IBC2700 Boiler Controller

Installation and Operating Instructions

IBC2700 Boiler Controller

1. SAFETY AND EMC INFORMATION

This controller is intended for industrial control applications when it will meet the requirements of the European Directives on Safety and EMC. Use in other applications, or failure to observe the installation instructions of this handbook may impair safety or EMC. The installer must ensure the safety and EMC of any particular installation.

Safety

This controller complies with the European Low Voltage Directive 73/23/EEC, amended by 93/68/EEC, by the application of the safety standard EN 61010.

Electromagnetic compatibility

This controller conforms with the essential protection requirements of the EMC Directive 89/336/EEC, amended by 93/68/EEC, by the application of a Technical Construction File. This instrument satisfies the general requirements of the industrial environment defined in EN 50081-2 and EN 50082-2. For more information on product compliance refer to the Technical Construction File.

GENERAL

The information contained in this manual is subject to change without notice. While every effort has been made to ensure the accuracy of the information, your supplier shall not be held liable for errors contained herein.

Unpacking and storage

The packaging should contain an instrument mounted in its sleeve, two mounting brackets for panel installation and this operating book. Certain ranges are supplied with an input adapter. If on receipt, the packaging or the instrument are damaged, do not install the product but contact Spirax Sarco. If the instrument is to be stored before use, protect from humidity and dust in an ambient temperature range of -30°C to +75°C.

SERVICE AND REPAIR

This controller has no user serviceable parts. Contact Spirax Sarco for repair.

Caution: Charged capacitors

Before removing an instrument from its sleeve, disconnect the supply and wait at least two minutes to allow capacitors to discharge. It may be convenient to partially withdraw the instrument from the sleeve, then pause before completing the removal. In any case, avoid touching the exposed electronics of an instrument when withdrawing it from the sleeve. Failure to observe these precautions may cause damage to components of the instrument or some discomfort to the user.

Electrostatic discharge precautions

When the controller is removed from its sleeve, some of the exposed electronic components are vulnerable to damage by electrostatic discharge from someone handling the controller. To avoid this, before handling the unplugged controller discharge yourself to ground.

Cleaning

Do not use water or water based products to clean labels or they will become illegible. Isopropyl alcohol may be used to clean labels. A mild soap solution may be used to clean other exterior surfaces of the product.

INSTALLATION SAFETY REQUIREMENTS

Safety Symbols

Various symbols are used on the instrument, they have the following meaning:


Caution, (refer to the accompanying documents)


Functional earth (ground) terminal

The functional earth connection is not required for safety purposes but is used to ground RFI filters.

☺ Helpful hints or information

Personnel

Installation must only be carried out by qualified personnel.

Enclosure of live parts

To prevent hands or metal tools touching parts that may be electrically live, the controller must be installed in an enclosure.

Wiring

It is important to connect the controller in accordance with the wiring data given in this handbook. Take particular care not to connect AC supplies to the low voltage sensor input or other low level inputs and outputs. Only use copper conductors for connections, (except thermocouple). Ensure that the wiring of installations comply with all local wiring regulations. For example in the in the UK, use the latest version of the IEE wiring regulations, (BS7671). In the USA, use NEC Class 1 wiring methods.

Power Isolation

The installation must include a power isolating switch or circuit breaker that disconnects all current carrying conductors. The device should be mounted in close proximity to the controller, within easy reach of the operator and marked as the disconnecting device for the instrument.

Earth leakage current

Due to RFI Filtering there is an earth leakage current of less than 0.5mA. This may affect the design of an installation of multiple controllers protected by Residual Current Device, (RCD) or Ground Fault Detector, (GFD) type circuit breakers.

Overcurrent protection

To protect the internal PCB tracking within the controller against excess currents, the AC power supply to the controller and power outputs must be wired through the fuse or circuit breaker specified in the technical specification.

Voltage rating

The maximum continuous voltage applied between any connection to ground must not exceed 264Vac.

The controller should not be wired to a three phase supply with an unearthed star connection. Under fault conditions such a supply could rise above 264Vac with respect to ground and the product would not be safe.

Voltage transients across the power supply connections, and between the power supply and ground, must not exceed 2.5kV. Where occasional voltage transients over 2.5kV are expected or measured, the power installation to both the instrument supply and load circuits should include a transient limiting device.

These units will typically include gas discharge tubes and metal oxide varistors that limit and control voltage transients on the supply line due to lightning strikes or inductive load switching. Devices are available in a range of energy ratings and should be selected to suit conditions at the installation.

Conductive pollution

Electrically conductive pollution must be excluded from the cabinet in which the controller is mounted. For example, carbon dust is a form of electrically conductive pollution. To secure a suitable atmosphere, install an air filter to the air intake of the cabinet. Where condensation is likely, for example at low temperatures, include a thermostatically controlled heater in the cabinet.

1.1 Installation Requirements for EMC

To ensure compliance with the European EMC directive certain installation precautions are necessary as follows:

- When using relay outputs it may be necessary to fit a filter suitable for suppressing the conducted emissions. The filter requirements will depend on the type of load. For typical applications we recommend Schaffner FN321 or FN612.
- If the unit is used in table top equipment which is plugged into a standard power socket, then it is likely that compliance to the commercial and light industrial emissions standard is required. In this case to meet the conducted emissions requirement, a suitable mains filter should be installed. We recommend Schaffner types FN321 and FN612.

Routing of wires

To minimise the pick-up of electrical noise, the low voltage DC connections and the sensor input wiring should be routed away from high-current power cables. Where it is impractical to do this, use shielded cables with the shield grounded at both ends. In general keep cable lengths to a minimum.

