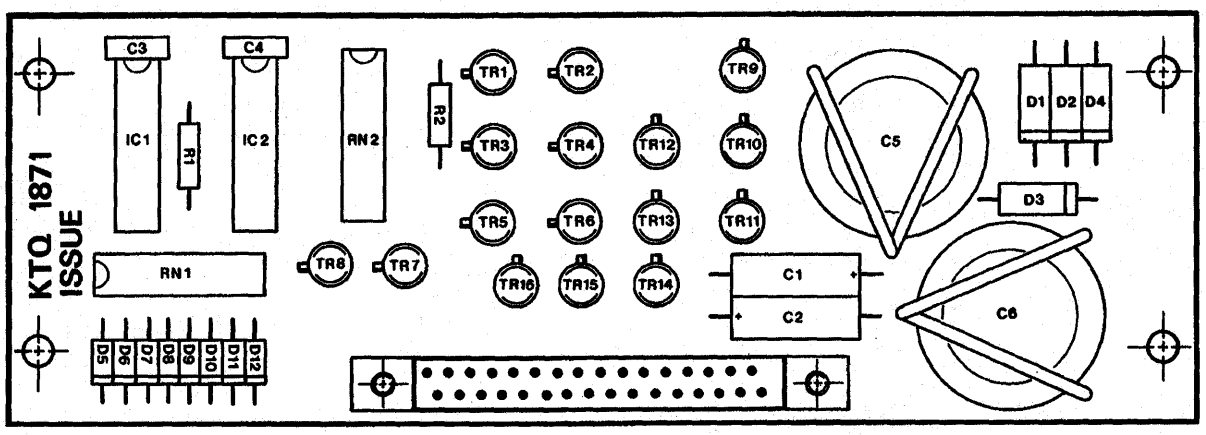
(1) Renewing Components

(a) The method of renewing components on the printed circuit board is self evident so only a general procedure is included. The locating of components is shown in Figure 1.

(b) Cut the connecting wires of the defective component close to the printed circuit board and remove all old solder and wire cuttings from the board. Wash the area with Arklone P and allow to dry.

(c) New component leads should be preformed as shown in Figure 2 and pretinned with the specified solder.

(d) Transipads should be removed from unserviceable components for use with the new component, where applicable.



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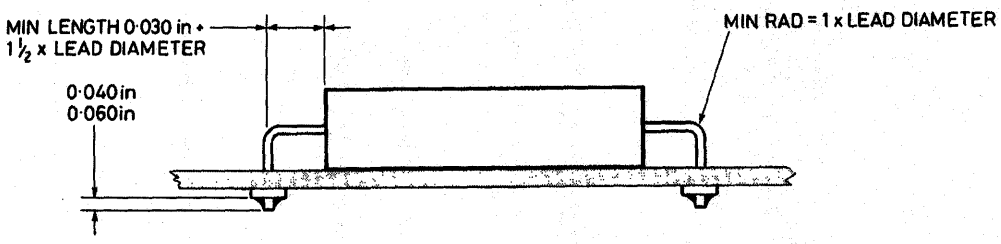
Bleed Valve Control Unit Indicator Board
Figure 1

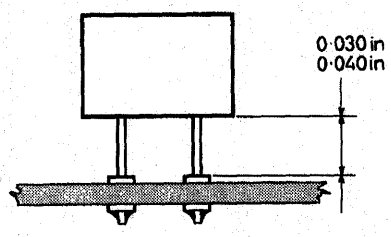
MOUNTING OF COMONENTS WITH AXIAL LEADS



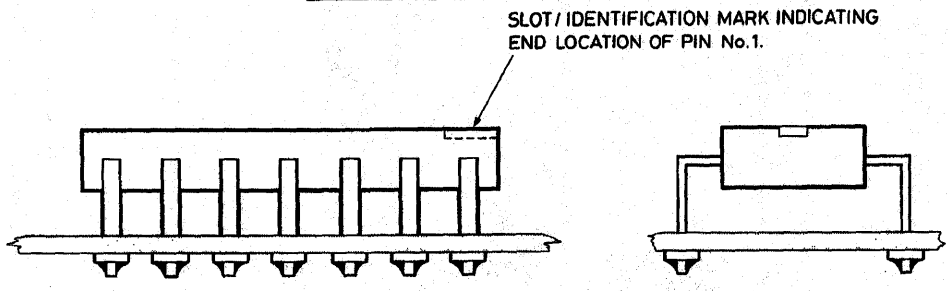
NOTE

COMPONENTS SHALL BE MOUNTED WITH THE BODY AXIS IN LINE WITH THE MOUNTING HOLES OR TERMINALS AND PARALLEL TO THE BOARD THE BODY SHALL BE IN CONTACT WITH THE BOARD AND NOMINALLY CENTRAL BETWEEN MOUNTING HOLES OR TERMINALS

MOUNTING OF COMPONENTS WITH TWO RADIAL LEADS



MOUNTING OF INTEGRATED CIRCUITS



NOTES

1. PIN No.1. POSITION IS IDENTIFIED ON THE PRINTED WIRING BOARDS BY A 0·075 in SQUARE PAD ON THE SOLDERING SIDE
2. COMPONENTS SHOULD BE MOUNTED WITH THEIR AXES PARALLEL AND PERPENDICULAR TO THE BOARD

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Component Mounting
Figure 2

(e) Components should be positioned on the board as shown in Figure 1 with care being taken in respect of polarised components. Heat shunts should be used when soldering components into place with the minimum of the specified solder.

(f) The component leads should not protrude more than 0.060 in from the rear face of the board.

(g) Components that are tied to the board should be tied with lacing tape and the knots should be locked with locking varnish.

(h) After soldering, clean the connections with Arklone P and allow to dry.

D. Solar Cell Panel Assembly

Refer to Figure 3 (4001 KTQ-1)
Refer to Figure 4 (4002 KTQ-1)

(1) Renewing Solar Cells OC1, OC2, OC3, OC4

NOTE: OC1, OC2, OC3 and OC4 consist of a photo cell 1D1, 2D1, 3D1 and 4D1 and a light emitting diode (LED) 1D2, 2D2, 3D2 and 4D2. The solar cells used on the assembly for 4001 KTQ-1 have an additional LED In each cell 1D3, 2D3, 3D3 and 4D3.

(a) Cut the wires from the negative terminal of the defective photo cell. Remove the old solder and wire cuttings from the insulated strap and clean with Arklone P.

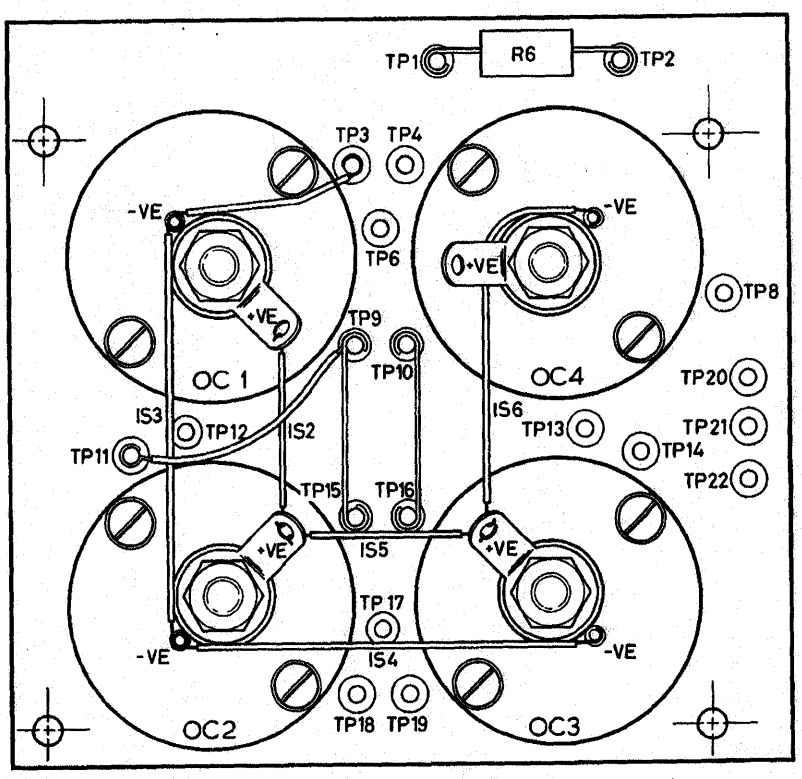
(b) Remove the large nut, washer, solder tag and nylon washer from the stud of the photo cell.

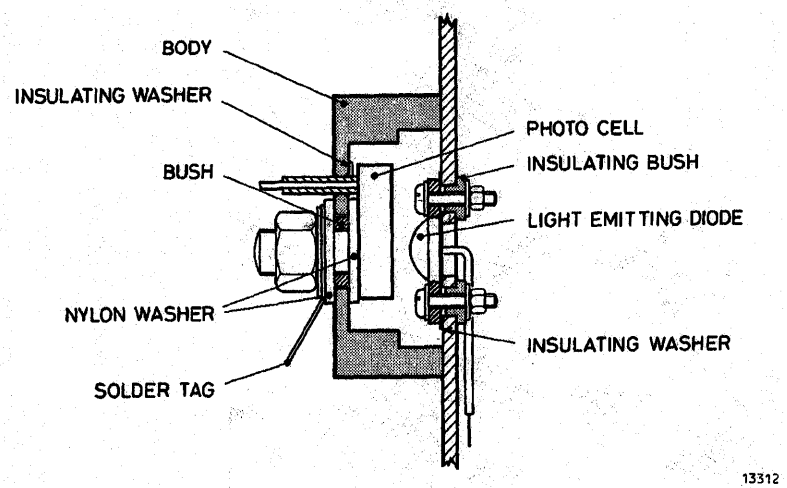
(c) Remove the two screws, nuts, spring washers and the four plain washers securing the body of each solar cell to the panel and remove the body.

(d) Remove the photo cell from the bush in the body. On the photo cell used on the 4002 KTQ-1 Tester remove and retain the insulating spacer washers for fitting to the replacement photo cell.

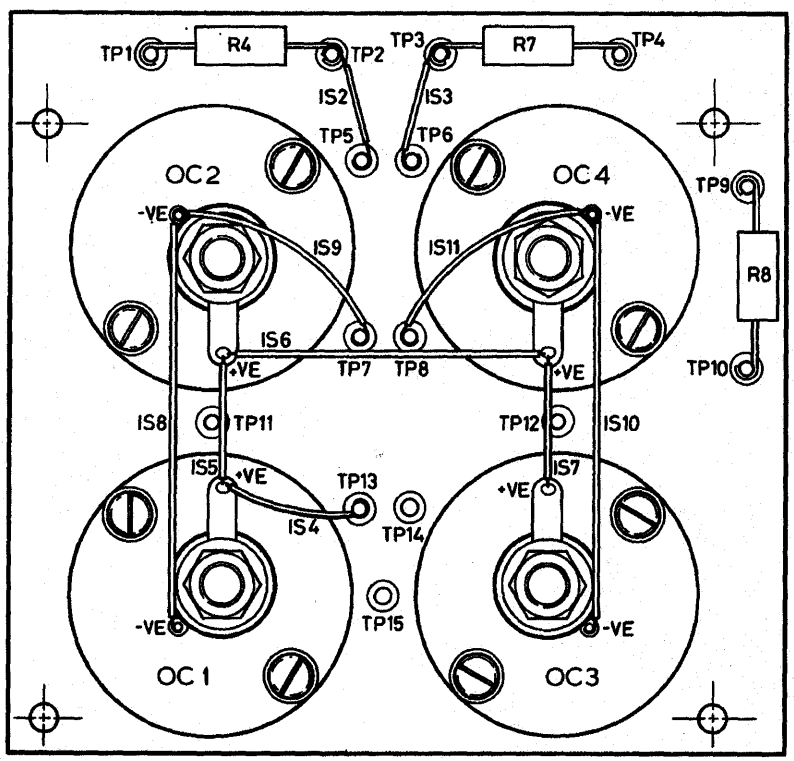
(e) Cut the wires of the defective LED from the relevant terminal pins. Remove the old solder and wire cuttings and clean with Arklone P.

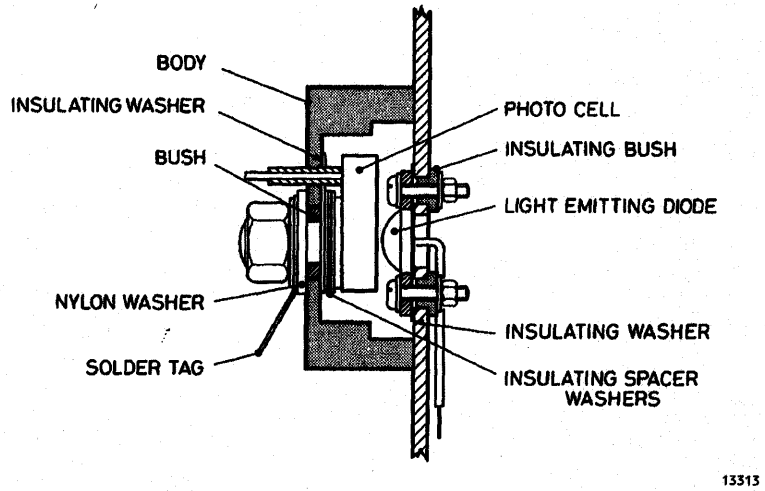
(f) Remove the two screws and nuts and the four plain washers securing each LED to the panel and remove the LED together with the insulating bushes and washer.





Solar Cell Panel Assembly (4001 KTQ-1)
Figure 3





Solar Cell Panel Assembly (4002 KTQ-1)
Figure 4

(g) Fit insulating washer and bushes to replacement LED and secure to the panel with the two screws, nut and four plain washers.

(h) Cut the connecting wires of the LED to allow not more than 3/4 turn and not less than 1/2 turn around the terminal post. Sleeve the wires with the appropriate sleeving, see note.

NOTE: The sleeving supplied with the replacement LED is to be replaced with PTFE sleeving, red for the positive lead and black for the negative lead. See list of materials in Chapter 3-10.

(j) Attach a suitable heat shunt to the connecting wires and solder them into place on the relevant terminal pins using the specified solder. Clean the connections with Arklone P.

(k) Fit replacement photo cell in the bush of the body ensuring the insulating spacer washers are refitted on the photo cell used on the 4002 KTQ-1 Tester.

(l) Secure the body of the solar cell to the panel using the two screws, nuts, spring washers and four plain washers.

(m) Secure the photo cell to the body with the nylon washer, solder tag, washer and large nut.

(n) Sleeve the negative connecting wire of the photo cell. Solder the wire to the appropriate insulated strap and clean with Arklone P.

(2) Renewing Resistors

(a) Cut the connecting wires of the defective resistor close to the terminal pins. Remove all old solder and wire cuttings and clean with Arklone P.

