

**CONSORT  
THERMOMETER BRIDGE  
TYPE 5840E**

**OPERATING INSTRUCTIONS  
ITS-90**

IMPORTANT

5840E THERMOMETER BRIDGE

THIS INSTRUMENT MUST BE SWITCHED  
ON FOR THE FIRST TIME WITH THE  
PROGRAMMING BUTTON "*PROG*"  
HELD IN. NEXT PRESS "*CHANGE/*  
*ENTER*"

THIS WILL INITIALISE THE BATTERY  
BACKED MEMORY.

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## **GENERAL**

### 1. a. **INTRODUCTION**

This bridge is intended for use with four terminal resistance thermometers, meeting the requirements for the realisation of ITS 90.

It is provided with 2 ranges to accept platinum resistance thermometers with RO 2.5 ohms to 100 ohms, and Rhodium Iron thermometers with RO 40 ohms or 100 ohms.

#### **resistance ranges**

*100 ohm range:* This is the basic range which provides the highest accuracy. It is intended for use with 25 ohm RO platinum thermometers over the range 90K to 660°C or 2.5 ohm platinum thermometers up to 960°C and also for rhodium iron thermometers at cryogenic temperatures.

*10 ohm range:* For use with 25 ohm RO platinum thermometers at low temperatures.

#### **CURRENT RANGES**

A range of measuring currents are provided from 0.1mA to 3mA. The lower currents are used for rhodium iron thermometers at very low temperatures and the higher currents are used for platinum thermometers at the lower end of their temperature range.

For most purposes a 1.0mA measuring current is preferred.

1. b. **INITIAL CHECKOUT**

Unpack the instrument carefully and check the following items:

Consort Bridge 5840E

Shorting Link ( connects to thermometer BNC sockets)

2 off free BNC plugs

Mains Lead

Operation Manual

Check that the voltage selector on the rear panel is set for the mains input voltage to be used, i.e. 230V or 115V.

Connects the mains supply and switch on. Check that all LED's are on for a few seconds including power on. Then 100 ohm and auto should be selected. Press the "PROG" button. The prog light should come on and the meter will display "Program set points". Connect the 4 terminal short provided to the thermometer BNC sockets of the bridge. Press the "AUTO" button and the instrument should read zero +/- 1 digit, i.e. - 0.0001, 0.0000 or 0.0001.

Wait approximately 30 minutes. Check the "OVEN" light has cycled on and off a few times (indicating that the resistor oven has stabilised at its working temperature). Connect an accurately known 100 ohm AC/DC standard resistor to the front panel measurement sockets labelled *THERMOMETER*, by means of 50 ohm BNC plugs. After balancing, the reading on the display should correspond to the known value of the resistor (with allowance for effects of temperature on the standard resistor).

## 2. OPERATION

To operate the bridge, connect the thermometer, and switch on the bridge. Wait approximately 30 seconds (during this time the bridge is being initialised and the display will show "5840E"). After initialisation the "CONSORT" will be on internal standard, 100 ohm range, 1mA current, auto mode and will display in ohms. Select the required range and measuring current. The reading will be correct when the internal standards have reached their operating temperature as indicated by the on/off cycling in the oven.

