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1. Introduction

Automatic Systems Laboratories would like to thank you for purchasing the Metal Block Calibrator.
The equipment is supplied in a fully operational state, but ASL strongly suggests these brief operating instructions and guidelines be read before starting to use the apparatus. Should you have any difficulty understanding the instructions, or have any questions regarding the calibrator, please call our customer support group.

2. Safety

WARNING This apparatus is capable of reaching up to 140 °C and as low as -35 °C in normal operation. Burns to the skin can result through careless or negligent use. The calibrator has been configured at ASL, only change the configuration settings after reference to this handbook. Please follow the guidelines below as a minimum procedure for safe operation.

i) Always handle the calibrator as if the block and inserts are hot.

ii) Position the calibrator in such a way that it cannot be knocked from the bench. Pay careful attention to the positioning of the mains lead to avoid tripping.

iii) Do not cover the fins on the top of the calibrator or restrict the airflow.

iv) When removing hot inserts from the block, always place them away from flammable material and beware of boiling water in the wells condensed from earlier cooling.

v) Do not drop probes or articles down between the fins visible on the top surface of the calibrator. They will become jammed in the fan. Should this occur turn off the power immediately.

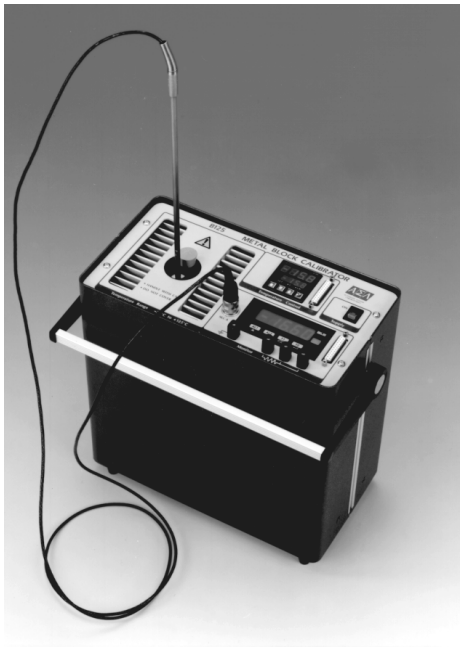


Figure 1. Model B140 with Independent Indicator

3. Setting up the calibrator

The calibrator is designed to give best performance when operated in a constant temperature environment without draughts. The calibrator should therefore be positioned away from air conditioners and direct sunlight. A cooler ambient will allow the calibrator to achieve lower temperatures. Please read section 5 of this manual to achieve the best results from the equipment.

3.1 Getting Started

Firstly check and adjust the voltage selection switch if necessary. This can be found on the underside of the calibrator.

WARNING: Ensure the correct line voltage fuse is fitted before turning on or adjusting the line voltage. Plug in the mains lead and turn on the calibrator using the green switch marked supply on the top panel. The cooling fan will start and the controller will start its self check procedure.

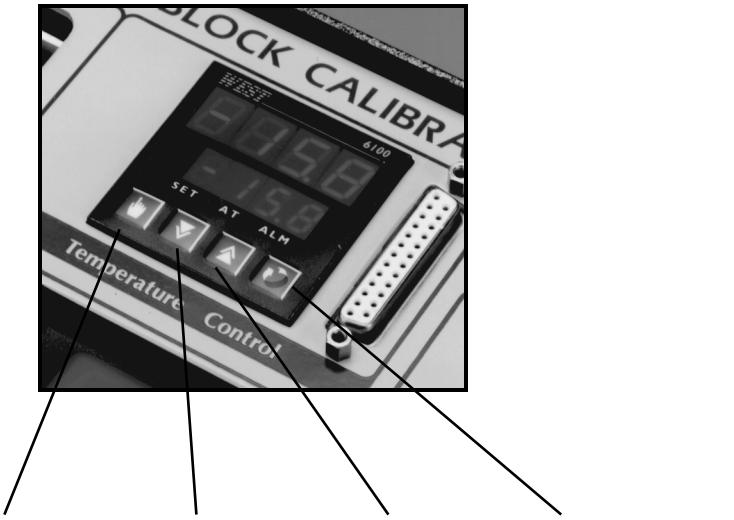
Voltage	Fuse
230V	T2A 250 VAC (1 Amp Slow
115V	T4A 250 VAC (2 Amp Slow

3.2 Power ON/OFF switch

I = Power ON O = Power OFF

The power switch itself will be illuminated (green), when the Block Calibrator power is switched ON.
Care should be taken not to limit access to the power ON/OFF switch.

3.3 Operating Mode



Auto/Manual Key Low Key High Key Function Key

Figure 2. The Controller keys

Whilst operating, the controller will show two temperatures on the controller panel, and the supply switch will be illuminated.