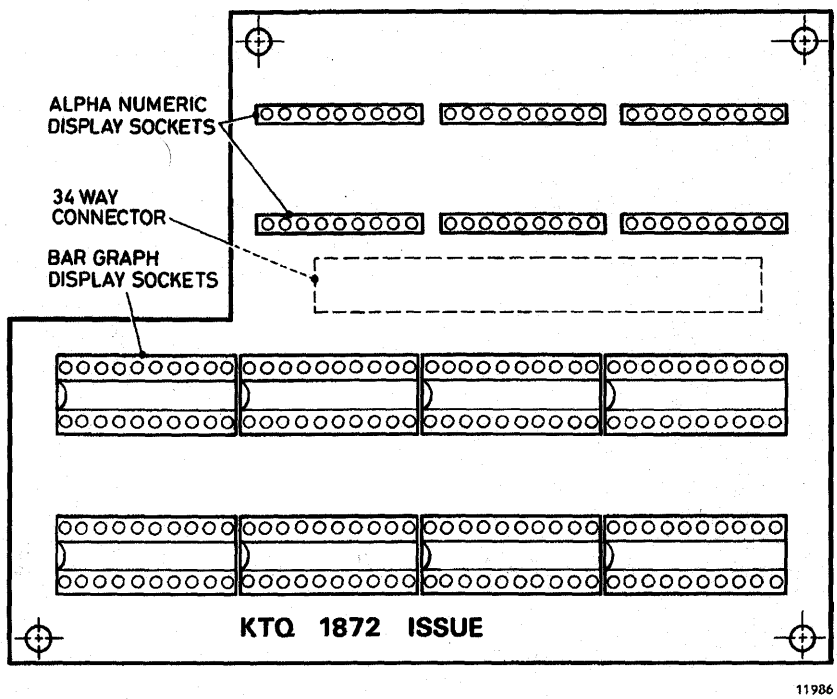
(b) Cut the connecting wires of the replacement resistor to allow not more than 3/4 turn and not less than 1/2 turn around the terminal pins.

(c) Position the replacement resistors as shown in Figures 3 and 4 and attach a suitable heat shunt to the connecting wires.

(d) Solder the connecting wires to the terminal pins using the specified solder and clean with Arklone P.

E. Display Board Assembly

Refer to Figure 5



Display Board Assembly
Figure 5

(1) Renewing Connectors

(a) The method of renewing the three types of connectors on the display board is self evident so only a general procedure is included. The location of the connectors is shown in Figure 5.

(b) Unsolder the defective connector and remove. Clear area of excess solder and clean with Arklone P.

(c) Solder the new connector into position, see Figure 5, using the minimum of specified solder.

NOTE: If the sockets for the alpha numeric displays need renewing the ten contact replacement socket must have one contact removed.

(d) After soldering clean connections with Arklone P.

F. Renewing Electrical Connectors SK2 and on 4001 KTQ-1 only SK5

(1) The removal of connectors from individual positions of the Tester is self evident therefore detailed procesures are not included. The general procedures are as follows:

(a) Slide the sleeving away from the pins of the damaged connector, then cut all the wires as close to the pins and discard the connector.

(b) Strip the insulating from the ends of the severed wires and, with reference to Table 1, solder them to the new connector terminals using the specified solder. Ensure that heat shunts are fitted on the component leadouts, otherwise damage may result.

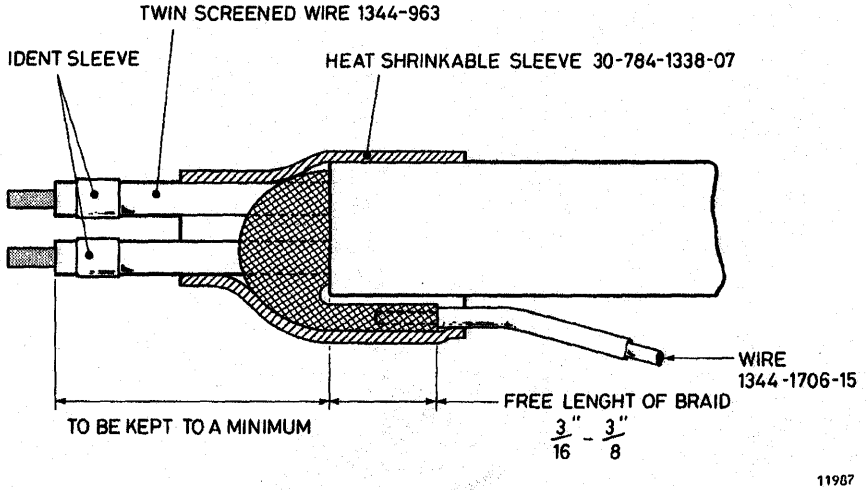
(c) After soldering, clean the connections with Arklone P to remove all traces of flux and particles of solder.

(d) Refit the sleeves so that they cover the soldered joints.

(e) Using the multimeter check the wiring for continuity by reference to Table 1.

G. Renewing Electrical Wiring

(1) The method for removing individual wires of the Tester is self evident therefore detailed procedures are not included. When renewing the twin screened cable refer to Figure 6, for terminating the screen, and for these cables and the renewing of individual wires the following general precautions should be observed.



Terminating Screened Cables
Figure 6

(a) Cut away the lacing to enable the repair to be made but ensure that the shape of the cable form is not lost.

(b) When soldering connections, apply heat to the terminals for brief periods only, otherwise the PVC insulating will be damaged. When soldering to terminals which carry electrical components, fit heat shunts to the connecting wires, otherwise damage may result.

(c) After renewing wiring, clean the soldered joints with Arklone P to remove all traces of flux and particles of solder.

(d) Remake all ties that were disturbed to carry out repairs, using Terylene tape and maintain the original shape of the cable form. Treat the knots with the appropriate locking varnish.

(e) When the defective wire has been renewed, refer to Table 1 and check the wiring for continuity, using the multimeter.

TABLE 1
Point to Point Wiring

This Table is applicable to the 4001 KTQ-1 and 4002 KTQ-2 Testers unless otherwise stated.

No.	Colour			From	To	Type (See Note)
	Wire	Sleeve 1	Sleeve 2			
200	R	Bk	Bk	TC1	PL3-H)Twisted	1
400	Y	Bk	Bk	TC1	PL3-J)Pair	1
201	R	Bk	Bn	TC1	PL3-N)Twisted	1
401	Y	Bk	Bn	TC1	PL3-M)Pair	1
202	R	Bk	R	TC1	PL3-R)Twisted	1
402	Y	Bk	R	TC1	N/C)Pair	1
600	B	Bk	Bk	TC1	PS1+ve	1
601	B	Bk	Bn	TC1	SK2-A15	1
602	B	Bk	R	TC1	SW3-A	1
603	B	Bk	O	TC1	SW6/2-21	1
604	B	Bk	Y	TC1	SW3-E	1
605	B	Bk	G	TC1	SW6/2-15	1
606	B	Bk	B	TC1	SW6/1-15	1
608	B	Bk	S	SW3-C	SW6/1-21	2
613	B	Bn	O	C3,C4	SW6/3 Wiper	2
614	B	Bn	Y	RL1-13	SK1-3	2
615	B	Bn	G	FS2-a	SK1-1	2
616	B	Bn	B	RL1-12	FS2-b	2
617	B	Bn	V	RL1-10	SK1-2	2
618	B	Bn	S	Solar Panel TP20	PS1-ve	2

Continued ...

No.	Colour			From	To	Type (See Note)
	Wire	Sleeve 1	Sleeve 2			
619	B	Bn	W	SK2-B25	PS2 Common	2
620	B	R	Bk	T1 0V (Sec)	PS1-ve	2
621	B	R	Bn	C2+ve	PS1-ve	2
622	B	R	R	Solar Panel TP4	PS1+ve	2
623	B	R	O	SK2-C2	Solar Panel TP15 *	2
624	B	R	Y	SK2-A3	Solar Panel TP10 *	2
628	B	R	S	PL3-K	SW4-C	2
629	B	R	W	SW4-C	SW5-D	2
630	B	O	Bk	SW5-D	SW6/4 wiper	2
631	B	O	Bn	SW6/4 wiper	SW6/3 wiper	2
632	B	O	R	C3, C4	PS1-ve	2
633	B	O	O	SK2-C22	C3	2
634	B	O	Y	C3	SW6/1 wiper	2
635	B	O	G	SK2-A22	C4	2
636	B	O	B	C4	SW6/2 wiper	2
637	B	O	V	SK2-A11	SW4-A	2
638	B	O	S	SK2-C25	SW5-C	2
639	B	O	W	SK2-C25	SW5-E	2
640	B	Y	Bk	SK2-A27	SW5-B	2
641	B	Y	Bn	SK2-A8	SW6/3-17	2
642	B	Y	R	SK2-A9	SW6/3-19	2
643	B	Y	O	SK2-A10	SW6/3-23	2
644	B	Y	Y	SK2-A7	SW6/4-17	2
645	B	Y	G	SK2-C20	Solar Panel TP4 *	2
646	B	Y	B	SK2-C24	Solar Panel TP8 *	2
647	B	Y	V	SK2-C17	Solar Panel TP14 *	2
648	B	Y	S	SK2-C18	Solar Panel TP7 *	2
649	B	Y	W	SK2-A28	Solar Panel TP1 *	2
650	B	G	Bk	SK2-A1	R3-1	2
651	B	G	Bn	R3-1	R2-3	2
652	B	G	R	SK2-C28	R3-2	2
653	B	G	O	SK2-A5	R3-3	2
654	B	G	Y	R3-3	R2-1	2
655	B	G	G	SK2-C27	R2-2	2
656	B	G	B	SK2-C4	PS2+ve	2
657	B	G	V	SK2-C5	N/C *	2
658	B	G	S	SK2-C1	PS2-ve	2
659	B	G	W	SK2-A2	N/C *	2
660	B	B	Bk	SK2-C13	T1-18.5V (2)	2
661	B	B	Bn	T1-18.5V (2)	N/C *	2
662	B	B	R	T1-18.5V (1)	N/C *	2
663	B	B	O	PL2-A	N/C *	2
664	B	B	Y	PL3-G	N/C *	2
665	B	B	G	SW2-C	PL2-C	2

* Connections for 4002KTQ-1 only.

Continued ...

No.	Colour			From	To		Type (See Note)
	Wire	Sleeve 1	Sleeve 2				
666	B	B	B	SW2-E	PL2-B		2
667	B	B	V	SW2-B	PL2-G		2
668	B	B	S	SW2-D	PL2-H		2
669	B	B	W	SW2-C14	PL2-A		2
670	B	V	Bk	PL1-A	FS1-a		2
671	B	V	Bn	FS1-b.	SW1-E		2
672	B	V	R	PL1-D	SW1-G		2
673	B	V	O	PL1-E	ET1		2
674	B	V	Y	C1+ve	ET1		2
675	B	V	G	PS1-AC	SW1-C		2
676	B	V	B	PS1-AC	PS2-AC		2
677	B	V	V	T1-57.5V (2)	PS2-AC		2
678	B	V	S	T1-57.5V (2)	RL1-8		2
680	B	S	Bk	PS1-AC	SW1-D		2
681	B	S	Bn	PS1-AC	PS2-AC		2
682	B	S	R	T1-57.5V (1)	PS2-AC		2
683	B	S	O	T1-57.5V (1)	RL1-6		2
9001	Bk	Bk	Bn	PL2-F	SK2-B21	Screen	3
9201	R	Bk	Bn	PL2-D	SK2-C21	Red Core	
9601	B	Bk	Bn	PL2-E	SK2-A21	Blue Core	
9002	Bk	Bk	R	PL2-c	SK2-B9	Screen	3
9202	R	Bk	R	PL2-a	SK2-C9	Red Core	
9602	B	Bk	R	PL2-b	SK2-C10	Blue Core	
9003	Bk	Bk	O	PL2-Z	SK2-B29	Screen	3
9203	R	Bk	O	PL2-X	SK2-A29	Red Core	
9603	B	Bk	O	PL2-Y	SK2-C29	Blue Core	
9004	Bk	Bk	Y	PL2-W	SK2-B30	Screen	3
9204	R	Bk	Y	PL2-U	SK2-A30	Red Core	
9604	B	Bk	Y	PL2-V	SK2-C30	Blue Core	
9005	Bk	Bk	G	PL2-T	SK2-B31	Screen	3
9205	R	Bk	G	PL2-R	SK2-A31	Red Core	
9605	B	Bk	G	PL2-S	SK2-C31	Blue Core	
9006	Bk	Bk	B	PL2-P	SK2-B26	Screen	3
9206	R	Bk	B	PL2-M	SK2-C26	Red Core	
9606	B	Bk	B	PL2-N	SK2-C23	Blue Core	

Continued ...

No.	Colour			From	To		Type (See Note)
	Wire	Sleeve 1	Sleeve 2				
9007	Bk	Bk	V	PL2-L	SK2-B12	Screen	3
9207	R	Bk	V	PL2-J	SK2-C12	Red Core	
9607	B	Bk	V	PL2-K	SK2-C11	Blue Core	
9008	Bk	Bk	S	PL3-C	SK2-B17	Screen	3
9208	R	Bk	S	PL3-A	SK2-C16	Red Core	
9608	B	Bk	S	PL3-B	SK2-C6	Blue Core	
9009	Bk	Bk	W	PL3-F	SK2-B19	Screen	3
9209	R	Bk	W	PL3-D	SK2-C19	Red Core	
9609	B	Bk	W	PL3-E	SK2-C15	Blue Core	
IS1	G			SW6/4-13	SW6/4-17		4
IS2	G			SW6/4-17	SW6/4-21		4
IS3	G			SW6/4-21	SW6/4-25		4
IS4	G			PL3-K	PL3-P		5
IS6	G			SK2-A5	SK2-A4		5
IS7	G			SK2-A4	SK2-A3		5
IS8	G			SK2-A1	SK2-C1		5
IS9	G			SK2-C2	SK2-C3		5
IS10	G			SK2-C4	SK2-C5		5
BS1				SW6/1-11	SW6/1-12		6
BS2				SW6/1-12	SW6/1-13		6
BS3				SW6/1-13	SW6/1-14		6
BS4				SW6/1-14	SW6/1-15		6
BS6				SW6/1-19	SW6/1-20		6
BS7				SW6/1-20	SW6/1-21		6
BS9				SW6/2-11	SW6/2-12		6
BS10				SW6/2-12	SW6/2-13		6
BS11				SW6/2-13	SW6/2-14		6
BS12				SW6/2-14	SW6/2-15		6
BS14				SW6/2-19	SW6/2-20		6
BS15				SW6/2-20	SW6/2-21		6
BS17				SW6/3-15	SW6/3-16		6
BS18				SW6/3-16	SW6/3-17		6
BS20				SW6/3-19	SW6/3-20		6
BS21				SW6/3-20	SW6/3-21		6
BS23				SW6/3-23	SW6/3-24		6
BS24				SW6/3-24	SW6/3-25		6

Continued ...