2. INTRODUCTION

The IBC2700 Boiler Controller is a panel mounted instrument used to:-

1. To control the **level** of the liquid in the boiler and provide alarms if the upper or lower levels are exceeded.
2. Monitor the conductivity of liquids and to control **TDS** (Total Dissolved Solids) levels in a boiler system.
3. To provide a **boiler blowdown** sequence using a valve or condensate dump valve.
4. Control steam mains warm up

The front panel has a multi-line electro-luminescent display showing the process conditions found in boiler systems. Push-buttons allow different displays to be shown and to select, view and change parameters or settings.

A Pt100 temperature sensor may be connected to the controller to provide temperature compensation for TDS measurement. This is recommended if the boiler is working at varying pressures, or for other applications such as condensate monitoring or coil boilers, where the temperature may vary. If a temperature probe is not fitted the controller defaults to a temperature of 184°C at a pressure of 10Bar. This value is adjustable by the user.

☺ When this symbol appears in this handbook it indicates a useful tip or short cut.

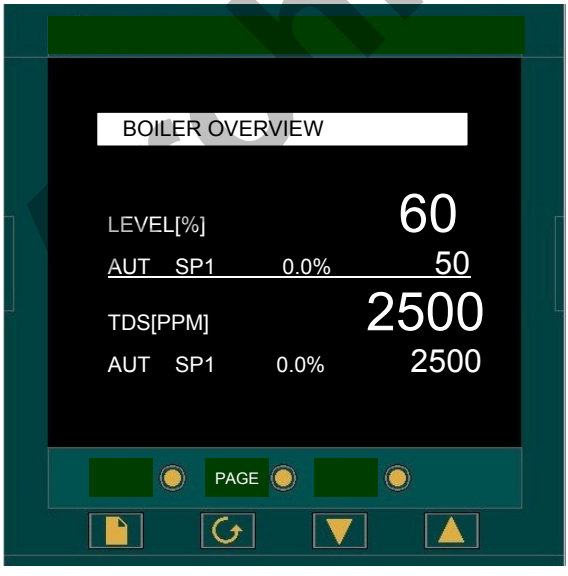


Figure 2-1: Overview Display

3. INSTALLATION

3.1 Positioning

The controller can be mounted vertically or on a sloping panel of maximum thickness 15mm (0.6in). Adequate access space must be available at the rear of the instrument panel for wiring and servicing purposes. The outline dimensions are shown in figure 3-1.
Take care not to cover ventilation holes in the top, bottom and sides of the instrument.
Before proceeding please read Appendix B 'Safety and EMC Information'.

3.2 Outline Dimensions Model IBC2700

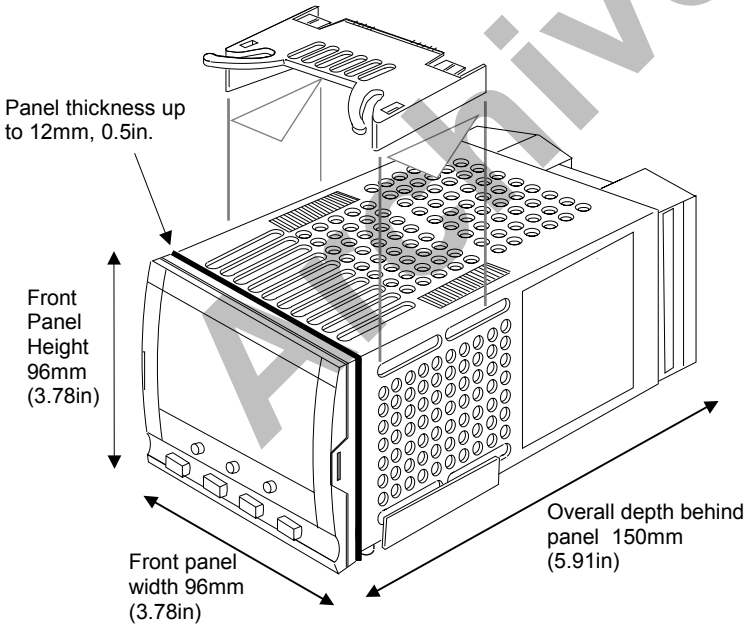


Figure 3-1: Outline Dimensions

3.3 Panel Mounting the Controller

1. Prepare the panel cut-out to the size shown in Figure 3-2. Ensure that there is sufficient spacing between instruments as shown by the minimum dimensions given in Figure 3-2. Ensure also that the controller is not mounted close to any device which is likely to produce a significant amount of heat which may affect the performance of the controller.
2. Insert the controller through the panel cut-out.
3. Spring the upper and lower panel retaining clips into place. Secure the controller in position by holding it level and pushing both retaining clips forward.

Note:- If the retaining clips subsequently need removing, in order to extract the controller from the control panel, they can be unhooked from the side with either your fingers or a screwdriver.

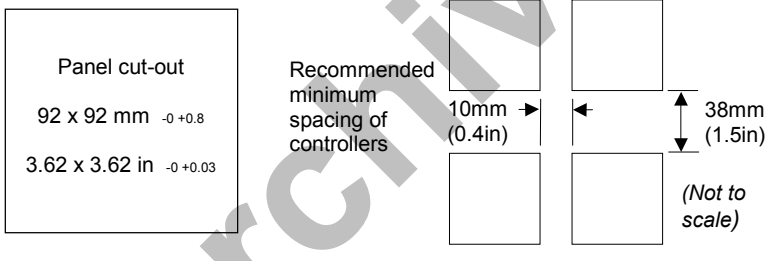


Figure 3-2: Panel Cut-out and Minimum Spacing Requirements

3.4 Unplugging and Plugging in the Controller

If required, the controller can be unplugged from its sleeve by easing the latching ears outwards and pulling the controller forward out of the sleeve. When plugging the controller back into its sleeve, ensure that the latching ears click into place.