The temperature shown at the top of the controller display is a block temperature. At start up this can be expected to be close to room temperature unless the calibrator has been recently used.

The lower of the two displayed temperatures is the controller set point. For safety, all equipment leaving the factory is set to 20°C (68°F). The last set point is retained in the controller memory.

3.4 Setting the Temperature

i) Press the "Function" Key as shown above.

ii) The lower display will change to SP (set point).

iii) Use the up arrow or the down arrow keys to set the desired temperature on the upper display. The calibrator will begin to heat, or cool. Keeping the up or

down arrow key depressed will cause the rate of the displayed set point to accelerate. Momentary release of the button will bring the rate of change back to a low speed.

iv) After entering the new set point, the operator may return to the previous display by pressing the "Function" Key a second time.

Note: if this step is omitted, the display will return automatically after some seconds.

v) The upper display shows the actual block temperature, the lower display shows the new Set Point temperature.

vi) Depending on the ambient temperature and the set point temperature, the controller will take some time to stabilize at the new temperature. The stabilization process is best watched by reading the reference probe inserted in the block. It is normal for the calibrator controller to indicate an overshoot of some degrees on first approaching a new set point.

3.5 Controller Settings

The controller has been set to optimize stability over the full operating range of temperatures. Customers who wish to customize these settings to optimize a particular temperature are referred to the WEST 6100 handbook supplied with the unit. ASL cannot accept any responsibility for damage caused by incorrect setting of the controller parameters by our customers. The controller configuration settings should not be changed under any circumstances as these relate to the range and alarm functions. Customers are advised to note the configuration settings on their unit before making any changes. See appendix 3 for factory settings.

3.6 Changing from Centigrade to Fahrenheit mode

The calibrator can operate in Centigrade or Fahrenheit mode.

Firstly the controller parameters need to be noted if they are different to the default ASL settings (for example where different P.I.D terms are used).

To do this enter the "LOC" code (default 8 set by ASL) by pressing the "Function" button and the up arrow together, the display will show "ULOC" in the lower section. Enter the LOC code using the up and down arrows and press "Function" to accept.

The controller will now display the operating parameters that can be scrolled through to note the values. Do this by repeatedly pressing the "Function" key, when back at the start press "Function" and up together to exit, and the set LED will extinguish. To Alter the range from °C to °F, the input range code has to be changed, a list of these codes can be found in Appendix A of the West Instruments Site Manual. The relevant ranges of codes are listed under the title "For RTD inputs". The default codes for units leaving

the factory are given in Appendix 3 of this manual. To enter the new range the configuration mode has to be accessed.
To do this turn the power off. Turn the power back on and within 30 seconds of power-up, hold down the up and "Function" keys simultaneously for five seconds.

The controller will then show the current input code selected. This can be changed with the up and down arrow keys. As soon as the value is changed the upper display will flash indicating that the new value has yet to be confirmed, when the value is as required it may be confirmed by pressing the "Auto/Manual" key, whereupon the display will become static. Next return from the configuration mode by pressing "Function" and up together. Having returned the display will show the temperature but with all the decimal points showing, indicating that the controller parameters need resetting.

Note: If the input code is changed the values in the setup mode will return to the default values.

WARNING

The set point maximum (SPhi) will default to the upper limit of range, as will the high alarm, this would be 537.3°C or 999.1°F.

To enter the setup mode use the "LOC" code as above and re-enter the values noted down except the values in °C or °F which will need changing to new scale. This is very important for safety. The alarm values will need particular care.

The default values can be found for °C or °F in Appendix 3 of this manual.

Another precaution would be to indicate on the front panel that the units are now set to Fahrenheit in case someone assumes Centigrade and sets the temperature dangerously high.

4. The Serial Interface for the controller (if fitted)

The controller may be optionally fitted with an RS232 or an RS485 interface. Refer to the WEST 6100 controller manual for instructions on using the RS232/RS485.

Connections for the interfaces are:

RS485	*25 Way 'D' type socket*
"A" or XMT + terminal	Pin 2
"B" or XMT - terminal	Pin 15
RS232	*25 Way 'D' type socket*
CTS	Pin 5
R x D	Pin 3
T x D	Pin 2
DTR	Pin 20
GND	Pin 7
DSR	Pin 6

4.1 Factory Default Settings

RS232: Factory set to 4800 baud, even parity, 7 data bits and 1 stop bit.

RS485: As above, Address1.