No.	Colour			From	To	Type (See Note)
	Wire	Sleeve 1	Sleeve 2			
The remainder of this Table is applicable to 4001 KTQ-1 only						
210	R	Bn	Bk	SK5-1	LP11/1-1	7
211	R	Bn	Bn	LP11/1-2	LP12/2-3	7
212	R	Bn	R	LP12/2-4	LP13/2-3	7
213	R	Bn	O	LP13/1-2	LP14/2-3	7
214	R	Bn	Y	LP14/2-4	LP15/2-3	7
215	R	Bn	G	LP15/2-4	LP16/2-3	7
216	R	Bn	B	LP16/2-4	LP17/1-1	7
217	R	Bn	V	LP17/1-2	LP18/1-1	7
218	R	Bn	S	SK5-2	LP11/2-3	7
219	R	Bn	W	LP11/2-4	LP12/1-1	7
220	R	R	Bk	LP12/1-2	LP13/1-1	7
221	R	R	Bn	LP13/2-4	LP14/1-1	7
222	R	R	R	LP14/1-2	LP15/1-1	7
223	R	R	O	LP15/1-2	LP16/1-1	7
224	R	R	Y	LP16/1-2	LP17/2-3	7
225	R	R	G	LP17/2-4	LP18/2-3	7
226	R	R	B	SK5-11	LP11/1-6	7
227	R	R	V	SK5-10	LP11/2-5	7
228	R	R	S	SK5-12	LP12/1-6	7
229	R	R	W	SK5-13	LP12/2-5	7
230	R	O	Bk	SK5-15	LP13/1-6	7
231	R	O	Bn	SK5-14	LP13/2-5	7
232	R	O	R	SK5-16	LP14/1-6	7
233	R	O	O	SK5-17	LP14/2-5	7
234	R	O	Y	SK5-18	LP15/1-6	7
235	R	O	G	SK5-19	LP15/2-5	7
236	R	O	B	SK5-20	LP16/1-6	7
237	R	O	V	SK5-21	LP16/2-5	7
238	R	O	S	SK5-23	LP17/1-6	7
239	R	O	W	SK5-22	LP17/2-5	7
240	R	Y	Bk	SK5-25	LP18/1-6	7
241	R	Y	Bn	SK5-24	LP18/2-5	7
242	R	Y	R	PL4-B	SK2-C7	7
243	R	Y	O	PL4-E	SW11-NO	7
244	R	Y	Y	PL4-H	SW12-NO	7
245	R	Y	G	PL4-F	SW13-NO	7
246	R	Y	B	PL4-G	SW14-NO	7
247	R	Y	V	PL4-D	SW15-NO	7
248	R	Y	S	PL4-E	SW16-NO	7
249	R	Y	W	PL4-N	SW17-NO	7
250	R	G	Bk	PL4-M	SW18-NO	7

Continued ...

No.	Colour			From	To	Type (See Note)
	Wire	Sleeve 1	Sleeve 2			
251	R	G	Bn	SW11-NO	SK5-26	7
252	R	G	R	SW12-NO	SK5-27	7
253	R	G	O	SW13-NO	SK5-28	7
254	R	G	Y	SW14-NO	SK5-29	7
255	R	G	G	SW15-NO	SK5-30	7
256	R	G	B	SW16-NO	SK5-31	7
257	R	G	V	SW17-NO	SK5-32	7
258	R	G	S	SW18-NO	SK5-33	7
269	R	B	W	SW11-C	SW12-C	8
270	R	V	Bk	SW12-C	SW13-C	8
271	R	V	Bn	SW13-C	SW14-C	8
272	R	V	R	SW14-C	SW15-C	8
273	R	V	O	SW15-C	SW16-C	8
274	R	V	Y	SW16-C	SW17-C	8
275	R	V	G	SW17-C	SW18-C	8
276	R	V	B	SW18-C	Solar Panel TP21	8
277	R	V	V	PL4-C	Solar Panel TP21	8
280	R	S	Bk	SK2-C8	Solar Panel TP22	9
281	R	S	Bn	PL4-A	Solar Panel TP22	9
282	R	S	R	SK5-9	Solar Panel TP22	9
623	B	R	O	SK2-C2	Solar Panel TP4	2
624	B	R	Y	SK2-A3	Solar Panel TP20	2
645	B	Y	G	SK2-C20	Solar Panel TP1	2
646	B	Y	B	SK2-C24	OC4+ve	2
647	B	Y	V	SK2-C17	OC1+ve	2
648	B	Y	S	SK2-C18	Solar Panel TP3	2
649	B	Y	W	SK2-A28	Solar Panel TP9	2
657	B	G	V	SK2-C5	SK5-6	2
659	B	G	W	SK2-A2	SK5-4	2
661	B	B	Bn	T1-18.5V (2)	SK5-5	2
662	B	B	R	T1-18.5V (1)	SK5-3	2
663	B	B	O	PL2-A	PL4-R	2
664	B	B	Y	PL3-G	SW7-C	2
9010	Bk	Bn	Bk	PL4-A	SK2-B32 Screen	3
9210	R	Bn	Bk	PL4-L	SK2-C32 Red Core	3
9610	B	Bn	Bk	PL2-K	SK2-A32 Blue Core	3

Continued ...

No.	Colour			From	To		Type (See Note)
	Wire	Sleeve 1	Sleeve 2				
9011	Bk	Bn	Bn	N/C	SK2-B20	Screen	3
9211	R	Bn	Bn	PL4-U	SK2-A20	Red Core	3
9611	B	Bn	Bn	PL4-T	SK2-A19	Blue Core	3
IS11	G			LP11/1-1	LP11/1-2		4
IS12	G			LP12/1-1	LP12/1-2		4
IS13	G			LP13/1-1	LP13/1-2		4
IS14	G			LP14/1-1	LP14/1-2		4
IS15	G			LP15/1-1	LP15/1-2		4
IS16	G			LP16/1-1	LP16/1-2		4
IS17	G			LP17/1-1	LP17/1-2		4
IS18	G			LP18/1-1	LP18/1-2		4
IS21	G			LP11/2-3	LP11/2-4		4
IS22	G			LP12/2-3	LP12/2-4		4
IS23	G			LP13/2-3	LP13/2-4		4
IS24	G			LP14/2-3	LP14/2-4		4
IS25	G			LP15/2-3	LP15/2-4		4
IS26	G			LP16/2-3	LP16/2-4		4
IS27	G			LP17/2-3	LP17/2-4		4
IS28	G			LP18/2-3	LP18/2-4		4

NOTE: Wire Type 1 - Flying leads from Temperature Compensator.
Wire Type 2 - 7/0.2 mm silver plated copper wire, PTFE insulated, blue, Smiths Pt.No. 1344-1706-12.
Wire Type 3 - 7/0.125 mm twin core silver plated copper wire, screened, PTFE insulated, Smiths Pt.No. 1344-963.
Wire Type 4 - 1/0.45 mm tinned copper wire, Smiths Pt.No. 1341-409. Sleeved with PTFE sleeving, green, Smiths Pt.No. 1837-708-11.
Wire Type 5 - 7/0.2 mm silver plated copper wire, PTFE insulated, green, Smiths Pt.No. 1344-1706-11.
Wire Type 6 - 1/0.45 mm tinned copper wire, Smiths Pt.No. 1341-409.
Wire Type 7 - 7/0.2 mm silver plated copper wire, PTFE insulated, red, Smiths Pt.No. 1344-1706-07.
Wire Type 8 - 19/0.25 mm silver plated copper wire, PTFE insulated, red, Smiths Pt.No. 1344-2702-07.
Wire Type 9 - 19/0.2 mm silver plated copper wire, PTFE insulated, red, Smiths Pt.No. 1344-1708-07.

ASSEMBLY

1. Procedures

A. General

(1) The procedure detailed in this chapter provides a quick, logical method of assembly after a complete overhaul. If the Tester has only undergone partial overhaul, the procedure may be modified to suit a particular requirement. After the Tester has been repaired or overhauled it must be subjected to the complete procedure detailed in Chapter 3-6, TESTING.

(2) Seal screw heads and washers to the front panel with Hylomar jointing compound.

(3) Unless otherwise stated lock all threads with Omnifit 5L during assembly.

(4) Before despatch the Tester must be packed as detailed in STORAGE INSTRUCTIONS, Chapter 3-9.

B. Assembling Components to the Front Panel

(1) Indicator/Switches SW11 to SW18 (4001 KTQ-1 only)

(a) Position the indicator/switches in their relevant places on the front panel, slide on the retaining sleeve, and secure with two screws inside the housing of the indicator/switches.

(b) With reference to Table 1 of Chapter 3-5, REPAIRS, solder the wires into place on the relevant indicator/switches using the specified solder.

(2) Potentiometer and Mount Assemblies R2 and k3

(a) Apply a thin coat of FS1292 grease to the new 'O' rings and Hylomar jointing compound to each side of the new gaskets, fit an 'O' ring and gasket to each potentiometer and mount assembly.

(b) Position the potentiometer and mount assemblies in their relevant places on the front panel and secure with three csk head screws.

(c) Fit the knobs to the shafts of the potentiometer and mount assemblies and secure with nuts, fit the caps to the top of the knobs.

(d) With reference to Table 1 of Chapter 3-5, REPAIRS, solder the wires into place on the relevant potentiometer and mount assemblies using the specified solder.

(3) Switch SW6

(a) Apply a thin coat of FS1292 grease to a new '0' ring and fit the '0' ring over the shaft of the switch.

(b) Position the switch on the front panel and secure with three csk head screws.

(c) Fit the knob to the shaft of the switch and secure with nut. Fit the cap to the top of the knob.

(d) With reference to Table 1 of Chapter 3-5, REPAIRS, solder the wires into place on the switch using the specified solder.

(4) Display Board Assembly

(a) Replace any faulty alpha numeric or bar graph displays that were removed during disassembly.

(b) Position the display board assembly in the Tester and secure to the front panel with four pillars, csk head screws, nuts, plain and spring washers.

(5) Compensation Assembly TC1

(a) Position the compensation assembly and insulating plate on the front panel and secure with four csk head screws.

(b) With reference to Table 1 of Chapter 3-5, REPAIRS, connect the wire to the positive terminal of power supply PS1, the remaining wires solder into position using the specified solder. Slide the sleeves, where fitted, over the soldered connections.

(c) Lace the wires to the cable form with terylene tape and treat the knots with locking varnish.

(6) Switches SW1, to SW5 inclusive, and switches SW7 and SW8 on sets 4001 KTQ-1 only.

NOTE: On assembly, switch SW5 will need to be fitted with its spring loaded bias set between OFF and SET T.A. Switches SW7 and SW8 are not connected.

(a) Position the switches in their relevant places on the front panel and secure with the hexagon nut.

(b) With reference to Table 1 of Chapter 3-5, REPAIRS, solder the wires into place on the relevant switches using the specified solder. Slide sleeves over the soldered connections of SW1.

(7) Fuses FS1 and FS2

(a) Position the fuses in their relevant places on the front panel and secure with the hexagon nut.

(b) With reference to Table 1 of Chapter 3-5, REPAIRS, solder the wires into place on the relevant fuses using the specified solder. Slide sleeves over the soldered connections.

(8) Connectors SK1, PL1, P12, PL3 and on 4001 KTQ-1 only PL4

(a) Apply a thin coat of Hylomar jointing compound to each side of the new gaskets and fit the gaskets to the connectors.

(b) Position the connectors and gaskets in their relevant places on the front panel and secure with the four pan head screws, nuts, spring washers and the eight plain washers.

(c) With reference to Table 1 of Chapter 3-5, REPAIRS, crimp pins to each wire and insert the pin into place in the connector. Fill all unused positions with pins and fit filler plugs.

C. Assembling the Bleed Valve Control Unit Indicator Board Assembly (4001 KTQ-1 only)

(1) Position the board assembly in the Tester and secure with the four csk head screws, nuts, plain and spring washers.

(2) Fit the connector to PL1 of the board assembly.

D. Assembling Components to the Base Plate Sub-Assembly

NOTE: Support the base plate sub-assembly to prevent strain on the wires while assembling components.

(1) Solar Cell Assembly

(a) Position the solar cell assembly on the base plate sub-assembly and secure with the four screws, nuts, spring washers, pillars and the eight plain washers.

(b) With reference to Table 1 of Chapter 3-5, REPAIRS, solder the wires to the terminal pins of the solar cell assembly.

(2) Capacitors C1, C2, C3 and C4

(a) Position the capacitors on the base plate sub-assembly and secure with terylene tape, treat the knots with locking varnish.

(b) Using heat shunts, to prevent damage to the capacitors, solder the capacitors into place between the terminal pins on the base plate sub-assembly using the specified solder.

(3) Relay RL1, Capacitor C5 and Diode D1

(a) Fit the relay bracket to the relay, if removed during disassembly, and secure with the nut and washer.

(b) Position the relay and relay bracket on the base plate sub-assembly and secure with the two pan head screws, nuts and plain and spring washers.

(c) Using heat shunts, to prevent damage to the components, solder the capacitor and diode to the relay terminals and with reference to Table 1 of Chapter 3-5, REPAIRS, solder the wires to the terminals of the relay.

(4) Transformer T1

(a) Position the transformer on the base plate sub-assembly and secure with the four pan head screws, nuts and plain washers.

(b) With reference to Table 1 of Chapter 3-5, REPAIRS, solder the wires to the terminals of the transformer.

(5) Power Supplies PS1 and PS2

(a) Position the power supplies in their relevant place on the base plate sub-assembly and secure each power supply with the four pan head screws and plain washers.

(b) With reference to Table 1 of Chapter 3-5, REPAIRS, connect the wires to each of the power supplies.

E. Assembling the Base Plate Sub-Assembly

(1) Position the base plate sub-assembly in the Tester and secure with the four screws and washers.

F. Assembling the Processor Board

(1) Before handling the processor board refer to paragraph 2 of Chapter 3-2, DISASSEMBLY.

(2) Slide the processor board along the card guides on the base plate sub-assembly until it mates with the 96-way connector (PL1).

(3) Swivel the stop plate to hold the processor board in position and secure the stop plate with the two screws, a nut and a washer.

(4) Fit the connector assembly to PL1 of the display board and to PL2 of the processor board.

G. Assembling the Case

(1) Hold the mechanism by means of the D-shaped handles and lower it carefully into the case.

NOTE: The panel is shaped to ensure the mechanism can be fitted one way only.

(2) Secure the mechanism in the case with twelve 2BA x 1/2 in cheese head screws and sealing washers.

(3) Apply the tests detailed in Chapter 3-8, TESTING.

FITS AND CLEARANCES

1. Fits and Clearances

Not applicable.

TESTING

1. Procedures

A. General

(1) The Tester may be tested in any convenient position, i.e. the control panel in either the vertical or horizontal planes. The tests must be carried out at a temperature of 20 degrees Celsius ±5 degrees Celsius.

(2) The Tester must be connected, via pins A and D of the power supply connector (1), to a 115 V 400 Hz single phase supply with pin E connected to earth.

(3) The tests detailed in this chapter apply to both Testers for all engine applications unless otherwise stated.

(4) Tests involving the RB211-535 engines will require a link to be fitted between pins A and C of panel test connector (3). No link is required for RB211-524 unit tests.

(5) Items 1 and 3 to 16 inclusive of the list in SPECIAL TOOLS, FIXTURES AND EQUIPMENT, Chapter 3-10, will be required.

(6) The numbers in parenthesis are the front panel references.

(7) Where the values obtained during testing are outside the permitted tolerances given, the user is to seek the advice of Smiths Industries, or an approved Smiths Industries technical representative.

B. Fuse Check

(1) Unscrew the caps on the two fuse holders (5) and (6). Extract the fuses and check that they are 1 A cartridge fuses. Refit the fuses and screw on the fuse holder caps.

C. Bonding Check

(1) Disconnect the power supply lead from the power supply connector (1) and using the Low Range Ohmmeter check that the resistance between the following points does not exceed 0.5 ohms.

(a) Terminal pin E of power supply connector (1) and the shell of test connector (2).

(b) Front panel handles and electrical connector shells.