### A. FRONT PANEL CONTROLS

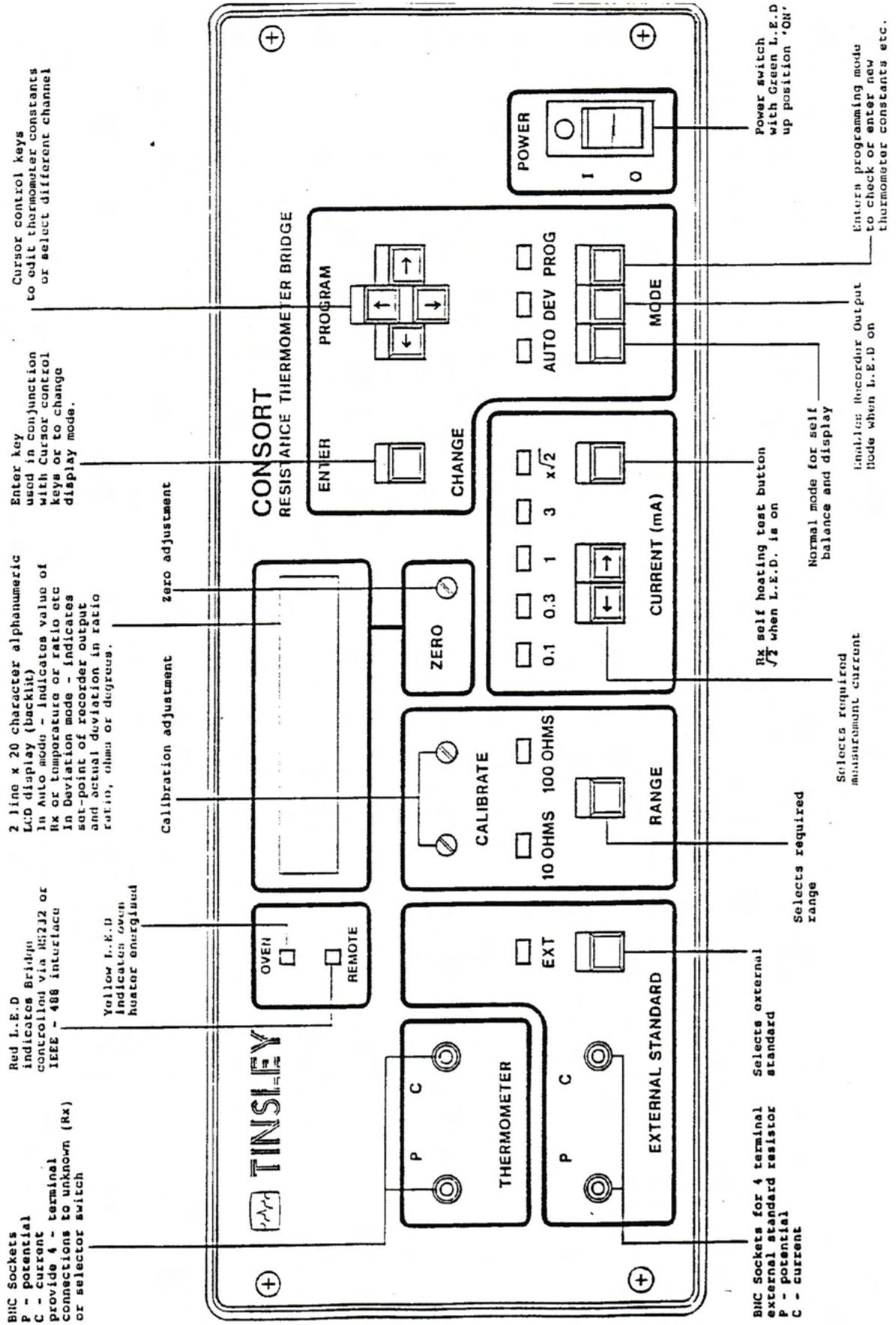
*On/Off Switch:* On is marked with 1, and off with 0.  
Power on is indicated by a green light.

*External Standard :* This switch toggles between internal or external standard. When external standard is selected the indicator above the switch is on and the resistance is displayed as a ratio relative to the external standard. The standard should be suitable for use on alternating current and have a nominal value of 10 or 100 ohms, according to which range is required. The bridge will read the ratio  $R_x/R_{std}$  and the resistance range of the bridge should be selected to match the value of the standard. If a 25 ohm external standard is used the bridge should be set to 100 ohm range. There may be a short delay before selection takes place.

*Range :* This switch toggles between the 10 ohm and 100 ohm ranges and the appropriate indicator is turned on. The full scale for the 10 ohm range is 15.99999 ohms and the full scale for the 100 range is 350.0000 ohms.

*Current:* These switches select the measuring current. The keys step up and down the current ranges and the appropriate indicator is turned on. *Note that 0.1mA and 0.3mA currents are not available on the 10 ohm range.*

$\sqrt{2}$  *Switch:* This increases the measuring accuracy by 1.41 on any current range. To evaluate the magnitude of the self heating effect, operate the  $\sqrt{2}$  switch and note the increase in bridge readings. When the bridge has stabilised at the new reading, note the increase and subtract it from the previous reading to eliminate the effect of self heating from the measurement.



- MODE** : The three lower switches are used to select the required mode the bridge is to operate in , and the selected mode is shown by the indicators above the switches.
- AUTO** : In this mode the bridge will balance and display the result in the units selected, the bridge will follow any changes in the thermometer connected to the BNC input connectors and update the display as required. The recorder output is switched off, this is indicated on the recorder (if one is connected) by the trace going to full scale positive and then full scale negative, then returning to zero volts.
- DEV** : In this the mode the bridge will balance and then display the deviation from a setpoint which is entered in the program mode, the setpoint can be in any of the measured units. The recorder output is on, this is indicated on the recorder, (if one is connected) by the trace going to full scale positive then full scale negative, then returning to a level proportional to the deviation from the setpoint. The dev mode enable variations of  $\pm 200\text{m}^\circ\text{C}$  to be plotted on a chart recorder if in K or  $^\circ\text{C}$  1 volt is equivalent to  $100\text{m}^\circ\text{C}$ . If in ohms mode, a voltage scaled at 1.00 volt per 100 milliohms for the 100 ohm range, or 1 volt for 10 milliohms on the 10 ohm range.
- PROG** : In this mode, all setpoints, thermometer constants, RS232 parameters and (if fitted) the IEEE-488 device number, can be programmed into the battery backed ram.

#### **CURSOR CONTROL AND ENTER CHANGE KEY:**

These keys have different functions, depending on the mode selected.

#### **AUTO AND DEV MODES:**

#### **CURSOR CONTROL KEYPAD:**

This group of switches is used to change the channel selected on a selector switch unit. The up key and right key increment the channel number, and the down key and left key decrement the channel number. The channel number is displayed in the top left of the display.

#### **ENTER/CHANGE**

This switch is used to change the display from ohms to degrees Celsius or Kelvin.