5. Achieving the best results using your Metal Block Calibrator

This section of your manual is written to help you achieve the best results from your calibrator. ASL has tested this product extensively and the results of tests to a typical production instrument can be found in Appendix 1 of this manual. Your Block Calibrator is designed to provide a reference temperature of high stability under the correct operating conditions. The absolute value of this temperature must be measured using a reference temperature probe. The indicated temperature on the temperature controller is not calibrated and cannot be used as a reference. ASL can provide a calibrated reference probe and indicator installed in the calibrator, or alternatively a more versatile and accurate standalone system. Please ask your representative for details.

5.1 Performance of the Calibrator

The calibrator reduces the temperature within the block by drawing heat out of the heat sink fins visible from the top panel. Performance will be reduced if the airflow is restricted in any way. In particular check that the Air inlet on the underside of the unit is free from loose material which may get sucked against the fan guard. In a cooler ambient the calibrator will be able to achieve a lower block temperature although this is dependent on the loading. No harm will occur if a set point lower than the specified minimum is set. However setting a figure higher than the maximum quoted temperature will cause serious and permanent damage to the unit.

5.2 Probe positioning and use of inserts

To ensure the correct orientation of probes in the Metal Block Calibrator the calibrator is fitted with location spigots in each well. When fitting inserts into the calibrator ensure that the locating hole in the bottom of the insert mates with the locating spigot.

The top surface of the block has a greater heat loss than the sides and bottom of the block. This gives rise to a variation in temperature at different vertical positions in the block. The block is designed to achieve the minimum possible variation in temperature at any horizontal plane within the block.

To avoid inaccuracies caused by the vertical temperature variations above, the user should use a reference probe of the same type as the probe under test. If this is not possible, the reference probe should be designed to match the physical and thermal characteristics of the probe under test as closely as possible. The insertion depth of the test probe measure point should be exactly the same as the reference probe measure point.

5.3 Thermal Contact

To achieve the best possible accuracy, all probes that are inserted in the block should have the largest possible contact area with the metal of the block or insert. A good fit for the probe into its well is desirable. It would be possible to achieve an even a greater thermal transfer by using a medium such as heat sink compound, commonly used in the electronics industry, coating the probe to fit in the insert. This is not recommended in anything other than an insert that can be removed for cleaning. The temperature range of the compound must be checked before use. Holes are drilled right through the inserts - oil etc. will leak into the well.

5.4 Custom Drilled Inserts

ASL provides a standard block that is drilled to accommodate 2 x 5/8 " (15.875 mm) diameter inserts.

In addition, ASL provides inserts that can be factory drilled to order, or drilled by our customers to accommodate different types of probe. As may be seen from the test results in Appendix 1, the temperature difference between inserts may be several tenths of a degree. As previously observed for the probe/block contact area, the contact area between the insert and the block may vary, and the inclusion of a second metal/air/metal boundary will degrade the accuracy that can be obtained when using inserts.

It is important to ensure that the probes are at the same depth within the insert well to achieve a higher matching of the probes temperatures.

ASL therefore recommend that you use factory drilled inserts that will provide you with the correct fit and are anodized after drilling to prevent corrosion.

5.5 Use of "Twin" Inserts

To obtain maximum accuracy, ASL recommends the use of inserts drilled to accommodate 2 probes within the same insert. These "Twin" inserts may be factory or customer drilled, and allow the qualification of up to 2 different probe types in one calibration run. (Each insert must contain one reference probe and one probe under test). ASL can provide blank inserts for our customers to drill themselves. Due to the possibility of incorrectly sized inserts becoming stuck in the block we recommend the use of factory supplied blanks. We also recommend that the inserts are anodized after drilling to prevent corrosion.

5.6 Condensation

When the calibrator is in use at temperatures below the dew point, water will condense on the surface of the block, insert and probes. Normally this is not a problem and can be ignored. When subsequently the water is frozen, probes and inserts can become stuck, raise the temperature to free them. It is wise to remove the inserts periodically

to empty them of water. Even where the block has been left at an elevated temperature for several hours with probes fitted (60°C) the water will not have evaporated.

5.7 Supply Voltage Variations

As with all electrical equipment, your calibrator is designed to operate most efficiently on a stable electrical supply. Transient variations in supply voltage will vary the quantity of heat output by the Heating element, and may adversely affect the temperature stability of the equipment. Customers should therefore make every effort to ensure a stable supply during testing and calibration.

5.8 Ambient Temperature Variations

The calibrator is unaffected by changes in ambient temperature taking place over several hours. Sudden temperature changes will cause a temporary disturbance in block temperature. For best results, we recommend that the calibrator be used in a draught free environment of constant temperature.

5.9 Insulating Probe Stems

The calibrator is supplied with two foam pipe lagging tubes. These are beneficial to reduce the stem conduction of the probes to the ambient temperatures.

Where long probes are used position the lagging around the probes and secure with releasable cable ties provided.

An increase in stability can be achieved by avoiding draughts on the probe stems.