D. Insulation Resistance Check

(1) Disconnect the power supply lead from the power supply connector (1), set the power supply switch (7) to the 'ON' position and using the Megohmmeter apply a 500 V d.c. supply between terminal pins A and E of power supply connector (1) for not less than 5 seconds.

(2) Check that the resistance reading is not less than 20 meghoms.

E. Cancel Datum and Redatum Switch Check

(1) Using the multimeter check that the following conditions exist when the Datum Select Switch (11) is in the positions stated.

(a) Short circuit between terminal pins B and C of test connector (3) when in the cancel datum mode.

(b) Short circuit between terminal pins G and H of test connector (3) when in the redatum mode.

(c) Open circuit between terminal pins B and C and terminal pins G and H of test connector (3) when in the NOR mode.

F. Torque Motor/Velocity Feedback Volts Check

NOTE: Torque Motor Volts is applicable to the 4001 KTQ-1 Tester for RB211-535 engines and Velocity Feedback Volts is applicable to both the 4001 KTQ-1 and 4002 KTQ-1 Testers for RB211-22 and RB211-524 engines.

(1) Set switch (7) to ON, and apply a suitably monitored variable 0-4 V d.c. supply to terminal pins J and K of test connector (3).

(2) Check that the indication of torque motor/velocity feedback volts (13) is within 5 percent of the supply potential over the range of the indicator when checked in both a positive and negative direction.

NOTE: Positive to J and negative to K for positive indication.
Negative to J and positive to K for negative indication.

G. Throttle Angle Volts/Motor Control Volts Check

NOTE: Throttle Angle Volts is applicable to the 4001 KTQ-1 Tester for RB211-535 engines and Motor Control Volts is applicable to both the 4001 KTQ-1 and 4002 KTQ-1 Testers for RB211-22 and RB211-524 engines.

(1) Throttle Lever Angle (TLA)

(a) Apply a suitable monitored variable 0-1 V r.m.s., 800 Hz supply to terminal pins B and C of test connector (20).

(b) Check that the indicator of throttle angle volts (14) is within 5 percent of the supply potential x4 over the range of the indicator.

(2) Throttle Lever Switch

(a) Apply a 0.5 V 800 Hz signal to terminals pins B and C of test connector (20).

(b) Check that the indication of throttle angle volts (14) indicates 2 V ±10%.

(c) Set switch (15) to SET TA and check that the throttle angle volts (14) indication drops to 0 V ±0.1 V.

(3) Motor Control Volts

(a) Apply a suitably monitored variable 0-120 V a.c. supply to terminal pins M and N of test connector (3).

(b) Check that the indication of motor control volts (14) is within 5 percent of the supply potential at every 10 volts scale mark over the range of the indicator.

NOTE: Test signal shall be the same phase orientation as Tester. Reversal of signal input shall give an indication of change on throttle angle volts/motor control volts (14).

H. Display Reference Checks

(1) Set switch (7) to ON and function switch (16) to DISPLAY TEST and check that the displays indicate the following:

(a) Display (8) indicates a readout of 00000 then each digit simultaneously increments by 1 until a readout of 99999 is displayed.

(b) The torque motor/velocity feedback volts (13) and throttle angle volts/motor control volts (14) displays increments by one LED bar until all LEDs are lit.

NOTE: The display reference checks will repeat while the function switch (16) remains in the DISPLAY TEST position.

J. Speed Channel Checks

(1) Measure N1 (Applicable to the 4001 KTQ-1 Tester for RB211-535 engines)

(a) Set switch (7) to ON, the test mode switch (9) to measure and the function switch (16) to N1.

(b) Using the a.c. oscillator apply a simulated speed signal, monitored by the frequency counter, to terminal pins X and Y of test connector (3).

(c) Check that the speed signal, displayed as a percentage speed, is within the values shown in Table 1.

TABLE 1
Measure N1

Input Signal Frequency Hz *	Indication Display (8) Percentage Speed
675	15 ±0.2
2250	50 ±0.2
4500	100 ±0.2
4950	110 ±0.2
5175	115 ±0.2

* Input signal amplitude 1.0 V peak to peak.

(2) Measure N1 (Applicable to the 4001 KTQ-1 and the 4002 KTQ-1 Testers for RB211-22 and RB211-524 engines)

(a) Set switch (7) to ON, the test mode switch (9) to measure and the function switch (16) to N1.

(b) Using the a.c. oscillator apply a simulated speed signal, monitored by the frequency counter, to terminal pins X and Y of test connector (3).

(c) Check that the speed signal, displayed as a percentage speed, is within the values shown in Table 2.

TABLE 2
Measure N1

Input Signal Frequency Hz *	Indication Display (8) Percentage Speed
585	15 ±0.5
3510	90 ±0.25
4095	105 ±0.25
4290	110 ±0.5

* Input signal amplitude 1.0 V peak to peak.

(3) Measure N2

(a) Set switch (7) to ON, the test mode switch (9) to measure and the function switch (16) to N2 adjacent to N1.

(b) Using the a.c. oscillator apply a simulated speed signal, monitored by the frequency counter, to terminal pins U and V of test connector (3).

(c) Check that the speed signal, displayed as a percentage speed, is within the values shown in Table 3.

TABLE 3
Measure N2

Input Signal Frequency Hz *	Indication Display (8) Percentage Speed
1750	25 ±0.5
6300	90 ±0.25
7350	105 ±0.25
7700	110 ±0.5
8400	120 ±0.5

* Input signal amplitude 1.0 V peak to peak.

(4) Measure N2 (Applicable to the 4001 KTQ-1 Tester for RB211-535 engines)

(a) Set switch (7) to ON, the test mode switch (9) to measure and the function switch (16) to N2 adjacent to N2$\sqrt{T2}$.

(b) Using the a.c. oscillator apply a simulated speed signal, monitored by the frequency counter, to terminal pins L and K of the bleed valve control unit test connector (20).

(c) Check that the speed signal, displayed as R.P.M., is within the values shown in Table 4.

TABLE 4
Measure N2

Input Signal Frequency Hz *	Indication Display (8) R.P.M.
1750	1750 ± 4
3000	3000 ± 7
5000	5000 ±12
7000	7000 ±17
7700	7700 ±19
8400	8400 ±21

* Input signal amplitude 1.0 V peak to peak.

(5) Measure N3

(a) Set switch (7) to ON, the test mode switch (9) to measure and the function switch (16) to N3.

(b) Using the a.c. oscillator apply a simulated speed signal, monitored by the frequency counter, to terminal pins R and S of test connector (3).

(c) Check that the speed signal, displayed as a percentage speed, is within the values shown in Table 5.

TABLE 5
Measure N3

Input Signal Frequency Hz *	Indication Display (8) Percentage Speed
210	50 ±0.5
378	90 ±0.25

Continued

TABLE 5
Measure N3

Input Signal Frequency Hz *	Indication Display (8) Percentage Speed
441	105 ±0.25
462	110 ±0.5

* Input signal amplitude 1.0 V peak to peak.

K. Temperature Channel Checks

(1) Measure T2 (Applicable to the 4001 KTQ-1 Tester for RB211-535 engines)

(a) Set switch (7) to ON, the test mode switch (9) to measure and the function switch (16) to T2.

(b) Using the d.c. signal injector together with a suitable temperature reference cell (see Figure 1), apply simulated temperature signals to terminal pins H and J of thermocouple connector (4).

(c) Check that the temperature, displayed in degrees Celsius, is within the values shown in Table 6.

TABLE 6
Measure T2

Input Signal mV	Indication Display (8) Degrees Celsius
-2.240	-54 ±2
-2.104	-50 ±2
-1.758	-40 ±2
-1.039	-20 ±2
-0.292	0 ±2
0.478	20 ±2
1.263	40 ±2

Continued

TABLE 6 Continued

Input Signal mV	Indication Display (8) Degrees Celsius
2.061	60 ±2
2.866	80 ±2
3.674	100 ±2
4.479	120 ±2

NOTE: The tolerances should be maintained with either side of the thermocouple input earthed.

(2) Measure T7 #10 - Non-Ballested

(a) Set switch (7) to ON, the test mode switch (9) to measure and the function switch (16) to T7.

(b) Using the d.c. signal injector apply simulated temperature signals, monitored by the temperature chamber and digital voltmeter, to terminal pins M and R of thermocouple connector (4).

(c) Check that the temperature, displayed in degrees Celsius, is within the values shown in Table 7.

TABLE 7
Measure T7

Input Signal mV*	Indication Display (8) Degrees Celsius
14.29	350 ±3
16.40	400 ±3
18.51	450 ±3
20.65	500 ±2
22.78	550 ±2
24.91	600 ±2
27.03	650 ±2

MV - .91mV

Continued

TABLE 7 Continued

Input Signal mV	Indication Display (8) Degrees Celsius
29.14	700 ±2
31.23	750 ±3
33.30	800 ±3
35.34	850 ±3
37.33	900 ±3 (Max 4002KTQ-1)
41.27	1000 ±3 (Max 4001KTQ-1)

NOTE: The tolerances should be maintained with either side of the thermocouple input earthed.

L. Simulated Signal Checks

(1) Inject N1 (Applicable to the 4001 KTQ-1 Tester for RB211-535 engines)

(a) Set switch (7) to ON, the test mode switch (9) to inject and the function switch (16) to N1.

(b) Use the oscilloscope and frequency counter as monitors, connected to terminal pins a and b of test connector (3), and check that:

(i) The display (8) reads less than 15 percent or Lo when the N injector control (12) is rotated fully counter clockwise.

(ii) The display (8) reads greater than 115 percent or Hi when the N injector control (12) is rotated fully clockwise.

(iii) The amplitude of the signal is 6.0 V ±1.5 V peak to peak into a load of 5 K ohms and that the wave form is a sine wave without significant distortion.

(2) Inject N1 (Applicable to the 4001 KTQ-1 and 4002 KTQ-1 Testers for RB211-22 and RB211-524 engines)

(a) Set switch (7) to ON, the test mode switch (9) to inject and the function switch (16) to N1.

(b) Use the oscilloscope and frequency counter as monitors, connected to terminal pins a and b of test connector (3), and check that:

(i) The display (8) reads less than 50 percent when the N injector control (12) is rotated fully counter clockwise.

(ii) The display (8) reads greater than 110 percent when the N injector control (12) is rotated fully clockwise.

(iii) The amplitude of the signal is 6.0 V ±1.5 V peak to peak into a load of 5 K ohms and that the wave form is a sine wave without significant distortion.

(3) Inject N2

(a) Set switch (7) to ON, the test mode switch (9) to inject and the function switch (16) to N2 adjacent to N1.

(b) Use the oscilloscope and frequency counter as monitors, connected to terminal pins D and E of test connector (3), and check that:

(i) The display (8) reads less than 60 percent when the N injector control (12) is rotated fully counter clockwise.

(ii) The display (8) reads greater than 110 percent when the N injector control (12) is rotated fully clockwise.

(iii) The amplitude of the signal is 6.0 V ±1.5 V peak to peak into a load of 5 K ohms and that the wave form is a sine wave without significant distortion.

(4) Inject N2 (Applicable to the 4001 KTQ-1 Tester for RB211-535 engines)

(a) Set switch (7) to ON, the test mode switch (9) to inject and the function switch (16) to the N2 adjacent to N2#T2.

(b) Use the oscilloscope and frequency counter as monitors, connected to terminal pins T and U of the bleed valve control unit test connector (20), and check that:

(i) The display (8) reads less than 1750 R.P.M. when the N injector control (12) is rotated fully counter clockwise.

(ii) The display (8) reads greater than 8400 R.P.M. when the N injector control (12) is rotated fully clockwise.

(iii) The amplitude of the signal is 6.0 V ±1.5 V peak to peak into a load of 5 K ohms and that the wave form is a sine wave without significant distortion.

(5) Inject T2 (Applicable to the 4001 KTQ-1 Tester for RB211-535 engines)

(a) Set switch (7) to ON, the test mode switch (9) to inject and the function switch (16) to T2.

(b) Use the digital voltmeter and a 0.25 ohm resistor as monitors, connected to terminal pins A and B of the thermocouple connector (4), and check that:

(i) The digital voltmeter reading is less than -2.443 mV (-60 degrees celsius) when the T injector control (17) is rotated fully counter clockwise.

(ii) The digital voltmeter reading is greater than 4.670 mV (+125 degrees celsius) when the T injector control (17) is rotated fully clockwise.

(6) Inject T7 (Not for RB211-22 ac-524)

(a) Set switch (7) to ON, the test mode switch (9) to inject and the function switch (16) to T7.

(b) Use the digital voltmeter and a 1Ω across D-E ohm resistor as monitors, connected to terminal pins D and E of the thermocouple connector (4), and check that:

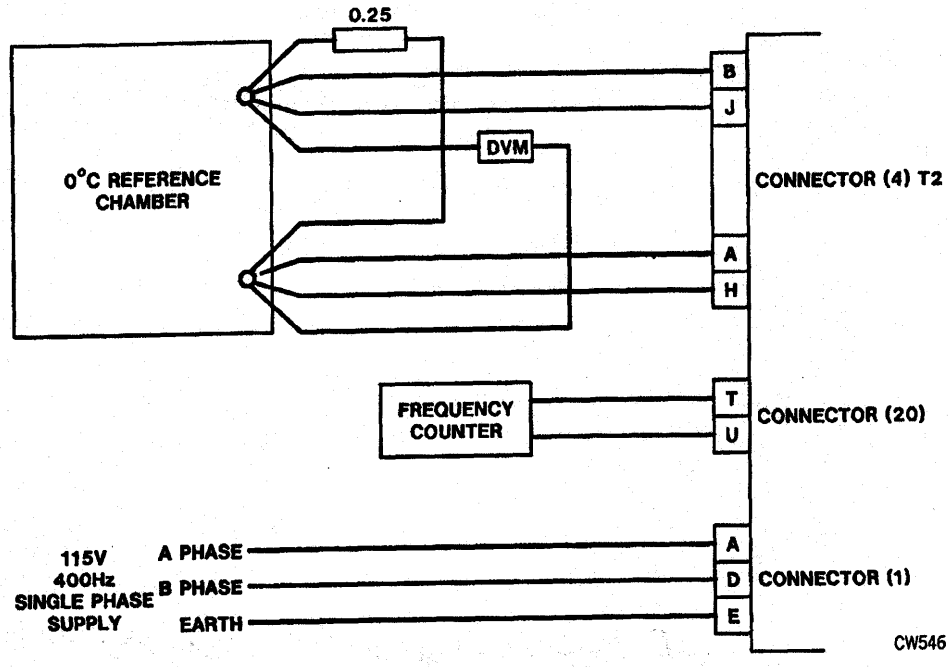
(i) The digital voltmeter reading is less than 14 mV (325 degrees celsius) when the T injector control (17) is rotated fully counter clockwise.

(ii) The digital voltmeter reading is greater than 42.24 mV (1025 degrees celsius) when the T injector control (17) is rotated fully clockwise.

(7) N2$\sqrt{T2}$ (Applicable to the 4001 KTQ-1 Tester for RB211-535 engines) sq.rt.

(a) Set switch (7) to ON, the test mode switch (9) to inject and the function switch (16) to T2.

(b) Connect the digital voltmeter and resistive load to the T2 circuit as shown in Figure 1. Using the digital voltmeter, monitor the T2 inject output and adjust the T injector control (17) such that the reading on display (8) is 0 degrees ±0.5 degrees celsius. Note the reading on the digital voltmeter.