**PROG MODE*****ENTERING SETPOINTS:***

1. Enter the prog mode.
2. Using either the up and down keys, or left and right keys, move around the menu until "*Program Setpoints ?*" is reached, then press the enter /change key. The display will now show "*review setpoint 123.12345 ohms*".
3. Using the up and down keys, roll the display around until the measurement units required are displayed, then press the enter/change key and the display will now show "*edit*" in the top left and the last digit is underlined by the cursor.
4. Using the up and down keys, the value of the digit marked by the cursor can be incremented or decremented.
5. Now using the left key, the cursor can be stepped to the next digit to be edited.
6. When the required value is displayed, press the enter/change key and the value will be stored, and the display will now revert to the review mode showing the stored value.
7. To edit any other set point, repeat from step 3.
8. Press the prog key to return to the main program menu, or press the mode key required.

## ENTERING THERMOMETER CONSTANTS.

1. Enter the prog mode.
2. Using either the up and down keys, or the left and right keys, move around the menu until "*Program Constants*" is reached, then press the Enter/Change key.
3. Using the right and left keys, increment or decrement the channel number until the required channel number is displayed in the top right of the display.
4. The display will now show "*Review CH:O Platinum Down to XX*". Press the Enter/Change key to enter the edit mode.  
Using the cursor control pad, select the required thermometer range, then press the Enter/Change key. The thermometer ranges available are:-

Down to 14K	For thermometers calibrated down to 13.8033K
Down to 24K	For thermometers calibrated down to 24.5516K
Down to 54K	For thermometers calibrated down to 54.3584K
Down to 84K	For thermometers calibrated down to 83.8058K
-39C to 30C	For thermometers calibrated in the range -38.83344C to +29.7646C
Down to 0C	For thermometers calibrated down to 0 Celsius
Rhodium/Iron	For all Rhodium/Iron thermometers.

After setting the correct thermometer type, press Enter. The display will now show "*set all constants to defaults:- No*". Pressing the up or right arrow will select yes. Pressing the down or left arrow will reselect No.

After selecting Yes or No, press Enter. This will revert to review mode, and after about 3 seconds the display will show the first constants.

5. Using the up or down keys, each constant can be reviewed, when the constant to be edited is reached, press the Enter/Change key to enter the edit to the mode.
6. Using the up or down keys, the value of the digit marked by the cursor can be incremented or decremented.
7. Now using the left or right keys, the cursor can be stepped up to the next digit to be edited.
8. When the required value is displayed, press the Enter/Change key, the value will be stored and the display will now revert to the review mode, showing the new stored value, then after about 2 seconds the next constants will be displayed.
9. To edit any other constant repeat from step 5.
10. To edit the constants for another channel repeat from step 3.
11. Press the prog key to return to the main program menu, or press the mode key required.

### **ENTERING RS232 PARAMETERS**

1. Enter the prog mode.
2. Using either the up and down keys, or the left and right keys, move around the menu until "*Program RS232*" is reached, then press the Enter/Change key. The display will now show "*review Baud Rate*".
3. Using the up or down keys, the display can be toggled between baud rate and data format, when the required parameter is displayed, press the Enter/Change key to enter the edit mode.
4. Use the up or down keys to step through the alternative values. When the required value is reached, press the Enter/Change key.
5. To edit any other parameter, repeat from step 3.
6. Press the prog key to return to the main program menu or press the mode key required.

### **ENTERING IEEE-488 DEVICE NUMBER**

1. Enter the prog mode.
2. Using either the up and down keys, or the left and right keys move around the menu until "*Program IEEE-488?*" is reached, then press the Enter/Change key. The display will now show "*review device no.:*"
3. Press the Enter/Change key to enter the edit mode.
4. Use the up or down keys to increment or decrement the device number, when the required number is reached, press the Enter/Change key.
5. Press the prog key to return to the main menu or press the mode key required.

**ZERO :** This control is used in conjunction with the special zero shorting link supplied with the bridge. Select the required range, fit the zero link and carefully adjust the zero control until the display indicates 0000000.

**CALIBRATE:** Two adjusters are provided to trim the absolute value of the two internal resistance standards. This enables the calibration to be maintained indefinitely, without losing the use of the bridge. The calibration should be checked against certified standards at monthly intervals.

**B. INDICATORS**

*OVEN:* The oven light confirms that the internal standards are at the correct working temperature. The light will glow continuously when first switched on, then after an interval of about 20 minutes, will commence a slow on/off cycle which indicates that the temperature is under control.

*EXT:* Indicates that the bridge is reading ratio against an external standard, and is not utilising the internal standards supplied.

*REMOTE:* Indicates that the bridge is under remote control and that all front panel controls are disabled, except the on/off switch.