6. The Independent Indicator (if fitted)

The calibrator may be optionally fitted with an independent temperature monitor.

The monitor is linked to a 5 way DIN connector and terminal block on front of the controller (see Appendix 2 for wiring details).

To use the independent monitor connect a PRT to either the DIN connector or the terminal block, insert the PRT into the block. The monitor will now display the block temperature in degrees Centigrade. If you have ordered an Independent Indicator to be set up in thermocouple mode, then a thermocouple needs to be connected instead of a PRT.

Connections for the interfaces are:

RS485	*25 Way 'D' type socket*
"A" or XMT + terminal	Pin 2
"B" or XMT - terminal	Pins 14, 15
RS232	*25 Way 'D' type socket*
T x D	Pin 2
R x D	Pin 3
GND	Pin 7
CTS ┐ Linked internally	Pin 5
RTS ─	Pin 4
DSR ┐ Linked internally	Pin 6
DTR ─	Pin 20

6.1 Factory Default Settings

The Independent Indicator is factory set to 9600 baud, 8 bit, no parity and 1 stop bit.

6.2 Linearizing the Independent Indicator

The following instructions tell you how to linearize the independent indicator.

The Indicator must initially be set to suit the reference probe and temperature range of the block
(See Figure 3)

Range	Resolution	Accuracy
-200 to +850°C	0.1°C	± 0.5°C
-60 to +130°C	0.02°C	± 0.5°C

The reference Pt100 probe and block has to be calibrated as a system to give the required number of 'temperature pairs' (expected and actual),up to a maximum number of 17.

The above temperature pairs are then entered into the linearization feature of the independent indicator (CSLin), using the calibration procedure (See Figure 4)

Note: The setup menu is selected by pressing the AL1 and F1 keys simultaneously.

The expected readings (test temperature) are 'OU 1' to 'OU 17'.

The actual readings (Indictor reading) are 'IN 01' to 'IN 17'.

The system is then calibrated a second time and the initial errors between the test temperature and the Block -II Independent Indicator should be reduced.

Example:

1st calibration results at 5 points:

Test Temperature	Indicator Reading
-24.214	-24.42
0.385	00.16
49.824	49.52
99.285	98.96
124.074	123.68

Enter the data pairs as below:

IN 01 = -24.42	OU 01 = -24.21
IN 02 = 00.16	OU 02 = 0.39
IN 03 = 49.52	OU 03 = 49.82
IN 04 = 98.96	OU 04 = 99.29
IN 05 = 123.68	OU 05 = 124.07