$N2\sqrt{T2}$ Test Circuit
Figure 1

(c) Set function switch (16) to N2.

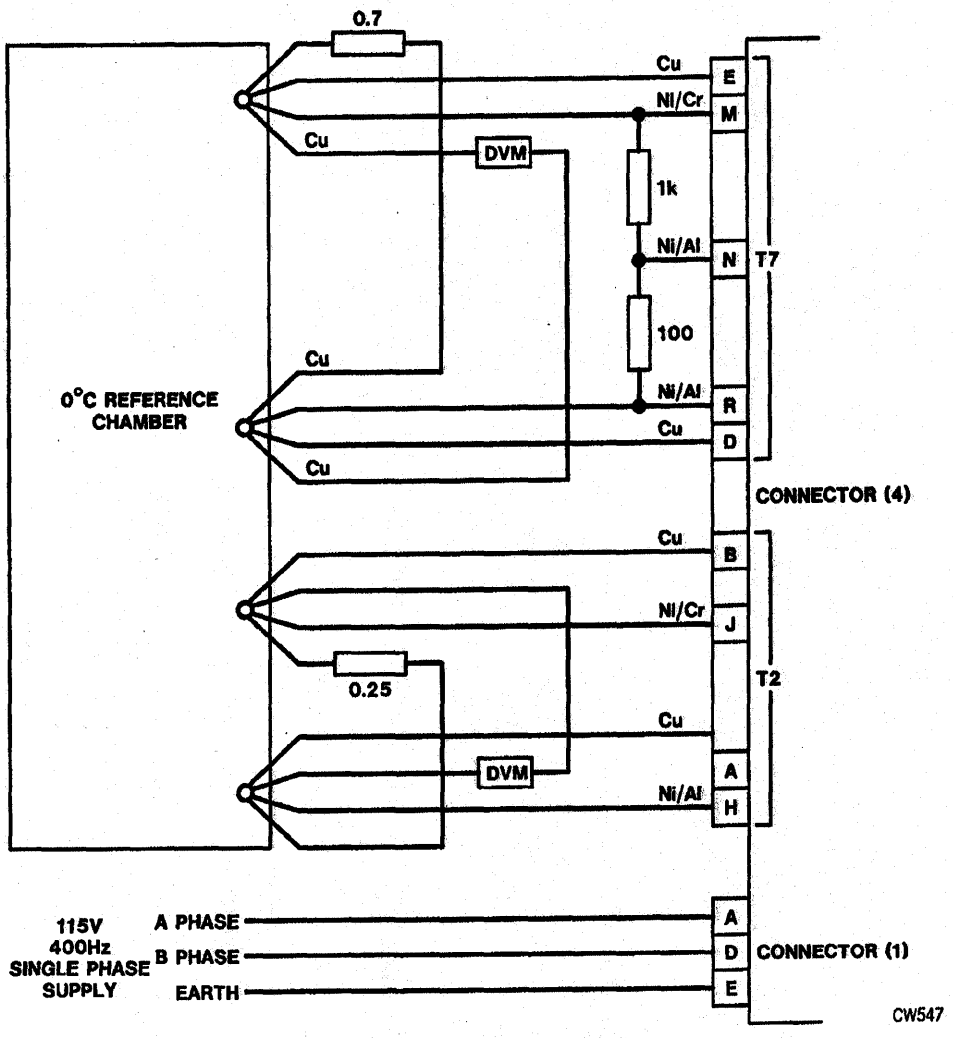
(d) Connect the frequency counter, as shown in Figure 1, to monitor the N2 inject output and adjust the N injector control (12) so that the reading on the display (8) is 5785 RPM ±4 RPM. Note the reading on the frequency counter.

(e) Set function switch (16) to $N2\sqrt{T2}$.

(f) Check that the readings on display (8) is 350 ±1 and that the reading on the digital voltmeter has not changed by more than ±20 μV or the reading on the frequency counter has not changed by more than ±4 Hz.

M. Ballasted Turbine Gas Temperature Check

(1) Connect a digital voltmeter and resistive load to the thermocouple connector (4) terminal pins as shown in Figure 2.



Ballasted Turbine Gas Temperature Check
Figure 2

(2) Set switch (7) to ON, the test mode switch (9) to inject and the function switch (16) to T7.

(3) Using the T injector control (17) apply a signal voltage equivalent to 800 degrees celsius (33.3 mV).

(4) Depress the ballasted switch (10) and check that the display (8) reading is 728 ±3 degrees celsius.

NOTE: The tests detailed in paragraphs N. and P. apply only to the 4001 KTQ-1 Tester for RB211-535 engines.

N. H.P. and I.P. Indicator/Switches Check

(1) Using the multimeter check that the conditions shown in Table 8 exist.

TABLE 8
H.P. and I.P. Indicator/Switches Check

Indicator/ Switch	Continuity State	Switch Condition	Across Pins of Bleed Valve Control Unit Connector (20)
HP1A	Open circuit	Normal	C and N
HP1A	Short circuit	Depressed	C and N
HP1B	Open circuit	Normal	C and M
HP1B	Short circuit	Depressed	C and M
HP2A	Open circuit	Normal	C and J
HP2A	Short circuit	Depressed	C and J
IP1A	Open circuit	Normal	C and H
IP1A	Short circuit	Depressed	C and H
HP2B	Open circuit	Normal	C and F
HP2B	Short circuit	Depressed	C and F
IP1B	Open circuit	Normal	C and G
IP1B	Short circuit	Depressed	C and G
IP2A	Open circuit	Normal	C and D
IP2A	Short circuit	Depressed	C and D
IP2B	Open circuit	Normal	C and E
IP2B	Short circuit	Depressed	C and E

(2) Set switch (7) to ON, and check that the illuminated state of HP1A and HP2B change from close to open, and HP2A, IP1A, HP2B, IP1B, IP2A and IP28 change from open to close when the switch is depressed.

P. Closed Loop Test

(1) Connect the Tester to the test circuit box LMT 3716, set the test mode switch (9) to inject, the function switch (16) to T7, switch (15) to closed loop and switch (7) to ON.

(2) Adjust the T injector control (17) until a signal of 1 V $\pm$0.25 V is displayed on the torque motor display (13).

(3) Allow the reading on display (8) to stabilise and note the reading.

(4) Rapidly rotate T injector control (17) to change reading by ±20 degrees celsius

(5) Allow the reading on display (8) to stabilise and note the reading.

NOTE: The difference between the readings obtained in paragraphs (3) and (5) must not be greater than ±1 degrees celsius.

(6) Set function switch (16) to N1.

(7) Adjust the N injector control (12) until a signal of 1 V ±0.25 V is displayed on the torque motor display (13).

(8) Allow the reading on display (8) to stabilise and note the reading.

(9) Rapidly rotate the N injector control (12) to change reading by ±2%.

(10) Allow the reading on display (8) to stabilise and note the reading.

NOTE: The difference between the readings obtained in paragraphs (8) and (10) must not be greater than ±0.2%.

STORAGE INSTRUCTIONS

1. Procedures

A. General

These instructions are applicable to all climates. The packaging described is suitable for both storage and transit purposes.

B. Packaging

(1) Secure the lid to the case of the Tester by the eight captive screws.

(2) Clean the Tester and ensure that it is free from dust and corrosion.

(3) Cover the lid and edges of the Tester with cellulose wadding encased in 0.005 inch thick polythene, size to suit.

(4) Wrap the Tester in Kraft waxed paper and secure with adhesive tape.

(5) Place the Tester in two polythene bags 24 inch x 40 inch x 0.010 inch thick, extract all excess air and heat seal.

(6) Overwrap the primary package with Kraft paper and secure the ears with gummed Kraft paper tape.

(7) Insert the package in the rubberized hair pads of the appropriate wooden crate and place the top rubberized hair pad in position.

(8) Secure the lid of the crate with the captive screws.

(9) Bind the complete package with three bands of steel tape drawn around the battens so that they are embedded in the wood.

(10) Add labels and identification.

C. Storage Conditions

(1) The unit should be stored in conditions which are clean, dry, of even temperature, well ventilated and free from corrosive fumes. It should remain in its packing described in paragraph B.

D. Storage Limiting Period

(1) Providing that the storage conditions are observed the Tester may remain in storage for any period up to two years. After this time the Tester must be removed from its pack and subjected to the full testing procedure detailed in this manual.

(2) If the Tester passes these tests it may be repacked and returned to store for a second period of up to two years after which it must be certified in accordance with the procedure detailed in this manual.

(3) Any Tester failing the test must be rectified before being subjected to further storage or despatched for service.

SPECIAL TOOLS, FIXTURES AND EQUIPMENT

1. General

Items with an LMT part number are for local manufacture. Full manufacturing information for these items may be obtained from Smiths Industries. When ordering, please quote the part numbers.

2. Supplies

115 V, 400 Hz, single phase supply.
0 to 120 V, 400 Hz, single phase supply.
0 to 4 V d.c. supply.

3. Tools, Fixtures and Equipment

Equivalent substitutes may be used for listed items.

Item	Description	Part No. or Ref.	Vendor
1	Multimeter (accuracy ±3%)	Model 8	Evershed & Vignoles (Avo)
2	Uno pen	Standard	Gordon
3	Low kange Ohmmeter	As available	
4	Megohmmeter	As available	
5	a.c. Oscillator (200 to 10 000 Hz at amplitudes up to 8 V peak to peak)	As available	
6	Frequency Counter (200 to 10 000 Hz)	As available	
7	a.c. Signal Injector (10 to 50 mV d.c.)	As available	
8	Temperature Chamber (-10 to +50 degrees celsius)	As available	
9	Digital Voltmeter (1 mV to 20 V a.c. and d.c.)	As available	
10	Oscilloscope	As available	

Continued ...

Item	Description	Part No. or Ref.	Vendor
11	Resistor, 0.25 ohms	As available	
12	Resistor, 0.8 ohms	As available	
13	Resistor, 10 ohms	As available	
14	Resistor, 100 ohms	As available	
15	Resistor, 1 K ohms	As available	
16	Test circuit box	RTG 1465	Smiths

4. Materials

Nomenclature and British Specification or Vendor's Trade Name	Vendor
1.1.1. Trichloroethane (BS.4487 or DEF STAN 68-20)	I.C.I.
Trichlorethylene	I.C.I.
Epoxy primer	International Paints
Epoxy primer filler	International Paints
Epoxy finish	International Paints
Abrasive paper, grade 320, wet and dry	As available
Polyscreen Part 1 and Catalyst Part 2	Screen Process
Omnifit 5L	Henkel
Hylomar jointing compound SQ32M	Marston
Grease FS1292	Dow
Multicore solder grade 60/40	Multicore

Continued ...

Nomenclature and British Specification or Vendor's Trade Name	Vendor
Arklone P	I.C.I.
Terylene tape, blue, 0.006 in thick by 0.125 in wide	As available
Avigel 100, clear, knot locking varnish	Polybond
PTFE Sleeving, 0.023 in i/d by 0.006 in wall thickness (red) (Smiths Pt.No. 1837-735-07)	Smiths
PTFE Sleeving, 0.023 in i/d by 0.006 in wall thickness (black) (Smiths Pt.No. 1837-735-15)	Smiths
PTFE Sleeving, 0.023 in i/d by 0.006 in wall thickness (green) (Smiths Pt.No. 1837-708-11)	Smiths
Wire, 1/045 mm tinned copper wire (Smiths Pt.No. 1341-409)	Smiths
Wire, 7/0.2 mm silver plated copper wire, PTFE insulated, red (Smiths Pt.No. 1344-1706-07)	Smiths
Wire, 7/0.2 mm silver plated copper wire, PTFE insulated, green (Smiths Pt.No. 1344-1706-11)	Smiths
Wire, 7/0.2 mm silver plated copper wire, PTFE insulated, blue (Smiths Pt.No. 1344-1706-12)	Smiths
Wire, 7/0.2 mm silver plated copper wire, PTFE insulated, black (Smiths Pt.No. 1344-1706-15)	Smiths
Wire, 19/0.2 mm silver plated copper wire, PTFE insulated, red (Smiths Pt.No. 1344-1708-07)	Smiths
Wire, 19/0.25 mm silver plated copper wire, PTFE insulated, red (Smiths Pt.No. 1344-2702-07)	Smiths
Wire, 7/0.125 mm twin core silver plated copper wire, screened, PTFE insulated, white sheath, red and black cores.	Smiths

5. Vendors Addresses

Vendor	Full Name and Address
Dow	Dow Corning International Limited, Reading Bridge House, Reading, Berkshire, RG21 8PW, U.K.
Evershed & Vignoles (Avo)	Evershed & Vignoles Limited, Avocet House, Archcliffe Road, Dover, Kent, CT17 9EN, U.K.
Gordon	Gordon & Gotch Limited, 75/79 Farringdon Street, London, EC4, U.K.
Henkel	Henkel Chemicals Limited, Industrial Adhesives Division, Merit House, The Hyde, Edgware Road, London, NW9 5AB, U.K.
I.C.I.	Imperial Chemical Industries Limited, Mond Division, The Heath, P.O.Box 13, Runcorn, Cheshire, U.K.
International Paints	International Paints Limited, (Pinchin Johnson Paints Division), 380 Richmond Road, Kingston-on-Thames, Surrey, KT2 5PS, U.K.
Marston	Marston Lubricants Limited, 9-11 Naylor Street, Liverpool, L3 6DS, U.K.
Multicore	Multicore Solder Limited, Maylands Avenue, Hemel Hempstead, Hertfordshire, HP2 7EP, U.K.
Polybond	Polybond Limited, 42 Warsash Road, Warsash, Southampton, SO3 6HX, U.K.
Screen Process	Screen Process Supplies Limited, 24 Parsons Green Lane, London, SW6 4HT, U.K.
Smiths	Smiths Industries Aerospace & Defence Systems, Product Support, Northolt Road, Heathrow Airport London, Hounslow, Middlesex, TW6 2LW, U.K.

CHAPTER 4

ILLUSTRATED PARTS LIST

TABLE OF CONTENTS

ILLUSTRATED PARTS LIST

1. Introduction

A. General

The Illustrated Parts List (IPL) contains a Designator Index, Numerical Index and Detailed Parts List which will enable the operator to easily identify a component part. The Numerical Index lists all parts in alpha numeric sequence. The Detailed Parts List gives an illustrated breakdown of spare parts together with the manufacturer's part number and a description of the part. Where the manufacturer is not Smiths Industries the appropriate vendor code is given in the nomenclature column together with any part number allocated by Smiths Industries.

WARNING: ONLY SPARES AND COMPONENTS SPECIFIED BY SMITHS INDUSTRIES SHOULD BE USED.

B. Ordering

Certain spare parts listed in the IPL are manufactured by other contractors and have the manufacturer's part number or British Standards reference quoted in addition to the part number under which Smiths Industries supply.

When ordering from Smiths Industries, please quote the Smiths Industries part number, the other manufacturer's part number or British Standards reference and the Code Number of the Line Replacement Unit, on all orders or enquiries.

When ordering from other manufacturer's please quote the manufacturer's number and/or British Standards reference only.

C. Vendors Code List

Code	Vendor's Address
K0004	Mullard Limited, Central Technical Services, New Road, Mitcham, Surrey, CR4 4XY, U.K.
K1365	Waycom Limited Wokingham Road, Bracknell, Berks, RG12 1ND, U.K.
K1630	Electronic Components Limited, Hirwaun Industrial Estate, Aberdare, Mid. Glamorgan, CF44 9YG, U.K.