**C. REAR PANEL: - See Fig. 2**

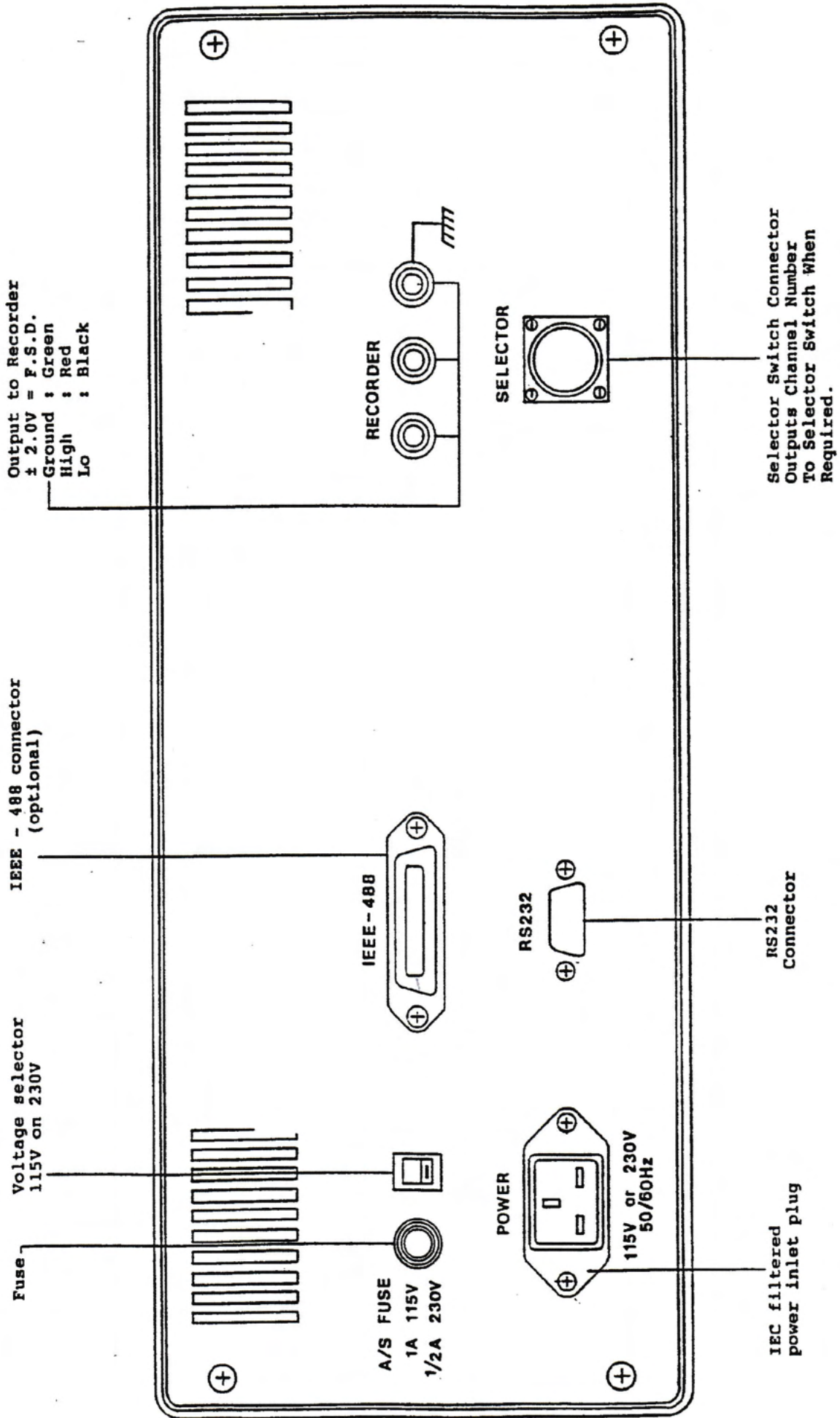
Power is supplied via the IEC filtered connector after checking the correct voltage setting and fuse values. A 6 way and 15 way selector switch, if required, can be fitted to the "selector" connector. This feeds power and channel select information to the selector switch.

When in DEV (deviation) mode, the recorder output is enabled, giving a  $\pm 2$  volt signal at the terminals on the rear panel, proportional to the difference between the measured value and the pre-programmed set point. The black terminal is connected to zero volts inside the bridge.

**D. REMOTE CONTROL**

All functions of the CONSORT can be remotely controlled via the standard RS232 interface on the rear panel, or the optional IEEE-488 interface, if fitted.

*Before using either interface it is necessary to check the relevant parameters are set up correctly, e.g. baud rates on RS232 or address on IEEE-488.*



**IEEE - 488 DEVICE NUMBER**

The IEEE-488 interface is an option, and the procedure below need only be followed if this option is fitted.

The device number of the bridge can be programmed from the front panel by following the procedure described below.

Switch on, and select the program mode by pressing the PROG key. The display will now show:-

PROGRAM SET POINTS ?
-------------------------

Using the UP, DOWN, LEFT OR RIGHT cursor control keys, step through the program menu until the display shows:

PROGRAM IEEE-488 ?
-----------------------

Press the Enter/Change key, and the display will now show:

REVIEW : DEVICE NO : 7
---------------------------

**NOTE:** The bridge device is set to 7 at the factory.

In this mode the device number can be viewed. To edit the device number, press the Enter/Change key and the display will now show:

EDIT : DEVICE NO : 7
-------------------------

Using the UP, DOWN, LEFT OR RIGHT cursor control keys, set the required device number, then press the Enter/Change key, this will store the new device number and return the display to review mode. To return to the program menu, press the PROG key, pressing AUTO or DEV mode keys will select the respective mode.