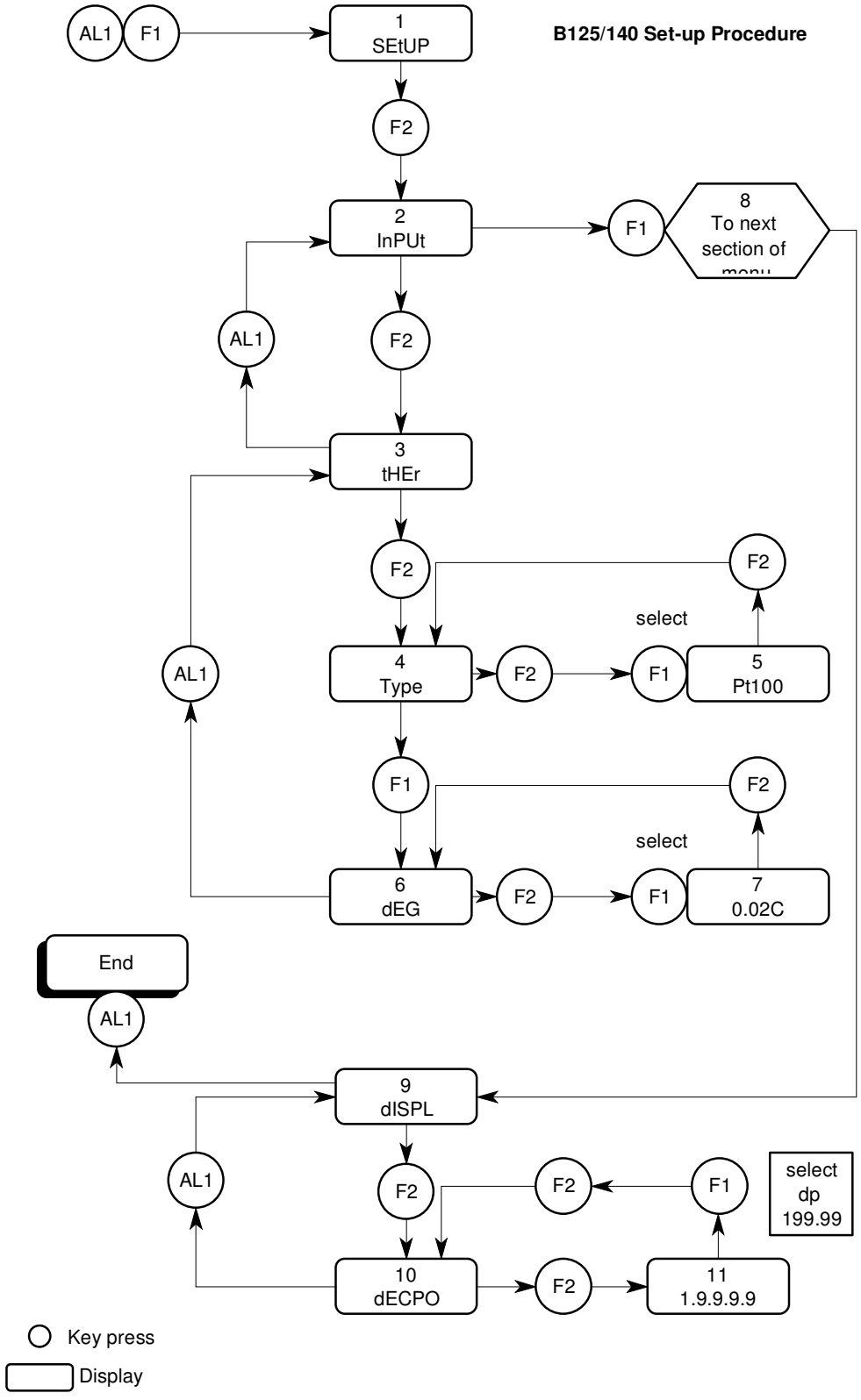


Figure 3. Independent Indicator initial set up.