It is recommended that the power to the controller is switched off when un-plugging or plugging the controller into its sleeve. This is to prevent premature wear on the controller connectors when current is flowing through them.

4. WIRING

WARNING

You must ensure that the controller is correctly configured for your application. Incorrect configuration could result in damage to the process being controlled, and/or personal injury. It is your responsibility, as the installer, to ensure that the configuration is correct.

☺ **Before proceeding further, please read the Safety and EMC section.**

4.1 Electrical Connections

All electrical connections are made to the screw terminals at the rear of the controller. They accept wire sizes from 0.5 to 1.5 mm^2 (16 to 22 AWG) and should be tightened to a torque of 0.4Nm (3.5lbin). If you wish to use crimp connectors, the correct type is AMP part number 349262-1. The terminals are protected by a clear plastic hinged cover to prevent hands, or metal, making accidental contact with live wires.

4.2 Hardware Configuration

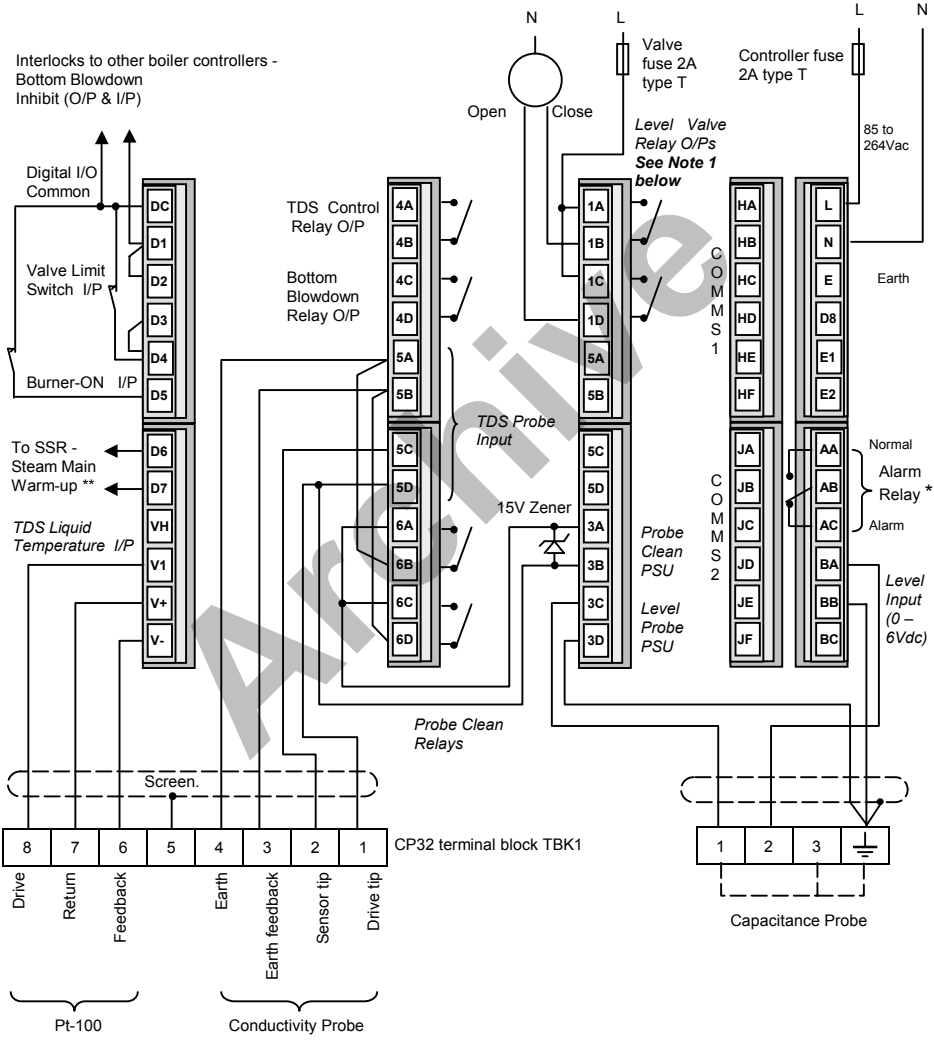
The IBC2700 controller has a modular build and contains the following plug in modules:-

Module	Terminals	Function	Part No
1	1A to 1D	A dual relay output is supplied to control an on/off level valve. Terminals 1A and 1B will control the valve and terminals 1C and 1D will provide power to drive the steam main warm up SSR	AH025246U002
1	1A and 1B	A 4-20mA output is supplied to control the level control valve. 1A is +; 1B is -	AH025728U003
3	3A to 3D	A dual output control module configured as:- Channel A - 24V probe clean power supply. This is limited to 15V using an external zener diode Channel C level probe power supply	AH027249U002
4	4A to 4D	Dual relay output Channel A - TDS control output Channel C - Bottom blowdown relay output	AH025246U002
5	5A to 5B	TDS probe input module	AH027720U002
6	6A to 6B	Dual relay output to switch 15Vdc to the probe to perform probe clean. This is automatically timed and freezes the TDS PV during this period	AH025246U002

The following connection diagram is shown for the above configuration.

4.3 General Wiring Diagram

A general wiring diagram is shown below:-



Note 1:- This diagram shows wiring for a level valve positioning motor. An option is available which interfaces with a 4-20mA level control valve. Wiring for this is shown in section 4.5.3.