**IEEE-488 SPECIFICATION**

SH1	RLO
AH1	PPO
T4	DCO
L2	DTO
SR0	CO

**RS232 CONNECTIONS**

PIN 2	SERIAL OUT
PIN 3	SERIAL IN
PIN 7	GND

**RS232 DATA FORMAT AND BAUD RATE**

The data format and baud rate for the RS232 interface can be programmed from the front panel of the bridge by following the procedure described below.

Switch on, and select the program mode by pressing the PROG key. The display will now show:

PROGRAM  
 SET POINTS ?

Using the UP, DOWN, LEFT or RIGHT cursor control keys, step through the program menu until the display shows:

PROGRAM  
 RS232 ?

Press the Enter/Change key and the display will now show:

REVIEW :  
 BAUD RATE : 9600

**NOTE:** The baud rate is set to 9600 at the factory.

In this mode the baud rate can be viewed. To edit the baud rate, press the Enter/Change key, and the display will now show:

EDIT :  
 BAUD RATE : 9600

Using the UP, DOWN, LEFT or RIGHT cursor control keys, set the required baud rate, then press the Enter/Change key. This will store the new baud rate and return the display to review mode. The baud rates available are 75, 150, 300, 600, 1200, 2400, 4800 and 9600.

To return to the program menu, press the PROG key, pressing AUTO or DEV mode keys will select the respective mode. Pressing one of the cursor keys will select the reviewed mode for the data format, the display will now show:

REVIEW ; FORMAT 1ST 8 DATA 1SP
-----------------------------------

**NOTE:** The data format is set at a start bit 8 data bits 1 stop bit, at the factory.

In this mode the data format can be viewed. To edit the data format, press the Enter/Change key and the display will now show:

EDIT ;FORMAT 1ST 8 DATA 1SP
--------------------------------

Using the UP, DOWN, LEFT or RIGHT cursor control keys, set the required data format, then press the Enter/Change key. This will store the new data format and return the display to the review mode. The data formats available are:

1 start bit	7 data bits	1 stop bit
1 start bit	7 data bits	2 stop bits
1 start bit	8 data bits	1 stop bit
1 start bit	8 data bits	2 stop bits

To return to the program menu, press the PROG key, pressing AUTO or DEV mode will select the respective mode. Pressing one of the cursor keys will select the reviewed mode for the baud rate.

### **REMOTE COMMANDS**

The remote commands listed below are common for RS232 and IEEE-488. All commands have to be entered in upper case, when using IEEE-488 send each command as an ASCII message string terminated with a carriage return only, not a line feed.



In the list below < denotes a carriage return (ASCII "OD")

## **REMOTE COMMANDS**

- AUTO*< Places the bridge in auto mode, the bridge will respond with a message " AUTO"
- DEVN*< Places the bridge in the deviation mode, the bridge will respond with the message "DEVN"
- LOCL*< Places the bridge in local control
- PROG*< Places the bridge in remote programming mode. The bridge will respond with the message "PROG". The bridge can be programmed with one of the following commands.
- DEVO*< This is used in the following format to program the deviation resistance set point, *DEVO* + 25.0000<. NOTE. a positive sign must be used in front of the set point, and the set point entered to 4 decimal places.
- DEVC*< This is used in the following format to program the deviation temperature ( °C ) setpoint *DEVC* +25.000<. NOTE. a positive sign must be given and the setpoint entered to 3 decimal places.
- DEVK*< This is used in the following format to program the deviation temperature (Kelvin) setpoint *DEVK* +25.000<. NOTE. a positive sign must be used in front of the setpoint and the setpoint entered to 3 decimal places.
- DEVR*< This is used in the following format to program the deviation ratio setpoint *DEVR* +1.123456<. NOTE. a positive sign must be used in front of the setpoint and the setpoint entered to 6 decimal places.

When programming thermometer constants, the temperature range of the thermometer must be entered in the following from. X is the channel number. Upper case must be used.

C13X	for thermometers down to 13.8033K
C24X	" " " " 24.5561K
C54X	" " " " 54.3584K
C84X	" " " " 83.8058K
CABX	For thermometers down to 38.8344C and up to 29.7646C
C0CX	" " " " 0 Celsius

To enter thermometer constants, first enter the remote programming mode, by sending "PROG"<, then for a Platinum thermometer use the following commands. Upper case must be used.

PR0X	Platinum	R0	X=Channel No
PA+X	"	A above Zero	"
PA+X	"	B " "	"
PC+X	"	C " "	"
PD+X	"	D " "	"
PW6X	"	W660 Resistance ratio at 660	"
PA-X	"	A below Zero	"
PB-X	"	B " "	"
PC1X	"	C1 " "	"
PC2X	"	C2 " "	"
PC3X	"	C3 " "	"
PC4X	"	C4 " "	"
PC5X	"	C5 " "	"

The above commands are followed by a space then the sign (if the constant is positive a + sign must be used), then the constant value to 6 decimal places e.g. PR02 +24.404850< Platinum, Thermometer, R0, Channel 2. If the thermometer is Rhodium Iron use the following commands. Upper case must be used.