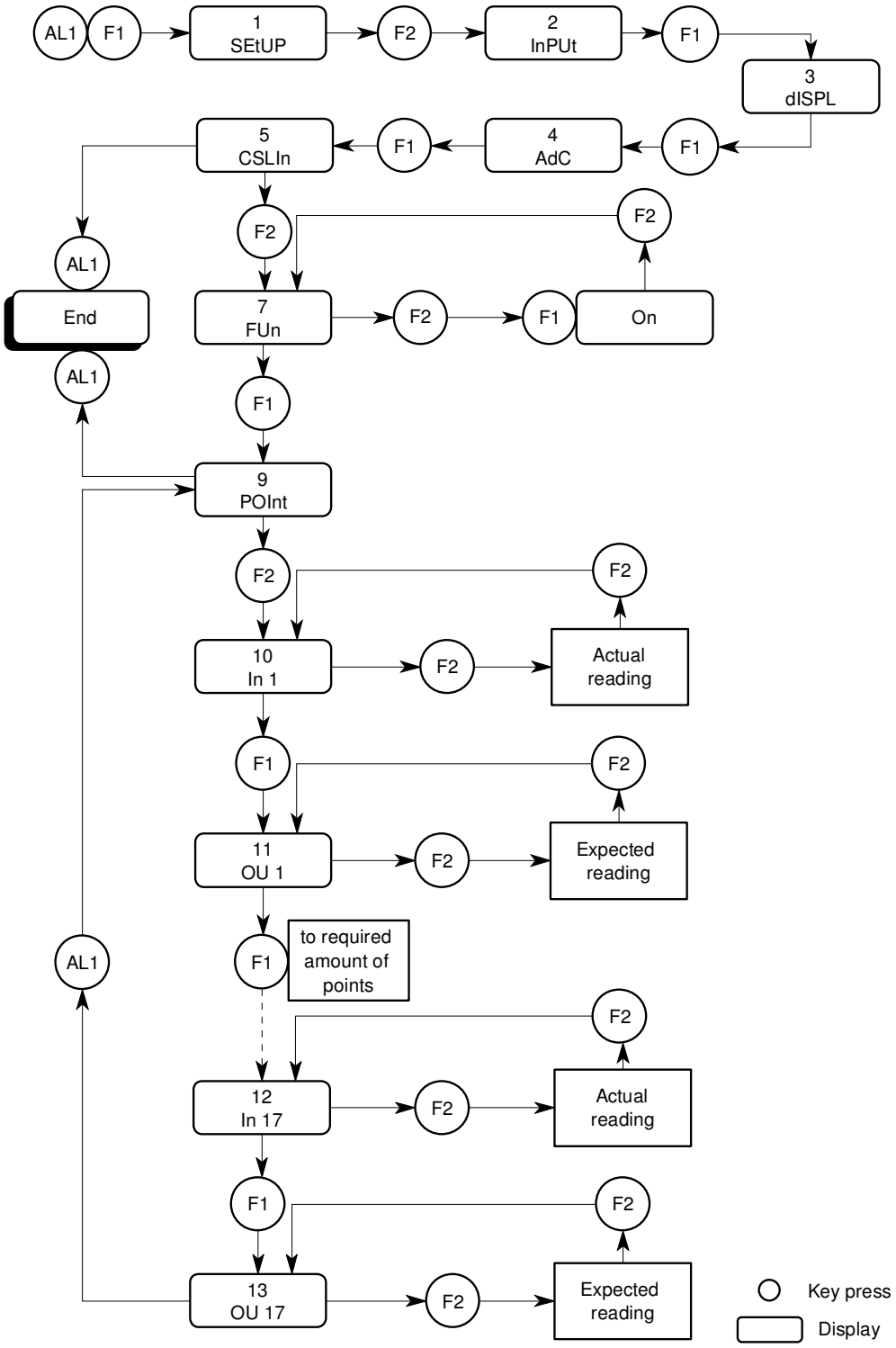


Figure 4. Independent Indicator Calibration Procedure.

7. Specifications

7.1 General

Model	Well Depth (mm)	Well Dia. (mm)	Insert Length (mm)	Temperature range in normal ambient of 22 °C	Stability
B140	155	2 x 16	150	<-25 °C to +140 °C	±0.05°C
				(<13 °F to +284 °F)	±0.09°F

7.2 Environment

Operating Temperature: 15°C to 25°C for full accuracy, 0°C to 50°C maximum.

Humidity: Specified to 90% RH at 40°C non-condensing.

Power Requirements: 230VAC +10% /-15%

115VAC +10% /-15%

Supply Voltage range is user delectable on rear panel.

Frequency range: 47-63Hz.

Power consumption: 320VA Max.

Dimensions: 305mm wide, 165mm depth, 325mm height (12" wide, 6.5" depth, 12.8" height)

Weight: 9 Kg (19.8 lb.)

8. Cleaning and Maintenance

8.1 Cleaning

Make sure the Block Calibrator is turned off and unplug the mains supply cable.

Clean the outsides of the instrument with a soft, clean cloth dampened with mild detergent. Do not allow water to enter the instrument.

WARNING Never use alcohol or thinners as these will damage the instrument.

Never use a hard or abrasive brush.

8.2 Preventative Maintenance

WARNING Regular inspection of the mains supply cable is required to ensure that

the insulation is not damaged.

8.3 General safety Warning

WARNING If the Block Calibrator is used in a manner not specified by ASL, then

the protection provided by the instrument may be impaired.

8.4 Internal fuse replacement

WARNING Switch off the instrument and remove the power supply cable before removing the instrument case.

It is recommended that a competent ASL trained technician carries out the work.

The Block Calibrator has an internally fitted automotive type blade fuse on the secondary of the toroidal power supply transformer.

If the fuse requires replacing ensure you use the correct type and value.

Model	Fuse rating
B140	F20A 250 VAC (16 Amp quick blow)

The Block Calibrator has an internally fitted fuse on the RS232 to RS485 converter (if fitted).

If the fuse requires replacing ensure you use the correct type and value.

Model	Fuse rating
B140	20mm T2A 115 VAC

9. Service and Warranty

Block Calibrator equipment and accessories, (unless stated otherwise), are covered by a 12 month warranty for parts and labor, but not including costs incurred in returning it to the factory for repair, from the date of dispatch from Automatic Systems Laboratories.

9.1 Technical Support

For all technical support, repair, warranty and service inquiries please contact:

ASL Customer Support Group
Automatic Systems Laboratories Ltd
15 Unions Street
Suite 410
Lawrence
MA01840
USA
Telephone: (978) 658 0000
Fax: (978) 658 5444

9.2 Returned Instruments

All returned goods should be sent carriage paid, insured and packed well, to the above address.

9.3 Documentation

The shipment should include:

i) Your goods return note, a delivery note or an export invoice stating clearly that GOODS RETURNED FOR REPAIR.

ii) Your Company / Establishment order or contract reference number.

iii) The name of your purchasing and technical contact.

iv) A brief fault report.

9.4 Non UK Return

Automatic Systems Laboratories has a general authority arrangement with UK Customs to temporarily import goods free of duty and import tax. Therefore pre-advice of shipment, date, carrier etc., will enable us to arrange prompt importation with our freight agents.

9.5 Repair Quotations

We shall be pleased to advise repair costs upon receipt and initial inspection of returned goods.

9.6 Re-Export of Repaired Instruments

It is our normal practice to return repaired equipment all charges forward and include import charges, that is import documentation and UK freight charges on our repair invoice. Please advise if you require return costs to be included in our repair quotation or have any special shipping instructions.