Figure 4-1: Overall Wiring Diagram

Notes:-
* If inductive loads are used for the alarm then external snubbers need to be fitted
** External floating PSU required if steam warm-up valve is needed

- Maximum cable length (probe to controller) 100 metres (328 ft)
- All wiring materials and methods shall comply with EN and IEC standards where applicable
- Relays are shown in the power off position
- Seven Digital I/O (terminals DC to D7) are configured as inputs or outputs
- Inputs are logic (-1 to 35Vdc) or contact closure
- Outputs are open collector requiring an external power supply.
- The AA changeover relay (terminals AA to AC) is configured as a general alarm and is rated 2A 264Vac resistive
- Terminals marked 2A to 2D are reserved. No connections should be made to these terminals
- Terminals marked HA to HF are connections for optional RS232, RS485, or RS422 communications modules
- Terminals marked JA to JF are connections for an optional slave communications module or second communications port used to communicate with other instruments
  The modules fitted into the above two communications slots can be inter-changed

4.4 Power Supply to the Controller

- The supply may be 85 - 264Vac 50 or 60 Hz
- Power supply terminals are marked L (Live), N (Neutral) and E (Earth)
- Before connecting the instrument to the power line, make sure that the line voltage corresponds to the description on the identification label
- For supply connections use 16AWG or larger wires rated for at least 75°C
- Use copper conductors only
- The power supply input is not fuse protected. This should be provided externally
- Relays must be connected to the same phase as the controller supply
- Safety requirements for permanently connected equipment state:
    - a switch or circuit breaker shall be included in the building installation
    - it shall be in close proximity to the equipment and within easy reach of the operator
    - it shall be marked as the disconnecting device for the equipment

Note: a single switch or circuit breaker can drive more than one instrument

Warning:- Take care that mains supplies are connected only to the power supply terminals (85 to 264Vac only), the fixed relay terminals or to relay modules. Under no circumstances should mains supplies be connected to any other terminals.

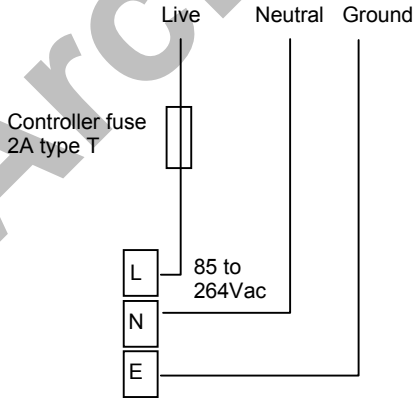


Figure 4-2: Controller Supply

4.5 Level Probe Wiring

The IBC2700 controller can accept a signal from a level probe or transmitter with voltage (0 - 6Vdc) interface. In some installations a PA20 pre-amplifier may be used with the level probe. A separate Installation and Maintenance Manual is available for this.

Note: The probe must be long enough to sense over the complete level range.

The controller compares the signal it receives from the level probe with a setpoint selected by the user. It then changes its output signal to control the level in the boiler.

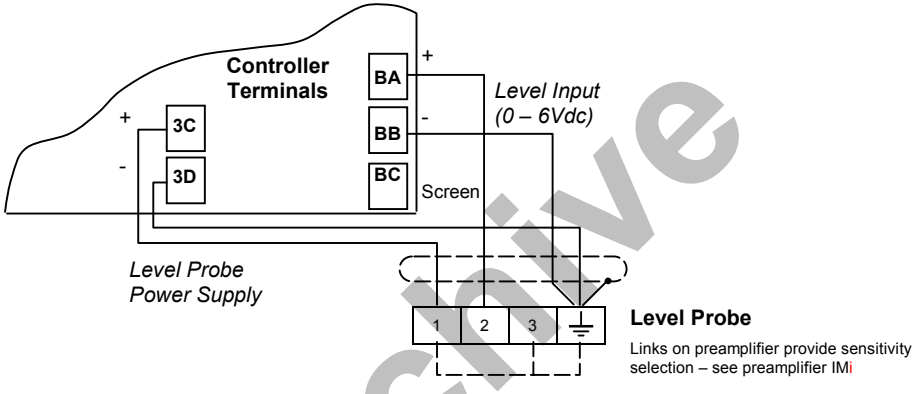


Figure 4-3: Level Probe Input

4.5.1 Probe Screen Connections

An earth current loop is created if a wire or screen is connected between two earth points which are different potential (voltage). The probe screen should only be connected to ground at one end.

- For level, the pre-amplifier and controller screen should only be connected to the earth at one end, i.e. at the PA20 earth terminal.

The PA20 earth terminal is a functional earth rather than protective earth.

- A protective earth provides protection from electric shock under a single fault condition. This product has double insulation and, therefore, does not require a protective earth.
- A functional earth is used in order for the product to operate. In this application, the earth, (tank/boiler shell) is used as the common of the probe/pre-amplifier. It also provides a sink/drain for any electrical interference.
- Ensure that the screen of the level probe is **not** connected to terminal BC of the controller and to the earth terminal of the PA20.

4.5.2 Level Probe Wiring: UL Version

The LP20 is a capacitance level probe which works in conjunction with a pre-amplifier type PA20. This gives an output of 0 – 6Vdc, and is connected directly to the high level analogue input terminals, BA & BB, of the controller.

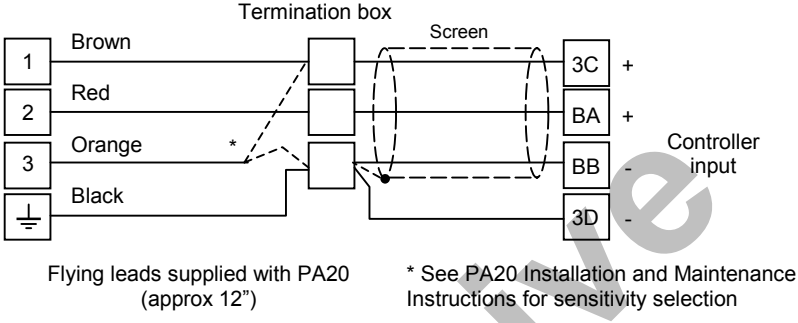


Figure 4-4: Level Probe Wiring UL Version

Note:- Screened high temperature, 3 core, 1mm^2 (18 – 16 AWG) copper cable is required for the probe wiring. The maximum permitted length is 100 metres (328ft). Use cable with a suitable temperature rating for the installation such as Pirelli FP200 or Delta Crompton Firetuf OHLS for the standard version. Connect the screens as shown above.