RRLX	Rhodium Iron	RL	X Channel No
RRUX	"	RU	"
RB0X	"	B0	"
RB1X	"	B1	"
RB2X	"	B2	"
RB3X	"	B3	"
RB4X	"	B4	"
RB5X	"	B5	"
RB6X	"	B6	"
RB7X	"	B7	"
RB8X	"	B8	"
RB9X	"	B9	"
RBAX	"	B10	"
RBBX	"	B11	"

The above commands are followed by a space then the sign (if the constant is positive a + sign must be used), then the constant value to 6 decimal places e.g. RRLF +3.206234< Rhodium Iron Thermometer, RL, Channel F (15). When the programming of the constants is finished the bridge can be placed in any mode.

CUR1<	Sets measurement current to 0.1mA
CUR2<	Sets measurement current to 0.3mA
CUR3<	Sets measurement current to 1.0mA
CUR4<	Sets measurement current to 3.0mA
X1.4<	Increases measurement current by a factor of 1.414
X1.0<	Reverts back to selected current
RAN1<	Selects 10 OHM range
RAN2<	Selects 100 OHM range
STD1<	Selects internal standard

- STDE<      Selects external standard  
 SELX<      Selects a channel number and sets the selector switch (if connected). X =  
 channel number 0-F, if a selector switch is connected and channel 0 is  
 selected the switch will be in manual control e.g. SEL6< selects channel 6.
- DIS0<      The bridge will display the answer in OHMS.
- DISC<      The bridge will display degrees in Celsius.
- DISK<      The bridge will display in Kelvin.

### **RS 232 ONLY**

The Consort bridge can store the answers from all 15 channels including the zero check (channel 0 with channel 0 selected on the selector switch). These answers can be recalled after a scan in any order and in any mode e.g. Ohms, degrees C, Kelvin or deviation mode.

The command to recall an answer from a specific channel is as follows:

ANSx where x is the required channel number from 0 - F.

If the answer is required in a different mode, then send the command to place the bridge in that mode before the answer is read e.g. sending the command DISC allows the answers to be taken in degrees C. If both resistance and temperature are required then send the command DIS0 (if not already in the ohms mode) read the answers then send the command DISC and read the answers in degrees C.

The format is as follows for each mode:

#### AUTO MODE

DISPLAY MODE	STRING LENGTH
OHMS	23 BYTES + CR LF
C	19 BYTES + CR LF
K	19 BYTES + CR LF
RATIO	24 BYTES + CR LF

To carry out a scan, select a channel number using the SELx command, then allow a balance and settling time (the longer the time the more accurate the result will be). If the resistance is within 100 milliohms of the previous reading on this channel the last time it was selected, then the balance time will be greatly reduced. To achieve the fastest possible scan always use the Ohms mode and it is recommended that a prescan is carried out. This will set the balance setting for each channel.

### 3. TECHNICAL DESCRIPTION

#### a. *ANALOGUE MEASUREMENT*

The linearity of sub division is defined by tapped current transformers of similar design to those used previously in a range of successful thermometer bridges, derived from an original design by the N.P.L. This method is used because the performance ratio of the current transformer is superior to other methods of sub division. The bridge therefore operates with an alternating current but the frequency is low enough to provide agreement with d.c. measurements well within the uncertainty of the d.c. calibration of the thermometer.

The transformers have decade windings and are cascaded such that any ratios from 0:1 to 1.5:1 in increments of 0.0001:1 may be obtained on the 10 Ohm ranges and from 0.1 to 3.5:1 on the 100 Ohm range. High accuracy is achieved by employing the multi stage principle which behaves as an integral comparator which reduces the ratio error to less than 10ppm.

The low frequency current passes through the standard resistor giving rise to a voltage  $i_s R_s$  across the standard. The voltage across the unknown is  $i_p R_x$  where:

$i_s$  = secondary current  
 $i_p$  = primary current  
 $R_s$  = resistance of standard resistor  
 $R_x$  = resistance of unknown

$i_s$  is a function of  $i_p$  and the ration of the transformer  $N$ , and if the transformer is perfect  $i_s = N i_p$ .

$N$  is the variable ration of the transformer and this is varied automatically until a detector finds the ratio where  $i_s R_s = i_p R_x$ .

$$\text{Then } \frac{i_p N R_s}{i_p} = R_x = N R_s$$

The bridge will be direct reading in ohms if  $N$  is displayed on the readout, suitably scaled according to the decade value of the standard resistor.

## **CONNECTIONS**

The four terminal connections to the bridge are made via coaxial BNC connectors such that the current pair is one coaxial cable and the potential pair is the other cable. This permits long parallel runs of cable with negligible inductive coupling between current and potential circuits.

The capacitive reactance of this system is high but the resulting quadrature component is ignored automatically by electronic circuitry. Low loss cable, such as UR, no M76 should be used to avoid errors due to the shunting effect of dielectric loss in the cable.

The thermometer is connected to the coaxial system by means of a special junction box or selector switch which should be sited near to the thermometers so that any unavoidable long run is made with coaxial cable.