10. Appendix 1 Performance Charts for B140 Block Calibrator

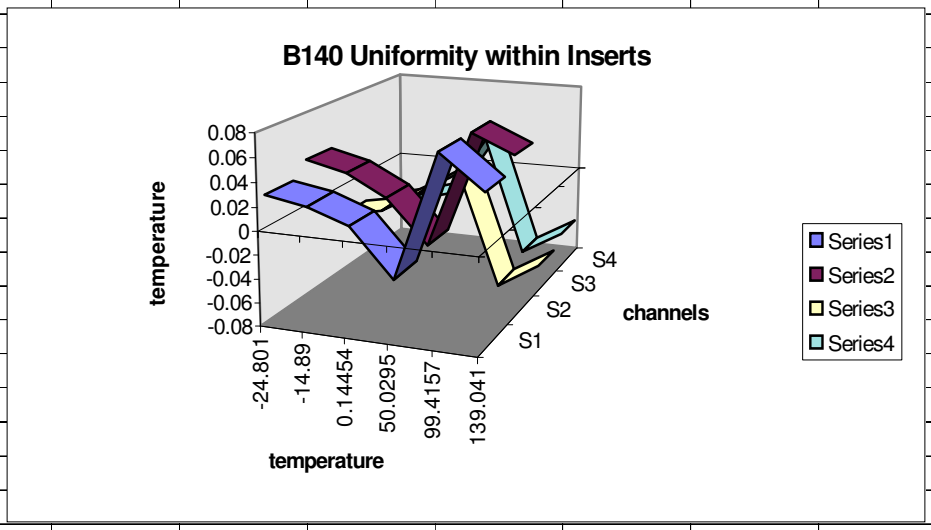
B140 Block Calibrator test Results. Data from second production model 04/97								
	Data capture using T25/02s		F250		SB250	Soft250 and Excel 5.0(tm)		
-25°C								
	Channel 1		Channel 2			Channel 3		Channel 4
count	68		68			68		68
duration hh:mm:ss	00:14:07		00:14:07			00:14:07		00:14:07
average	-24.8276		-24.8398			-24.7723		-24.7624
max	-24.813		-24.826			-24.76		-24.75
min	-24.849		-24.861			-24.79		-24.781
range K	0.036		0.035			0.03		0.031
stability ±K	0.018		0.0175			0.015		0.0155
stability ±mK	18	0	17.5	0		15	0	15.5
-15°C								
count	65		65			65		65
duration hh:mm:ss	00:13:05		00:13:05			00:13:05		00:13:05
average	-14.9107		-14.9205			-14.8683		-14.8598
max	-14.845		-14.857			-14.831		-14.82
min	-14.976		-14.976			-14.906		-14.899
range K	0.057		0.062			0.03		0.016
stability ±K	0.0285		0.031			0.015		0.008
stability ±mK	28.5	0	31	0		15	0	8
0°C								
count	41		41			41		41
duration hh:mm:ss	00:11:18		00:11:18			00:11:18		00:11:18
average	0.136205		0.131718			0.145692		0.164538
max	0.19		0.179			0.189		0.2
min	0.096		0.1			0.112		0.132
range K	0.094		0.079			0.077		0.068
stability ±K	0.047		0.0395			0.0385		0.034
stability ±mK	47	0	39.5	0		38.5	0	34
50°C								
count	60		60			60		60
duration hh:mm:ss	00:19:51		00:19:51			00:19:51		00:19:51
average	50.0603		50.0539			50.00943		49.99446
max	50.116		50.111			50.06		50.034
min	50.022		50.02			49.975		49.955
range K	0.094		0.091			0.085		0.079
stability ±K	0.047		0.0455			0.0425		0.0395
stability ±mK	47	0	45.5	0		42.5	0	39.5
100°C								
count	97		97			97		97
duration hh:mm:ss	00:32:29		00:32:29			00:32:29		00:32:29
average	99.34149		99.34152			99.49471		99.48519
max	99.38		99.38			99.525		99.514
min	99.305		99.308			99.468		99.455
range K	0.075		0.072			0.057		0.059
stability ±K	0.0375		0.036			0.0285		0.0295
stability ±mK	37.5	0	36	0		28.5	0	29.5
140°C								
count	116		116			116		116
duration hh:mm:ss	00:39:53		00:39:53			00:39:53		00:39:53
average	138.994		138.9821			139.0976		139.0896
max	139.014		139.001			139.114		139.105
min	138.972		138.961			139.082		139.07
range K	0.042		0.04			0.032		0.035
stability ±K	0.021		0.02			0.016		0.0175
stability ±mK	21	0	20	0		16	0	17.5