4.5.3 Level Control Output

4.5.3.1 Valve Motor Drive Version

The IBC2700 controller is supplied with a dual relay output to open or close a level valve or pump. It also provides alarm indication if the water level is too high or too low. A single change over relay is configured as 'new alarm' and this may be used to alert the operator.
See section 7.

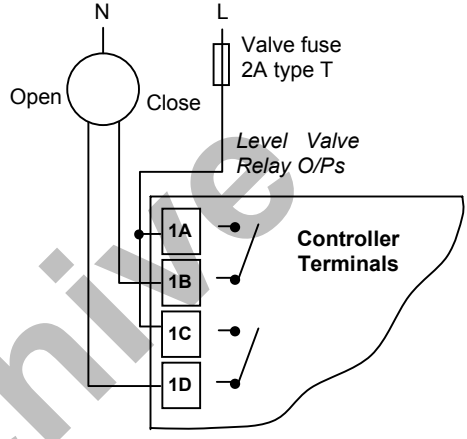
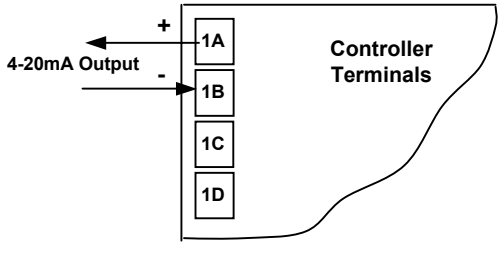


Figure 4-5: Level Control Output Connections

Note: No feedback potentiometer is required in the actuator since the control algorithms calculate the position of the valve.

4.5.3.2 4-20mA Version

The IBC2700 controller is supplied with a 4-20mA output to provide a signal to open or close a level valve or control a variable speed pump system.
The IBC2700 also provides alarm indication if the water level is too high or too low. A single change-over relay is configured as 'new alarm' and this may be used to alert the operator.



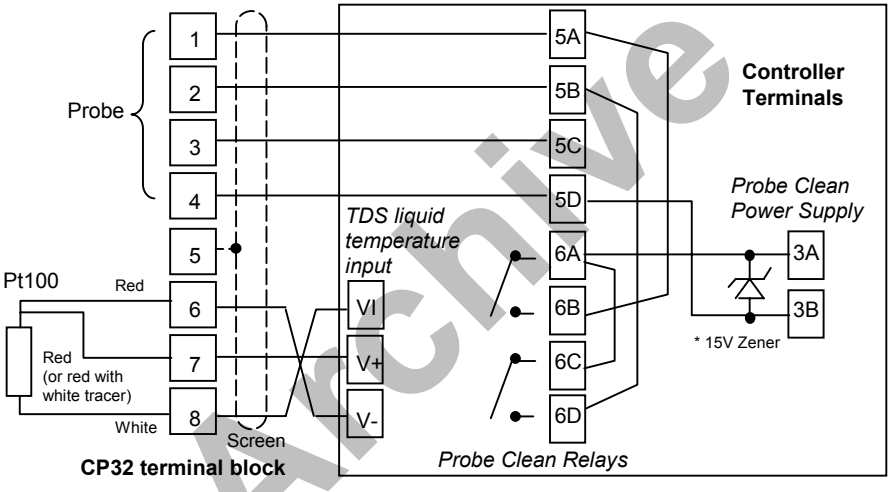
4.6 TDS Probe Wiring

The maximum cable length for the probes is 100m (328ft). All cables must be of the same gauge.

4.6.1 Probe in Boiler – CP32

The probe requires 8 way screened cable.

Caution: Do not connect any wires to the 5-way terminal block as it houses the very fine wiring from the probe which could easily become damaged in attempting to connect additional wires.



* For the TDS probe cleaning, it is important that all the connections shown in the wiring diagram are made. Please note the requirement of a Zener dioide across terminals 3A and 3B. This Zener Diode is included in the IBC2700 box taped to the retaining clips.'

Figure 4-6: CP32 TDS Probe Wiring

4.6.2 TDS Probe Screen Connections

Ensure that the screen is connected to the earth terminal of the TDS probe.
An earth current loop is created if a wire or screen is connected between two earth points which are different potential (voltage). The probe screen should only be connected to ground at one end.

- A protective earth provides protection from electric shock under a single fault condition. This product has double insulation and, therefore, does not require a protective earth.
- A functional earth is used in order for the product to operate. In this application, the earth, (tank/boiler shell) is used as the common of the probe. It also provides a sink/drain for any electrical interference.

4.6.3 CP10/CP30 Wiring

For the CP10 in most applications the 1.25m (4ft) heat resisting probe cable will need to be extended using a junction box. If not, link terminals 1 to 2 and 3 to 4. Total maximum cable length 100m (328ft).
Note: Whilst pairs of conductors are linked at the junction box, the four wire connection is required to compensate for voltage drop.