Continued ...

Code	Vendor's Address
K3558	Gresham Lion Electronics Limited, Twickenham Road, Hanworth, Middlesex, TW13 6HA, U.K.
K5319	Milton Ross & Company Limited, 175 Rickmansworth Road, Watford, Hertfordshire, WD1 7JH, U.K.
U0154	Belling and Lee Limited, 540 Great Cambridge Road, Enfield, Middlesex, EN1 3RY, U.K.
U1068	Dowty Seals Limited, Ashchurch, Tewkesbury, Gloucestershire, GL20 8JS, U.K.

2. Designator Index

	Reference Designator	Figure Item
	C1, C2	1-525A
	C1, C2	3-20A
	C3, C4	1-530A
	C3, C4	5-25A
	C5	1-520A
	C5, C6	1-30A
	D1	1-515A
	D1, D2, D3, D4	3-35A
	D5, D6, D7, D8,	
	D9, D10, D11,	
	D12	3-40A
	IC1, IC2	3-60A
	FS1, FS2	1-225A
	PL1	1-5A
	PL1	3-65A
	PL2	1-45A
	PL3	1-85A
	PL4	1-135A
	PS1	1-445A
	PS2	1-450A
	RL1	1-495A
	R1	3-5A
	R2	3-10A
	R2, R3,	1-315A
R	R6	2-90A
R	R4, R7	2-90BA

	Reference Designator	Figure Item
	R8	2-120A
	RN1, RN2	3-15A
	SK1	1-175A
	SK2	1-580A
	SK5	1-570A
	SW1, SW3, SW4,	
	SW7, SW8	1-235A
	SW1, SW3, SW4	1-235B
	SW2	1-245A
	SW5	1-250A
	SW6	1-295A
	T1	1-470A
	TC1	1-345A
	TR1, TR2, TR3	
	TR4, TR5, TR6,	
	TR7, TR8	3-45A
	TR9, TR10, TR11,	
	TR12, TR13, TR14,	
	TR15, TR16	3-50A
	1D1, 2D1, 3D1,	
	4D1	2-30A
	1D2, 1D3, 2D2,	
	2D3, 3D2, 3D3,	
	4D2, 4D3	2-60A
	1D2, 2D2, 3D2,	
	4D2	2-60B

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3. Numerical Index (Alpha)

	Part Number	Airline Part Number	Figure Item	TTL Req
	A103AP (see 30-297-612-03)			AR
	A103BP (see 30-297-612-04)			AR
	A31A8 (see 30-293-211-39)			AR
	A31B16 (see 30-293-211-59)			AR
	BCP1040		1-470A	1
	BCP1392		1-290A	6
	BCY70 (see 40-666-5113)		3-50A	8
	BC107 (see 40-666-6061)		3-45A	8
	BTE1259		1-270A	1
	BTE2265		1-320A	2
	GEM301 (see 40-675-177-01)		1-450A	1
	GEM345 (see 40-675-170-01)		1-445A	1
	KSS1035		1-205A	1
	KTQA477		1-610A	RF
	KTQA479		2-135B	1
	KTQA480		1-535B	1
			2-1B	RF
	KTQA481		1-575B	1
	KTQA482		1-565B	1
			3-1A	RF
R	KTQA483		1-355A	1
R				

Continued ...

	Part Number	Airline Part Number	Figure Item	TTL Req
	KTQA486		1-345A	1
	KTQA488		1-415A	1
	KTQA490		1-315A	2
	KTQA492		1-575A	1
	KTQA494		2-135A	1
	KTQA495		1-535A	1
			2-1A	RF
	KTQA527		1-420A	RF
R	KTQA624-***		1-575B	1
R	KTQA626-***		1-575C	1
	KTQ1881		1-560A	4
	KTQ1897		1-430A	1
	KTQ1900		2-5A	4
	KTQ1901		2-45A	4
	KTQ1903		2-80A	8
			2-80B	4
	KTQ1904		2-50A	4
	KTQ1909		1-380A	4
	KTQ1913		1-435A	1
	KTQ1914		1-440A	1
	KTQ1919		1-35A	1
	KTQ1921		2-55A	12
	KTQ1941		1-346A	1
	KTQ1983		1-335A	1
	KTQ1984		1-336A	1
	KTQ1985		1-337A	1
	KTQ1986		1-338A	1
	KTQ1987		1-339A	1

Continued ...

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Part Number	Airline Part Number	Figure Item	TTL Req
KTQ1988		1-340A	1
KTQ1989		1-341A	1
KTQ1990		1-342A	1
L1427B1A (see 40-615-139-14)		1-225A	2
SP126A (see 30-298-115-03)			AR
SP126B (see 30-298-115-04)			AR
SP47A (see 30-298-211-01)			AR
STD2556-2		2-75A	16
		2-75B	8
SUE19447		1-605A	2

4. Numerical Index (Num)

	Part Number	Airline Part Number	Figure Item	TTL Req
R	10171DAP (see 30-754-510-02)		3-55A	16
R	10238 DAP (see 30-754-526-02)		3-55B	16
	20-232-1059-11		2-65A	16
			2-65B	8
	20-233-1087-11		1-585A	2
	20-233-1107-11		1-540A	4
	20-234-1095-11		1-360A	4
	20-234-1099-11		1-425A	4
	20-234-1103-11		1-350A	4
	20-234-1175-11		1-425A	4
	20-271-1045-11		2-85A	16
			2-85B	8
	20-271-1047-11		1-375A	4
			1-600A	2
	20-271-1048-11		1-555A	4
	20-281-1055-11		2-70A	32
			2-70B	16
	20-281-1057-11		1-365A	4
			1-500A	1
			1-590A	2
			2-20A	8
	20-282-1055-11		1-370A	4
			1-595A	2
	300-001-1911-02 (see 40-343-606)		1-25A	4
			1-65A	4
			1-105A	4
			1-155A	4
			1-195A	4

Continued ...

0020D
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Part Number	Airline Part Number	Figure Item	TTL Req
300-06-20 (see 40-241-1089-04)		1-310A	2
302-55-20 (see 40-241-1062)		1-255A	1
30-277-802-11		1-505A	1
30-293-211-39 (see A31A8)			AR
30-293-211-59 (see A31B16)			AR
30-295-301-25		1-260A	3
30-295-301-28		1-330A	6
30-295-401-24		1-455A	8
30-295-401-28		1-10A	4
		1-50A	4
		1-90A	4
		1-140A	4
		1-180A	4
30-295-401-28		2-10A	8
30-295-401-41		1-475A	4
30-297-612-03 (see A103AP)			AR
30-297-612-04 (see A103BP)			AR
30-298-115-03 (see SP126A)			AR
30-298-115-04 (see SP126B)			AR
30-298-145-03			AR
30-298-211-01 (see SP47A)			AR

Continued ...

	Part Number	Airline Part Number	Figure Item	TTL Req
	30-543-102-02		1-285A	1
	30-752-501-04		2-40A	8
			2-40B	4
	30-754-510-02 (see 10171DAP)		3-55A	16
R	30-754-526-02 (see 10238DAP)		3-55B	16
	30-781-205-50		1-265A	1
			1-325A	2
	30-784-116		1-230A	4
			1-240A	10
			1-240B	6
			1-510A	3
	30-784-121		1-490A	1
	30-784-1338-07		1-620A	5
	30-784-506-01		1-625A	10
	30-784-506-02		1-630A	10
	30-784-506-05		1-635A	10
	30-784-506-07		1-640A	10
	30-784-506-08		1-645A	10
	30-784-506-09		1-650A	10
	30-784-506-11		1-655A	10
	30-784-506-12		1-660A	10
	30-784-506-13		1-665A	10
	30-784-506-14		1-670A	10
	30-784-506-15		1-675A	10
	30-867-101-07		2-35A	4
	30-867-111-07		1-465A	9
	30-867-116-07		1-215A	1
	30-867-6452-02		1-125A	3
	30-867-6452-04		1-130A	2

Continued ...

	Part Number	Airline Part Number	Figure Item	TTL Req
	37-756-736-01		1-115A	1
			1-165A	1
	30-756-737-01		1-75A	1
	4001KTQ1		1-1A	RF
	4002KTQ1		1-1B	RF
	40-241-1062 (see 302-55-20)		1-255A	1
	40-241-1089-04 (see 300-06-20)		1-310A	2
	40-343-606 (see 30-001-1911-02)		1-25A	4
			1-65A	4
			1-105A	4
			1-155A	4
			1-195A	4
R	40-511-1439-10		2-115A	1
			2-115B	3
R	40-511-1439-10E		2-102	AR
R	40-511-1439-12		2-91	AR
R	40-511-1439-15		2-92	AR
R	40-511-1439-18		2-93	AR
R	40-511-1439-22		2-94	AR
R	40-511-1439-27		2-95	AR
R	40-511-1439-33		2-96	AR
R	40-511-1439-39		2-97	AR
R	40-511-1439-47		2-98	AR
R	40-511-1439-56		2-99	AR
R	40-511-1439-68		2-100	AR
R	40-511-1439-82		2-101	AR
	40-518-162-12		3-10A	1
	40-518-162-56		3-5A	1

Continued ...

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	Part Number	Airline Part Number	Figure Item	TTL Req
R	40-518-702-12E		3-10B	1
R	40-518-702-56E		3-5B	1
	40-558-1306-15		3-20A	2
	40-558-1307-10		1-525A	2
	40-564-2643-47E		1-530A	2
	40-564-5323-10		3-25A	2
R	40-564-5613-10		3-25B	2
	40-565-1084-10		1-520A	1
	40-566-7746-47		3-30A	2
	40-611-4019E		1-235A	5
			1-235B	3
	40-611-405E		1-250A	1
	40-611-407E		1-245A	1
	40-613-4002-03		1-280A	1
	40-613-488-01 (see 59190)		1-295A	4
	40-615-139-14 (L1427B1A)		1-225A	2
	40-617-4221		1-495A	1
	40-621-170-46		1-340A	32
	40-628-949		2-60A	8
			2-60B	4
	40-628-950-01		1-400A	8
	40-628-951		1-405A	1
	40-628-952		1-410A	2
	40-651-755-25		3-15A	2
	40-652-2096-08		3-60A	2
	40-666-2202E		3-40A	8
	40-666-222E		1-515A	1
	40-666-2278		3-35A	4

Continued ...

	Part Number	Airline Part Number	Figure Item	TTL Req
	40-666-5113 (see BCY70)		3-50A	8
	40-666-6061 (see BC107)		3-45A	8
	40-667-323		2-30A	4
	40-675-170-01 (see GEM345)		1-445A	1
	40-675-177-01 (see GEM301)		1-450A	1
	40-712-361		1-220A	2
	40-716-1117		1-615A	6
			2-140A	2
	40-716-1118		2-145A	20
			2-145B	15
	40-741-1264-04		1-210A	1
	40-741-1295-10		1-40A	1
	40-741-1295-14		1-120A	1
			1-170A	1
	40-741-1295-16		1-80A	1
	40-741-6142-00U		1-175A	1
R	40-742-3172-00E		1-5A	1
	40-743-3131-00E		1-85A	1
	40-743-3131-01E		1-135A	1
	40-743-5316-00E		1-45A	1
	40-743-6519E		3-65A	1
	40-743-6520E		1-570A	1
	40-743-6650		1-395A	1
	40-743-9350		1-580A	1
	40-744-454		1-385A	6

Continued ...

Part Number	Airline Part Number	Figure Item	TTL Req
40-744-722		1-390A	8
59190 (see 40-613-488-01)		1-295A	4

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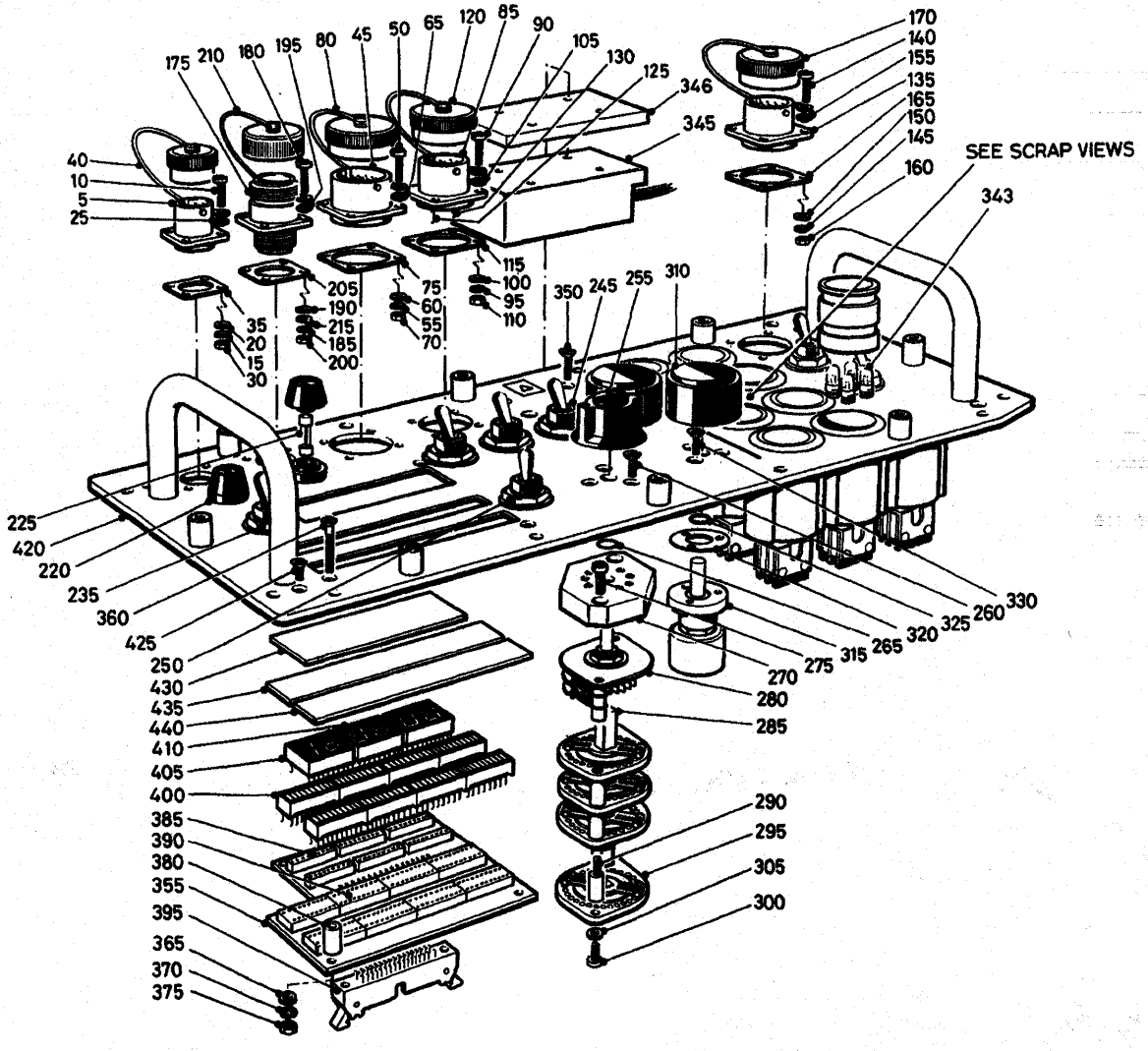