Uniformity of Block and inserts for B140

Apr-97

Average temperatures from all results, for each channel							Twin inserts	
(All temperatures in °C)						range	Ch0-Ch1	Ch2-Ch3
	Channel 1	Channel 2	Channel 3	Channel 4				
average	-24.8276	-24.8398	-24.7723	-24.7624		0.077449	0.012246	-0.00986
average	-14.9107	-14.9205	-14.8683	-14.8598		0.060667	0.009773	-0.00856
average	0.136205	0.131718	0.145692	0.164538		0.032821	0.004487	-0.01885
average	50.0603	50.0539	50.00943	49.99446		0.065836	0.006393	0.014967
average	99.34149	99.34152	99.49471	99.48519		0.153224	-3.1E-05	0.00952
average	138.994	138.9821	139.0976	139.0896		0.115453	0.01188	0.008017

Overall average		Difference from average.			
		Ch0	Ch1	Ch2	Ch3
-24.8005		0.027075	0.039322	-0.02827	-0.03813
-14.8898		0.020864	0.030636	-0.02147	-0.03003
0.144538		0.008333	0.012821	-0.00115	-0.02
50.02952		-0.03077	-0.02438	0.020094	0.035061
99.41573		0.07424	0.074209	-0.07898	-0.06946
139.0408		0.046812	0.058692	-0.05676	-0.04874



11. Appendix 2. Wiring Connections for DIN connector

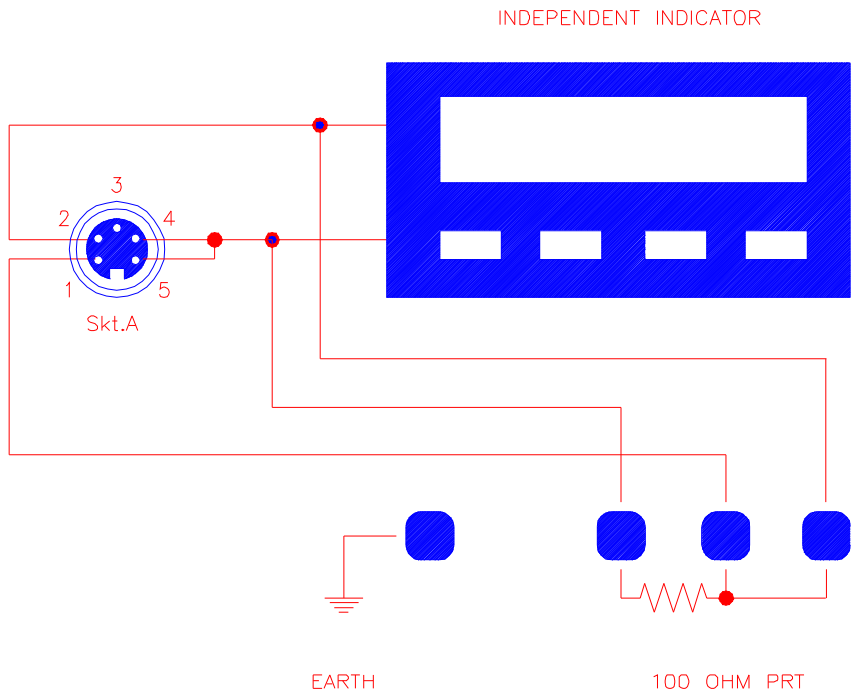


Figure 5. Wiring Diagram for Independent Indicator.

12. Appendix 3 Factory B140 West Controller Settings

12.1 Setup Mode

	Legend	**Value**	
		°C	**°F**
Digital filter	Filt	0.0	0.0
Offset	OFFS	0.0	0.0
Output power	Out1	not set able	not set able
Proportional band1	Pb1	1.0	1.0
Proportional band2	Pb2	1.0	1.0
Integral (reset)	Rset	0.05	0.05
Derivative (rate)	rATE	0.01	0.01
Overlap/deadband	OL	0	0
Manual reset (bias)	bIAS	25	25
Set point high limit	SPhi	145	293
Set point low limit	SPlo	-50	-50
Output 1 power limit	OPhi	100	100
High Alarm 2	h_A2	150	302
Loop alarm enable	LAEn	0	0
Auto pre-tune	Apt	0	0
Manual power enable	PoEn	0	0
Setpoint ramp enable	rPEn	0	0
Setpoint strategy	SPSt	1	1
Communications enable	CoEn	0, or 1 if comms fitted.	
Lock value	Loc	8	8

12.2 Configuration Mode

Input range	inPt	7222	(-100.9 to +537.3) °C
	inPt	7223	(-149.7 to +999.1) °F

WARNING

Read section 3.5 before altering the controller's parameters, in particular the set point limits. Exceeding the maximum temperature may cause permanent damage.