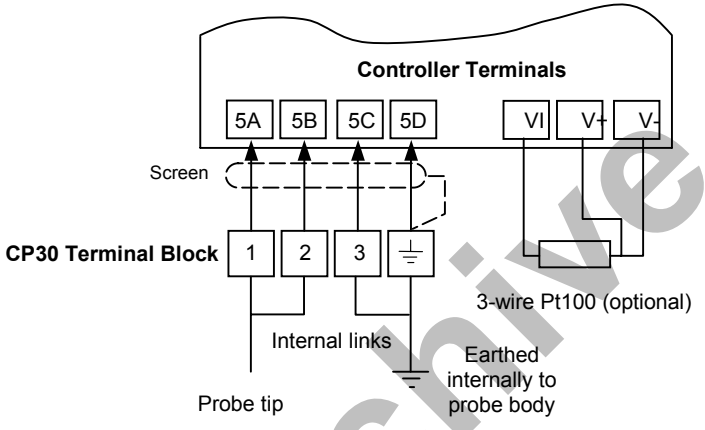


Figure 4-7: CP30 Probe (Probe in Boiler)

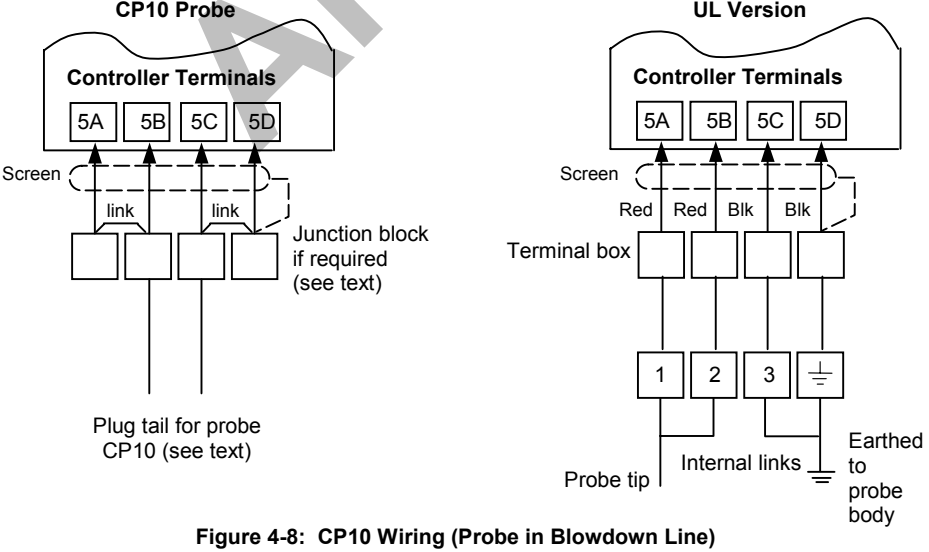


Figure 4-8: CP10 Wiring (Probe in Blowdown Line)

4.7 TDS Control Output Wiring

TDS control normally operates an external relay connected to terminals 4A and 4B. When the TDS is high the relay is closed.

Note: For switching currents greater than 2A additional external relays are required

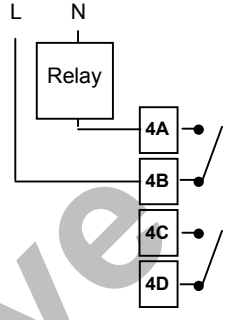


Figure 4-9: TDS Control Output Connections

4.8 Blowdown Wiring

Bottom blowdown is also controlled via an external relay connected to terminals 4C and 4D. When the blowdown is active the relay is closed.

Note: For switching currents greater than 2A additional external relays are required

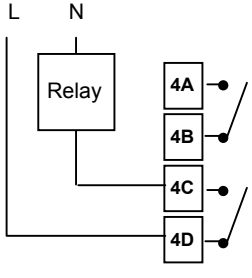


Figure 4-10: Blowdown Connections

4.9 Blowdown Interlock Wiring

Digital inputs and outputs are provided for interlocking up to eight boiler controllers. This is required to prevent other controllers from blowing down at the same time.

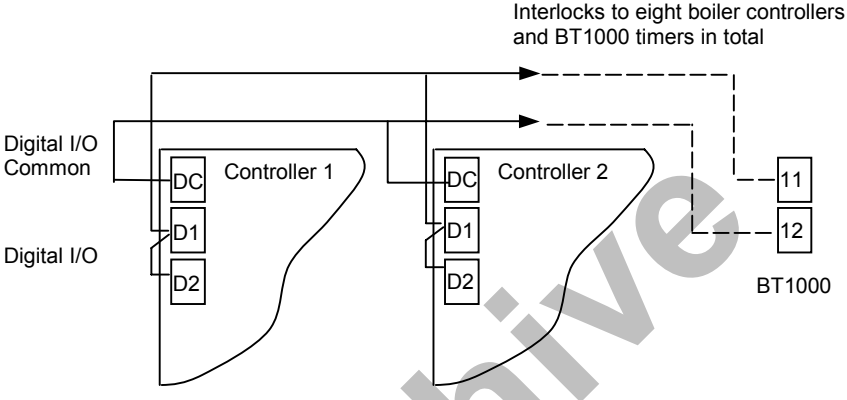


Figure 4-11: Blowdown Interlock Wiring

4.10 Valve Limit Switch Wiring

The valve limit switch closes when the blowdown valve opens to provide confirmation that the blowdown sequence has started.

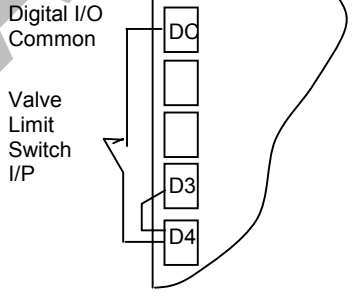


Figure 4-12: Blowdown Valve Limit Switch Wiring

4.11 Burner On Input Wiring

This is a contact to confirm that the burner is ON. It is used to suspend blowdown and disable purge when the boiler is off. The contact is closed when the burner is on.
If these contacts are not being used they must be replaced by a link.