## **CURRENT**

The measuring current flowing through the thermometer element will inevitably cause self heating and the optimum current will be a compromise between this effect and the resolution required from the measurement.

In general 1.0 milliamp is adequate for most measurements but in the case of platinum thermometers at low temperatures a high current may be used to obtain better resolution on the 10 Ohm resistance range.

In the special case of Rhodium Iron thermometers below 1 Kelvin the lowest current must be used to prevent excessive self heating, but the high sensitivity of this thermometer provides adequate resolution despite the low signal to noise ratio.

## **SELF HEATING**

Provision is made for a simple evaluation of the magnitude of the self heating effect so that a correction can be made to eliminate it. Since the heating effect is proportional to the square of the current it follows that the effect will be doubled if the current is increased by  $\sqrt{2}$ . It is then a simple matter to subtract this increment from the resistance reading to obtain the required value.

A push button is provided which will increase the current by  $\sqrt{2}$  on any range. The button should be pressed again to restore the nominal current once the self heating has been evaluated.

### **INTERNAL STANDARD RESISTORS**

The two internal standards are pre-aged and mounted within an oven operating at 35°C. This makes the bridge substantially independent of ambient temperature variations since the current transformers are not affected by temperatures within this range.

The standards have nominal values of 10 and 100 Ohms and each one may be trimmed to the exact value by comparison against a known ac/dc lab standard resistor.

This is accomplished by substituting the standard resistor in place of the platinum thermometer and adjusting the appropriate trimmer until the bridge displays the known value of the standard.

This is a convenient way of maintaining the necessary high accuracy without losing the use of the bridge when the standard is sent away for re-certification.

The drift rate of the standard is typically 2ppm per month so that monthly calibration is adequate for most purposes, but since calibration is a very quick and simple operation, it may be done as frequently as desired.

### **EXTERNAL STANDARDS**

The bridge may be used with external standards of the same nominal values as the two internal standards. The standards should be suitable for use on alternating current and be provided with means to connect the case to ground.

Use low loss coaxial cable to connect to the bridge and avoid large loops where the cable is opened to connect to the terminals of the standard. Also avoid siting the standard near a transformer or mains powered machine.

To use the bridge with external standards, press the EXT button and select the resistance range to match the value of the standard. If a 25 Ohm external standard is used the 100 Ohm range should be selected. The bridge will now read the ratio. RTH/RSTD.

**b. DIGITAL CONTROL*****GENERAL***

The instrument is controlled by a Hitachi 6303 microprocessor based computer with on board program in EPROM.

Most input/output connections are via input/output on the board with additional dedicated circuitry to drive the front panel LED's and IEEE-488 interface etc.

*INPUTS* - to the digital control section.

*Front panel controls* - The 16 keys form a 4 x 4 matrix. The depressed key is encoded and read by the micro.

*International Circuitry* - Signals are sent from the analogue measurement section to control the balance procedure of the bridge. Also 12 data bits plus a sign bit indicate the current out of balance status of the bridge.

*OUTPUTS* - from the digital control section.

The requested range and current are selected by BDC signals from the micro to the analogue section via interface circuitry. The required gain settings are then selected. Under program control, the current transformers variable ratio is selected in 3 decades steps to obtain a near balance of the bridge. The slight out of balance read from the A/D converter.

The 2 x 20 character LCD alphanumeric display on the front panel is also controlled from the micro using ASCII characters.

The display will give the resistance in Ohms or temperature in °C or K depending on the display mode chosen.

**RAM**

A 8K x 8 battery backed RAM chip is shared between the monitor EPROM and the 5840E bridge program. The battery is expected to last 10 years.

The RAM is used to store remote messages received, the thermometer calibration data, results of calculations and the current status of the instrument etc.

**ROM**

2 surface mount PROM's reside on the processor board. The first is a monitor which can be entered by pressing the return to monitor switch on the rear of the front panel board, this, using a remote RS232 terminal plugged into the RS232 connector, the analogue/digital sections can be exercised to facilitate fault finding.

The second EPROM is the 5840E bridge program which runs all the operations locally and remotely of the Consort. This program is entered automatically on switch on or by pressing the reset button on the microboard.



**SPECIFICATION**

Range	Resistance	10 Ohms internal standard 0-15.99999 Ohms 100 Ohms internal standard 0-350.0000 Ohms
	Ratio $R_t/R_s$	10 Ohms external Standard 0-1.599999 100 Ohms external Standard 0-3.500000
	Thermometers:	$R_0$ 2.5 - 100 Ohms

**Accuracy**

a) Ratio and Resistance measurement (relative to calibration standard)

Range	Current	Accuracy
100 Ohm	$0.1 \pm 0.2\%$	10 ppm $\pm$ 300 u Ohms
100 Ohm	$0.3 \pm 0.2\%$	10 ppm $\pm$ 200 u Ohms
100 Ohm	$1.0 \pm 0.2\%$	10 ppm $\pm$ 100 u Ohms
100 Ohm	$3.0 \pm 0.2\%$	10 ppm $\pm$ 100 u Ohms
10 Ohm	$1.0 \pm 0.2\%$	10 ppm $\pm$ 30 u Ohms
10 Ohm	$3.0 \pm 0.2\%$	10 ppm $\pm$ 20 u Ohms

**b) TEMPERATURE MEASUREMENT**

The internal resistance to temperature conversion accuracy is better than 1 millidegree and follows ITS 90. This uncertainty needs to be added to the uncertainty due to the resistance measurement as above and to the uncertainty of the actual sensor being used.