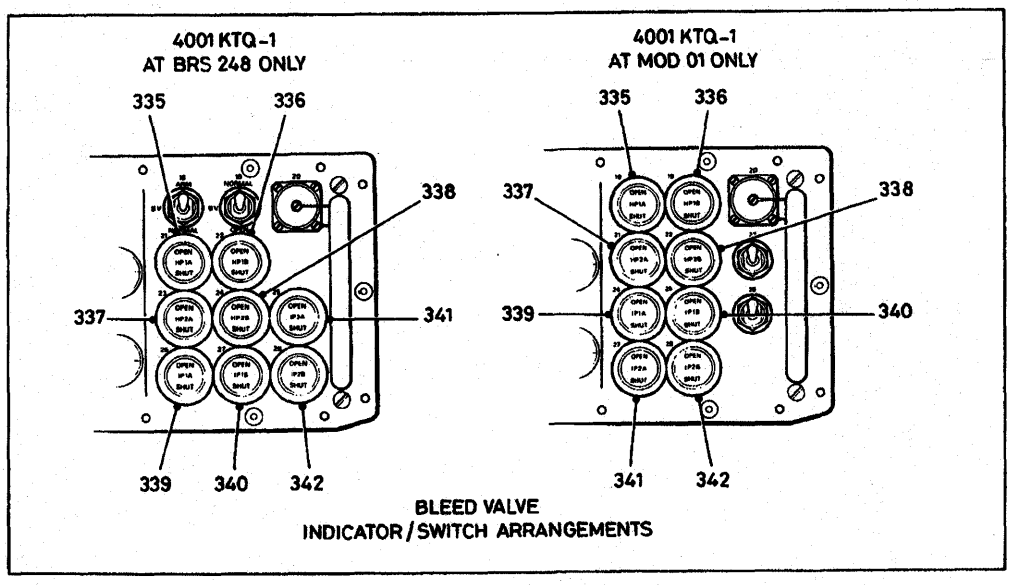

Figure 1 (Sheet 1)

5. Detailed Parts List 4000KTQ Series

FIG. ITEM	PART NUMBER	AIRLINE PART NUMBER	NOMENCLATURE 1234567	EFF. CODE	UNITS PER ASSY.
1-1A	4001KTQ-1		TESTER, SPEED, TEMPERATURE AND BLEED VALVE (Mod 02, 03)		RF
1B	4002KTQ-1		TESTER, SPEED AND TEMPERATURE (Mod 02, 03)		RF
5A	40-742-3172-00E		.Connector (PL1)		1
R 10A	30-295-401-28		.Screw, 4UNC x 1/2 in lg.		4
15A	SP47A		.Washer, spring, 4UNC (30-298-211-01)		4
20A	SP126A		.Washer, 4UNC (30-298-115-03)		4
25A	300-001-1911-02		.Seal, bonded V.U1068 (40-343-606)		4
30A	A103AP		.Nut, 4UNC (30-297-612-03)		4
35A	KTQ1919		.Gasket		1
40A	40-741-1295-10		.Cap and Cord Assembly		1
45A	40-743-5316-00E		.Connector (PL2)		1
50A	30-295-401-28		.Screw, 4UNC x 1/2 in lg.		4
55A	SP47A		.Washer, spring, 4UNC (30-298-211-01)		4
60A	SP126A		.Washer, 4UNC (30-298-115-03)		4
65A	300-001-1911-02		.Seal, bonded V.U1068 (40-343-606)		4
70A	A103AP		.Nut, 4UNC (30-297-612-03)		4
75A	37-756-737-01		.Gasket		1
80A	40-741-1295-16		.Cap and Cord Assembly		1
85A	40-743-3131-00E		.Connector (PL3)		1
90A	30-295-401-28		.Screw, 4UNC x 1/2 in lg.		4
95A	SP47A		.Washer, spring, 4UNC (30-298-211-01)		4
100A	SP126A		.Washer, 4UNC (30-298-115-03)		4
105A	300-001-1911-02		.Seal, bonded V.U1068 (40-343-606)		4
110A	A103AP		.Nut, 4UNC (30-297-612-03)		4
115A	37-756-736-01		.Gasket		1
120A	40-741-1295-14		.Cap and Cord Assembly		1
125A	30-867-6452-02		.Pin		3
130A	30-867-6452-04		.Pin		2
135A	40-743-3131-01E		.Connector (PL4)	1A	1

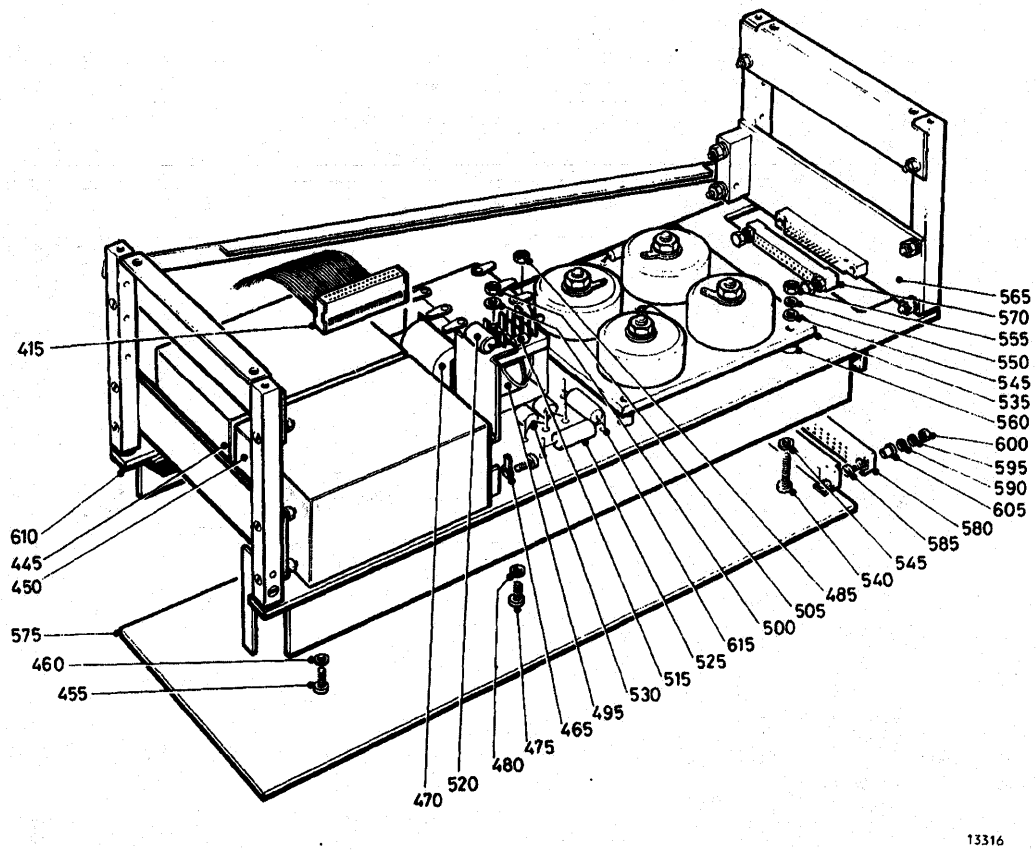

Figure 1 (Sheet 2)

FIG. ITEM	PART NUMBER	AIRLINE PART NUMBER	NOMENCLATURE 1234567	EFF. CODE	UNITS PER ASSY.
1-140A	30-295-401-28		.Screw, 4UNC x 1/2 in lg.	1A	4
145A	SP47A		.Washer, spring, 4UNC (30-298-211-01)	1A	4
150A	SP126A		.Washer, 4UNC (30-298-115-03)	1A	4
155A	300-001-1911-02		.Seal, bonded (40-343-606)	1A	4
160A	A103AP		.Nut, 4UNC (30-297-612-03)	1A	4
165A	37-756-736-01		.Gasket	1A	1
170A	40-741-1295-14		.Cap and Cord Assembly	1A	1
175A	40-741-6142-00U		.Connector (SK1)		1
180A	30-295-401-28		.Screw, 4UNC x 1/2 in lg.		4
185A	SP47A		.Washer, spring, 4UNC (30-298-211-01)		4
190A	SP126A		.Washer, 4UNC (30-298-115-03)		4
195A	300-001-1911-02		.Seal, bonded V.U1068 (40-343-606)		4
200A	A103AP		.Nut, 4UNC (30-297-612-03)		4
205A	KSS1035		.Gasket		1
210A	40-741-1264-04		.Cap and Cord Assembly		1
215A	30-867-116-07		.Tag, solder, 6BA		1
220A	40-712-361		.Fuseholder		2
225A	L1427B1A		.Fuse, 1A V.U0154 (FS1, FS2) (40-615-139-14)		2
-230A	30-784-116		.Sleeve, binding		4
235A	40-611-4019E		.Switch (SW1, SW3, SW4, SW7, SW8)	1A	5

- Item not illustrated

FIG. ITEM	PART NUMBER	AIRLINE PART NUMBER	NOMENCLATURE 1234567	EFF. CODE	UNITS PER ASSY.
1-235B	40-611-4019E		.Switch (SW1, SW3, SW4)	1B	3
-240A	30-784-116		.Sleeve, binding	1A	10
-240B	30-784-116		.Sleeve, binding	1B	6
245A	40-611-407E		.Switch (SW2)		1
250A	40-611-405E		.Switch (SW5)		1
255A	302-55-20		.Knob, Black V.K1365 (40-241-1062)		1
260A	30-295-301-25		.Screw, 4UNC x 5/16 in lg.		3
265A	30-781-205-50		.Seal '0'		1
270A	BTE1259		.Plate, adaptor		1
275A	A31B16		.Screw, 4BA x 1/2 in lg. (30-293-211-59)		2
280A	40-613-4002-03		.Plate assembly, switch		1
285A	30-543-102-02		.Bar, drive		1
290A	BCP1392		.Pillar		6
295A	59190		.Switch brush assembly (SW6) V.K1630 (40-613-488-01)		4
300A	A31A8		.Screw, 6BA x 1/4 in lg. (30-293-211-39)		2
305A	SP126A		.Washer, 4UNC (30-298-115-03)		2
310A	300-06-20		.Knob, black V.K1365 (40-241-1089-04)		2
315A	KTQA490		.Potentiometer assembly (R2, R3)		2
320A	BTE2265		.Gasket		2
325A	30-781-205-50		.Seal,. '0'		2
330A	30-295-301-28		.Screw, 4UNC x 1/2 in lg.		6
335A	KTQ1983		.Switch, engraved (IP1A)	1A	1
336A	KTQ1984		.Switch, engraved (IP1B)	1A	1
337A	KTQ1985		.Switch, engraved (IP2A)	1A	1
338A	KTQ1986		.Switch, engraved (IP2B)	1A	1
339A	KTQ1987		.Switch, engraved (HP1A)	1A	1

- Item not illustrated

FIG. ITEM	PART NUMBER	AIRLINE PART NUMBER	NOMENCLATURE 1234567	EFF. CODE	UNITS PER ASSY.
1-340A	KTQ1988		.Switch, engraved (HP1B)	1A	1
341A	KTQ1989		.Switch, engraved (HP2A)	1A	1
342A	KTQ1990		.Switch, engraved (HP2B)	1A	1
343A	40-621-170-46		.Lamp, filament, 28 V 0.04 A	1A	32
345A	KTQA486		.Compensation assembly (TC1)		1
346A	KTQ1941		.Insulating panel		1
350A	20-234-1103-11		.Screw, M3 x 12 mm lg		4
			* * *		
355A	KTQA483		.Board assembly, display		1
			Attaching Parts		
360A	20-234-1095-11		.Screw, M2.5 x 25 mm lg		4
365A	20-281-1057-11		.Washer, M2.5		4
370A	20-282-1055-11		.Washer, spring, M2.5		4
375A	20-271-1047-11		.Nut, M2.5		4
380A	KTQ1909		.Pillar		4
			* * *		
385A	40-744-454		..Socket, 10 contacts		6
390A	40-744-722		..Socket, 20 contacts		8
395A	40-743-6650		..Connector, 34 way		1
400A	40-628-950-01		.Display, bar-graph		8
405A	40-628-951		.Display, alpha-numeric		1
410A	40-628-952		.Display, alpha-numeric		2
415A	KTQA488		.Connector assembly		1
420A	KTQA527		.Panel assembly, front		RF
			Attaching Parts		
425A	20-234-1175-11		.Screw, M5 x 12 mm. lg.		4
			* * *		
430A	KTQ1897		..Filter, polarising		1
435A	KTQ1913		..Filter, polarising (screened)		1

- Item not illustrated

FIG. ITEM	PART NUMBER	AIRLINE PART NUMBER	NOMENCLATURE 1234567	EFF. CODE	UNITS PER ASSY.
1-440A	KTQ1914		..Filter, polarising (screened)		1
445A	GEM345		.Power Supply (PS1) V.K3558 (40-675-170-01)		1
450A	GEM301		.Power Supply (PS2) V.K3558 (40-675-177-01)		1
455A	30-295-401-24		.Screw, 4UNC x 1/4 in lg.		8
460A	SP126A		.Washer, 4UNC (30-298-115-03)		8
465A	30-867-111-07		.Tag solder, 4BA		9
470A	BCP1040		.Transformer (T1)		1
475A	30-295-401-41		.Screw, 6UNC x 5/16 in lg.		4
480A	SP126B		.Washer, 6UNC (30-298-115-04)		4
485A	A103BP		.Nut, 6UNC (30-297-612-04)		4
-490A	30-784-121		.Sleeve, binding, 3 mm i/d		1
495A	40-617-4221		.Relay (RL1)		1
500A	20-281-1057-11		.Washer, M2.5		1
505A	30-277-802-11		.Nut, 3UNC		1
-510A	30-784-116		.Sleeve, binding, 2 mm i/d		3
515A	40-666-222E		.Diode (D1)		1
520A	40-565-1084-10		.Capacitor, 0.1 µF ±20% (C5)		1
525A	40-558-1307-10		.Capacitor, 100 µF ±20% (C1, C2)		2
530A	40-564-2643-47E		.Capacitor, 0.047 µF ±20% (C3, C4)		2
535A	KTQA495		.Panel assembly, solar cell (See Fig.2 for detail breakdown)	1A	1
535B	KTQA480		.Panel assembly, solar cell (See Fig.2 for detail breakdown)	1B	1
			Attaching Parts		