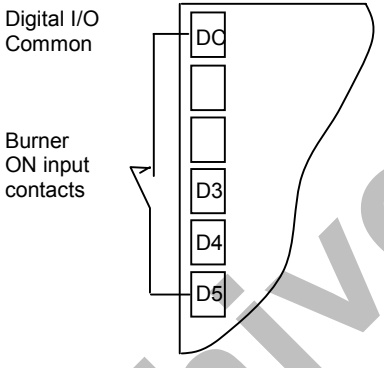


Figure 4-13: Burner On Switch Wiring

4.12 Main Steam Warm-up Wiring

The main steam warm-up is a modulating valve in which the open and close inputs are switched via two externally mounted SSRs (solid state relays). The SSRs are driven by digital outputs D6 and D7.

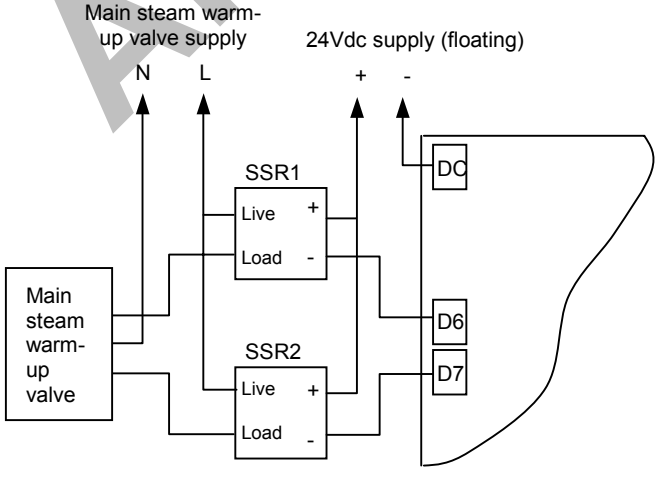


Figure 4-14: Main Steam Warm-up Valve Wiring

4.13 Digital Communications Wiring

Digital Communications modules can be fitted in two positions in the IBC2700 controller. The connections being available on HA to HF and JA to JF depending on the position in which the module is fitted.
The following diagrams show connections for RS232, 2-wire RS485, 4-wire RS422.

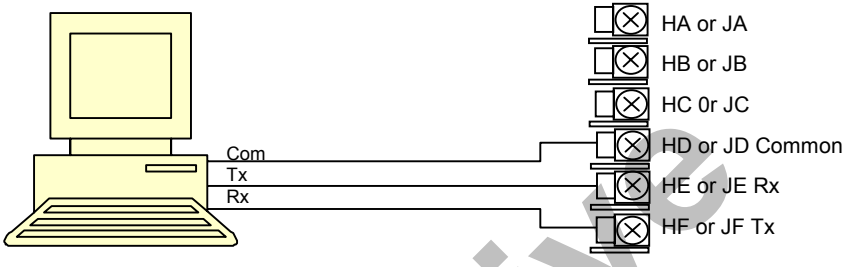


Figure 4-15: RS232

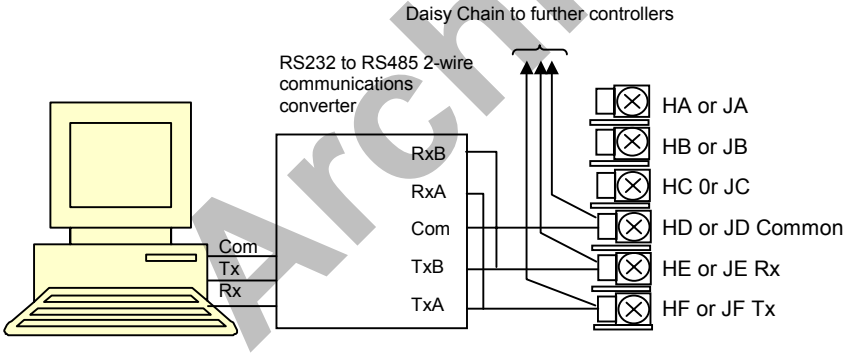


Figure 4-16: RS485 2-Wire

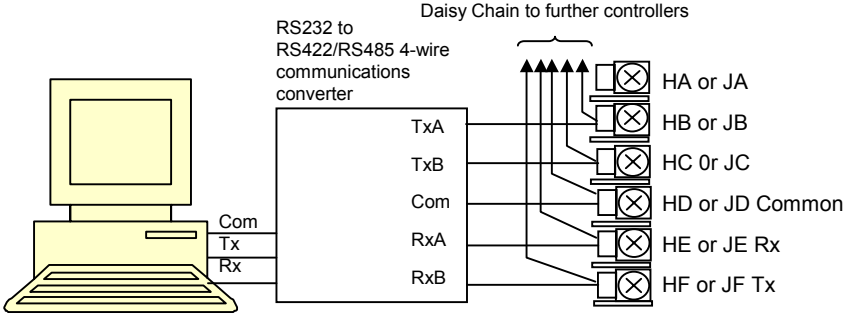


Figure 4-17: RS422 4-Wire

5. OPERATION

On power up the controller will perform a brief self test sequence in which the software version number is displayed. It then starts with display shown below and allows the Level and TDS setpoints to be entered. If an alarm is present during start up it must be acknowledged as instructed on the screen by pressing [ ] and [ ] together.