Typically between 0°C and 100°C using a 5187SA thermometer and Consort bridge accuracies of 6 millikelvin are achievable.

Resolution	:	Resistance: On 100 ohms range = 100u ohm On 10 ohms range = 10u ohm.
	:	Temperature: 0.0001°C. i.e 0.1 millikelvin.
Internal Reference	:	Rs 100 ohms $\pm$ 100ppm trimable to zero. T.C. = $\pm$ 0.2 ppm/ °C.
	:	10 ohms $\pm$ 200ppm trimable to zero. T.C. = $\pm$ 0.2 ppm/ °C.
Measurement Frequency	:	75Hz at 50Hz supply and 90Hz at 60Hz supply automatically switched
Sensor Current	:	0.1, 0.3, 1.0, 3.0, mA $\pm$ 0.2%. Constant Current source plus $\sqrt{2}$ x all currents.
Sensor Cables	:	20 Ohm max series R; 5nF max shunt capacity typically 100 metres coaxial cable.
Display Units	:	Ratio, Ohms, °C and K
Analogue O/P	:	1V 1Hz Bandwidth
Digital O/P	:	RS232 - Standard. IEEE-488 optional
Operating Temp	:	Range + 10 °C to + 30 °C
Supply	:	210 - 250v/105 - 125v. 50/60Hz, 150W.
Dimensions	:	W.400mm H.155mm D.350mm
Weight	:	10Kg

## 5. FAULT FINDING

In the event of an apparent malfunction try switching off, leave for 10 seconds then turn on again. This may clear the fault, if not, check that the range is correct for the measurement and that an external standard is connected if the function is required. Carefully check the interconnection leads to the thermometer. Switch off for 10 seconds, switch on again with auto button held in. This will reset system variables. If all else fails, connect a standard 100 R resistor to the thermometer terminals and if the fault persists remove the lid and proceed as follows:

### POWER SUPPLIES

Using a DVM with the low input on a OVL pin on the power supply unit. (PSU)

Measure the + 5V pin on the PSU, check it is  $5V \pm 0.25V$ . Check the + 6V1 pin on board 17 is  $+ 6V \pm 0.3V$  and the - 6V pin on board 17 is  $-6V \pm 0.3V$

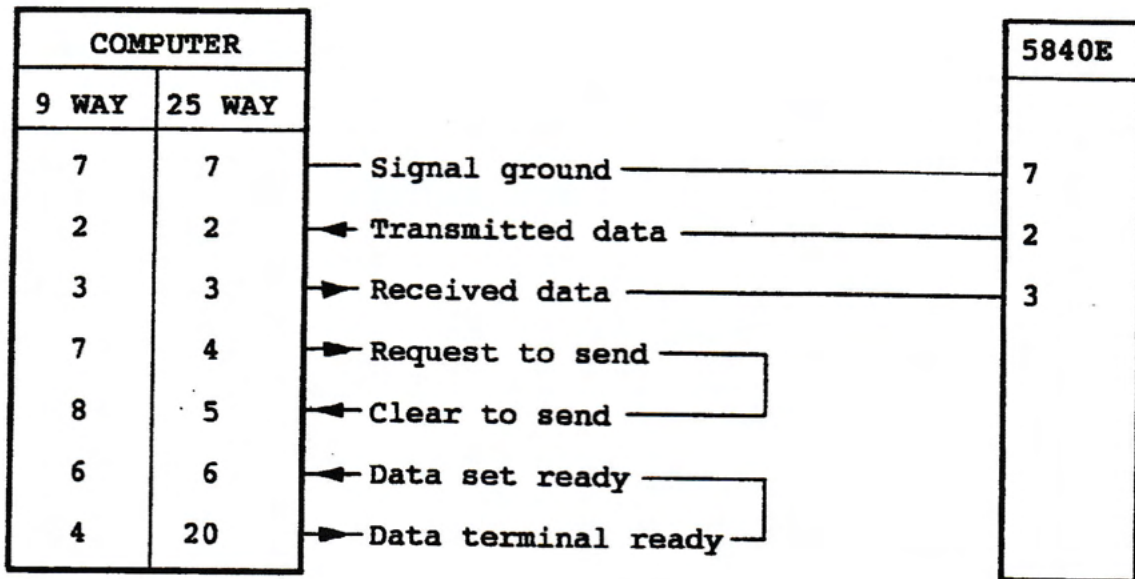
If correct, switch off and after 10 seconds, switch on again with program button held in.

This will reset all constants etc to default values and after verification of correct operation it will be necessary to re-center your thermometer constants.

**RS 232 CONNECTIONS**

PIN

2 SERIAL OUT  
 3 SERIAL IN  
 7 GROUND



**RS 232 CONNECTIONS**

PIN

- 2 SERIAL IN
- 3 SERIAL OUT
- 7 GROUND