-Item not illustrated

	FIG. ITEM	PART NUMBER	AIRLINE PART NUMBER	1234567 NOMENCLATURE	EFF. CODE	UNITS PER ASSY.
	1-540A	20-233-1107-11		.Screw, M3 x 20 mm lg		4
	545A	20-281-1058-11		.Wasner, M3		8
	550A	20-282-1006-11		.Washer, spring, M3		4
	555A	20-271-1048-11		.Nut, M3		4
	560A	KTQ1881		.Pillar		4
				* * *		
	565A	KTQA482		.Board assembly, bleed valve control unit indicator (See Fig.3 for detail breakdown)	1A	1
	570A	40-743-6520E		.Connector, 33-way (SK5)	1A	1
R	575A	KTQA492-***		.Board assembly, processor (Pre-Mod 03)	1A	1
R	575B	KTQA624-***		.Board assembly, processor (Mod 03)	1A	1
R	575C	KTQA481-***		.Board assembly, processor (Pre-Mod 03)	1B	1
R	575D	KTQA626-***		.Board assembly, processor (Mod 03)	1B	1
	580A	40-743-9350		.Connector (SK2)		1
	585A	20-233-1087-11		.Screw, M2.5 x 10 mm lg.		2
	590A	20-281-1057-11		.Washer, M2.5		2
	595A	20-282-1055-11		.Washer, spring, M2.5		2
	600A	20-271-1047-11		.Nut, M2.5		2
	605A	SUE19447		.Bush		2
	610A	KTQA477		.Plate assembly, base		RF
	615A	40-716-1117		..Terminal, stand-off		6
	-620A	30-784-1138-07		.Sleeve, 1/8 in i/d, red		5
	-625A	30-784-506-01		.Sleeve, ident, white		10
	-630A	30-784-506-02		.Sleeve, ident, yellow		10
	-635A	30-784-506-05		.Sleeve, ident, pink		10
	-640A	30-784-506-07		.Sleeve, ident, red		10
	-645A	30-784-506-08		.Sleeve, ident, orange		10
	-650A	30-784-506-09		.Sleeve, ident, brown		10
	-655A	30-784-506-11		.Sleeve, ident, green		10
	-660A	30-784-506-12		.Sleeve, ident, blue		10
	-665A	30-784-506-13		.Sleeve, ident, violet		10
	-670A	30-784-506-14		.Sleeve, ident, slate		10
	-675A	30-784-506-15		.Sleeve, ident, black		10

*** Indicates a software variant having a code:
4001KTQ-1-001, 4001KTQ-1-002 or 4001KTQ-1-003
4002KTQ-1-002, 4002KTQ-1-004, 4002KTQ-1-005 or 4002KTQ-1-006

-Item not illustrated

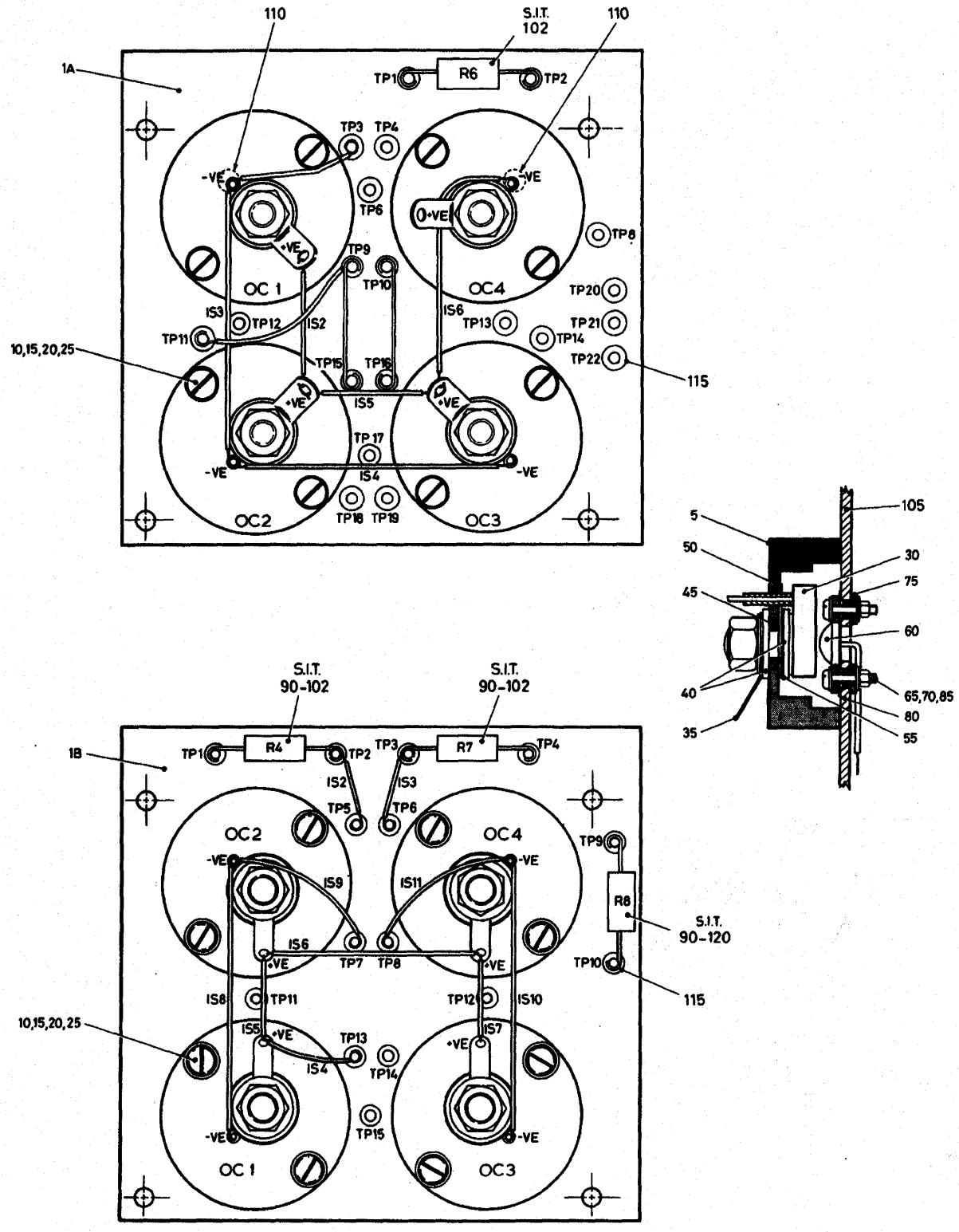
110
S.I.T. 102
110
1A
TP1
R6
TP2
TP3
TP4
-VE
-VE
TP6
+VE
+VE
TP8
TP9
OC 1
TP10
OC4
TP20
IS3
TP12
IS2
IS6
TP13
TP21
TP11
TP14
10,15,20,25
TP15
TP16
TP22
115
+VE
IS5
+VE
TP17
-VE
IS4
-VE
OC2
TP18
TP19
OC3
S.I.T. 90-102
S.I.T. 90-102
1B
TP1
R4
TP2
TP3
R7
TP4
IS2
IS3
TP5
TP6
OC2
OC4
TP9
-VE
IS9
IS11
-VE
R8
S.I.T. 90-120
IS6
TP7
TP8
+VE
+VE
TP10
IS8
TP11
TP12
IS10
115
10,15,20,25
IS5
+VE
TP13
IS7
+VE
IS4
TP14
-VE
TP15
-VE
OC 1
OC3
5
105
50
30
45
75
60
40
65,70,85
80
35
55
13314

Figure 2

FIG. ITEM	PART NUMBER	AIRLINE PART NUMBER	NOMENCLATURE 1234567	EFF. CODE	UNITS PER ASSY.
2-1A	KTQA495		Panel Assembly, Solar Cell (see Fig.1 for NHA)		RF
1B	KTQA480		Panel Assembly, Solar Cell (see Fig.1 for NHA)		RF
5A	KTQ1900		.Body		4
10A	30-295-401-32		.Screw, 4-40 UNCX 7/8		8
15A	30-298-145-03		.Washer, 6BA		16
20A	30-298-211-01		.Washer, spring, 6BA		8
25A	30-297-612-03		.Nut, 4-40 UNC		8
30A	40-667-323		.Cell, photo (1D1, 2D1, 3D1, 4D1)		4
35A	30-867-101-07		.Tag, solder, OBA		4
40A	30-752-501-04		.Washer, nylon, 1/4 in i/d	1A	8
40B	30-752-501-04		.Washer, nylon, 1/4 in i/d	1B	4
45A	KTQ1901		.Bush		4
50A	KTQ1904		.Washer, insulating		4
55A	KTQ1921		.Washer, insulating	1B	12
60A	40-628-949		.Diode, light emitting, 40 mV min. (1D2, 1D3, 2D2, 2D3, 3D2, 3D3, 4D2, 4D3)	1A	8

FIG. ITEM	PART NUMBER	AIRLINE PART NUMBER	NOMENCLATURE 1234567	EFF. CODE	UNITS PER ASSY.
2-60B	40-628-949		.Diode, light emitting, 40 mV min. (1D2, 2D2, 3D2, 4D2)	1B	4
65A	20-232-1059-11		.Screw, M2 x 10 mm lg	1A	16
65B	20-232-1059-11		.Screw, M2 x 10 mm lg	1B	8
70A	20-281-1055-11		.Washer, M2	1A	32
70B	20-281-1055-11		.Washer, M2	1B	16
75A	STD2556-2		.Bush, insulating	1A	16
75B	STD2556-2		.Bush, insulating	1B	8
80A	KTQ1903		.Washer, insulating	1A	8
80B	KTQ1903		.Washer, insulating	1B	4
85A	20-271-1045-11		.Nut, M2	1A	16
85B	20-271-1045-11		.Nut, M2	1B	8

	FIG. ITEM	PART NUMBER	AIRLINE PART NUMBER	NOMENCLATURE 1234567	EFF. CODE	UNITS PER ASSY.
	2-90A	40-511-1439-10		.Resistor, 1 ohm to 10 ohm ±5% (R6). Select from this and item 91A to 102A.	1A	1
R	90B	40-511-1439-10		.Resistor, 1 ohm to 10 ohm ±5% (R4, R7 and R8). Select from this item 91A to 102A	1B	3
R	91A	40-511-1439-12		.Resistor, 1.2 ohm ±5%		AR
	92A	40-511-1439-15		.Resistor, 1.5 ohm ±5%		AR
	93A	40-511-1439-18		.Resistor, 1.8 ohm ±5%		AR
	94A	40-511-1439-22		.Resistor, 2.2 ohm ±5%		AR
	95A	40-511-1439-27		.Resistor, 2.7 ohm ±5%		AR
	96A	40-511-1439-33		.Resistor, 3.3 ohm ±5%		AR
	97A	40-511-1439-39		.Resistor, 3.9 ohm ±5%		AR
	98A	40-511-1439-47		.Resistor, 4.7 ohm ±5%		AR
	99A	40-511-1439-56		.Resistor, 5.6 ohm ±5%		AR
	100A	40-511-1439-68		.Resistor, 6.8 ohm ±5%		AR
	101A	40-511-1439-82		.Resistor, 8.2 ohm ±5%		AR
	102A	40-511-1439-10E		.Resistor, 10 ohm ±5%		AR
	105A	KTQ494		.Panel sub-assembly	1A	1
	105B	KTQ479		.Panel sub-assembly	1B	1
	110A	40-716-1117		. . Pin terminal	105A	2
	115A	40-716-1118		. . Pin terminal	105A	20
	115B	40-716-1118		. . Pin terminal	105B	15

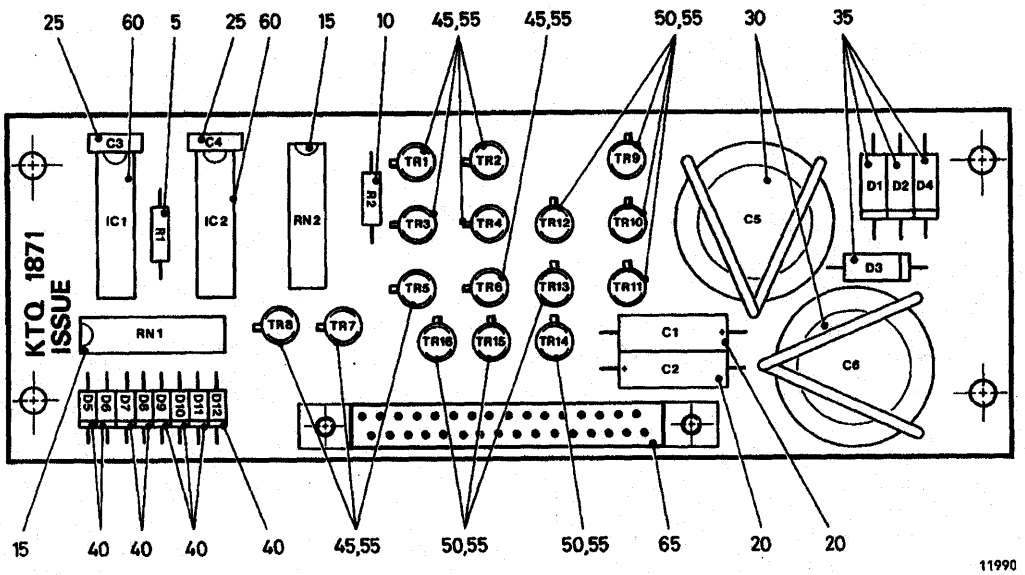
25
60
5
25
60
15
10
45,55
45,55
50,55
30
35
C3
C4
IC1
IC2
R1
RN2
R2
TR1
TR2
TR3
TR4
TR5
TR6
TR7
TR8
TR9
TR10
TR11
TR12
TR13
TR14
TR15
TR16
C5
C6
C1
C2
D1
D2
D4
D3
RN1
KTQ 1871
ISSUE
15
40
40
40
40
45,55
50,55
50,55
65
20
20
11990

Figure 3

	FIG. ITEM	PART NUMBER	AIRLINE PART NUMBER	NOMENCLATURE 1234567	EFF. CODE	UNITS PER ASSY.
	3-1A	KTQA482		Board Assembly, bleed valve control unit indicator (see Fig.1 for NHA)		RF
R	5A	40-518-162-56		.Resistor, 5.6 k ohm ±2% (R1) (alternative to 40-518-702-56E)		1
R	5B	40-518-702-56E		.Resistor, 5.6 k ohm ±2% (R1) (alternative to 40-518-162-56)		1
R	10A	40-518-162-12		.Resistor, 1.2 k ohm ±2% (R2) (alternative to 40-518-702-12E)		1
R	10B	40-518-702-12E		.Resistor, 1.2 k ohm ±2% (R2) (alternative to 40-518-162-12)		
	15A	40-651-755-25		.Resistor network, 10 k ohm ±2% (RN1, RN2)		2
	20A	40-558-1306-15		.Capacitor, 15 µF ±20% (C1, C2)		2
R	25A	40-564-5323-10		.Capacitor, 0.01 µF ±10% (C3, C4) (alternative to 40-564-5613-10)		2
R	25B	40-564-5613-10		.Capacitor, 0.01 µF ±10% (C3, C4) (alternative to 40-564-5323-10)		2
	30A	40-566-7746-47		.Capacitor, 47 µF ±20% (C5, C6)		2
	35A	40-666-2278		.Diode (D1, D2, D3, D4)		4
	40A	40-666-2202E		.Diode (D5, D6, D7, D8, D9, D10, D11, D12)		8
	45A	BC107		.Transistor (TR1, TR2, TR3, TR4, TR5, TR6, TR7, TR8) V.K0004 (40-666-6061)		8
	50A	BCY70		.Transistor (TR9, TR10, TR11, TR12, TR13, TR14, TR15, TR16) V.K0004 (40-666-5113)		8
R	55A	10171DAP		.Transipad V.K5319 (30-754-510-02) (alternative to 30-754-526-02)		16
R	55B	10238DAP		.Transipad V.K5319 (30-754-526-02) (alternative to 30-754-510-02)		16
	60A	40-652-2096-08		.Circuit, integrated (IC1, IC2)		2
	65A	40-743-6519E		.Connector, 33-way (PL1)		1