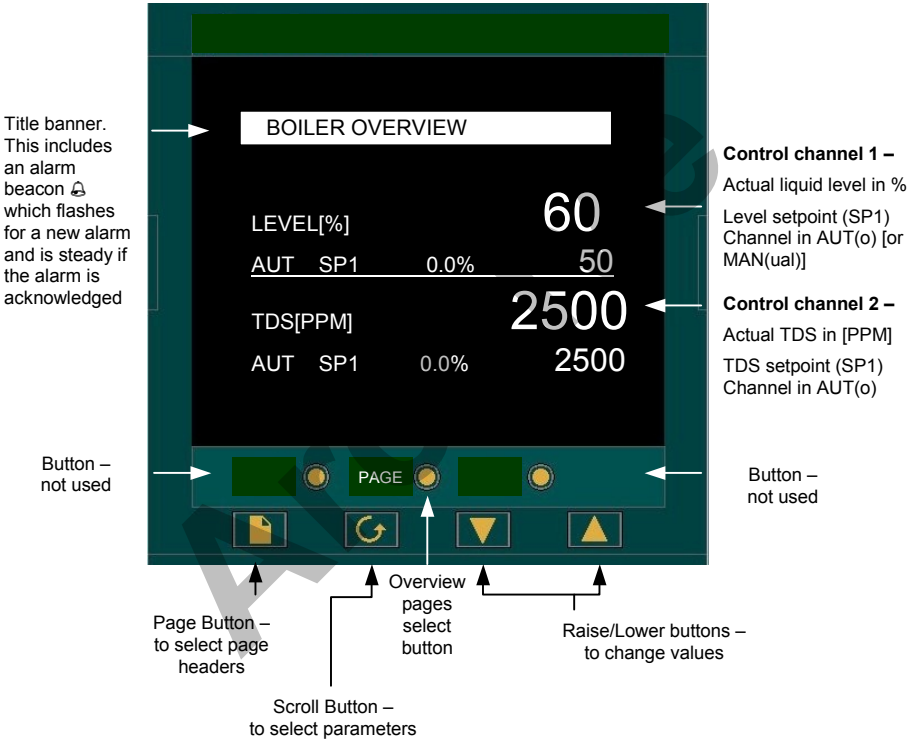


Figure 5-1: Boiler Overview Screen

5.1 To Change Setpoints

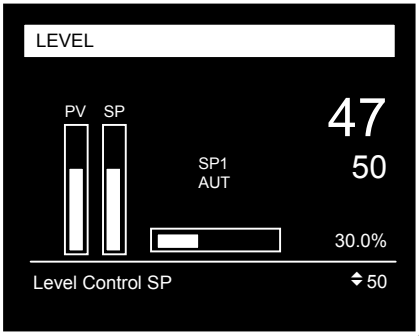
From the above view you can change the Level Setpoint and the TDS Setpoint.
Press [ ] to select the required setpoint. This is indicated by a flashing underline
Press [▲] or [▼] to raise or lower the setpoint respectively

5.2 To Select Further Operator Displays

Press PAGE

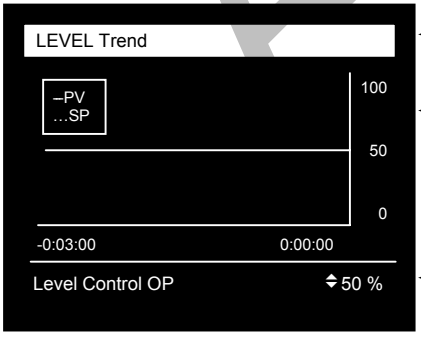
Repeated presses of this button will scroll through different operator views as follows:-

5.2.1 Level Control Page



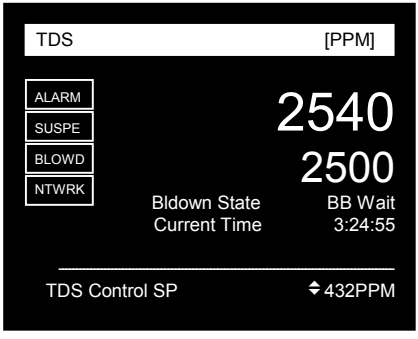
Press to scroll to:-	Press ▲ or ▼ to set value
Level Control SP	0 –100%
Loop Mode	Auto or Manual (a message occurs if the loop is left in manual for more than 10 minutes)
Level Control OP	0 –100% when Loop Mode in Manual

5.2.2 Level Trend Chart



Press to scroll to:-	Press ▲ or ▼ to set value
Level Control SP	0 –100%
Loop Mode	Auto or Manual (a message occurs if the loop is left in manual for more than 10 Minutes)
Level Control OP	0 –100% when Loop Mode in Manual
Timebase	0:00:30 to 24:00:00

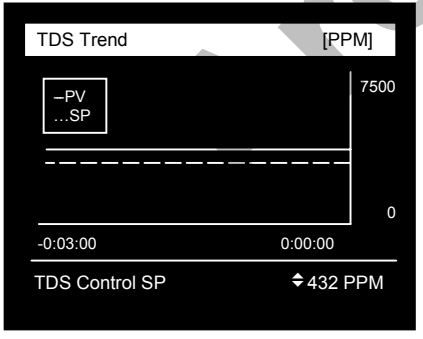
5.2.3 TDS



Press ⟳ to scroll to:-	Press ▲ or ▼ to set value
TDS Control SP	10 – 7500PPM
Bdown Alarm Ack	No or Yes

The ALARM beacon illuminates on high TDS alarm
The SUSPE beacon illuminates when the blowdown is being suspended
The BLOWD beacon illuminates when blowdown is in progress
The NTWRK beacon illuminates when this or another controller is performing a blowdown

5.2.4 TDS Trend Chart

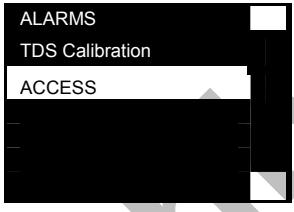
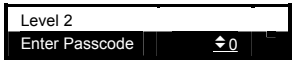
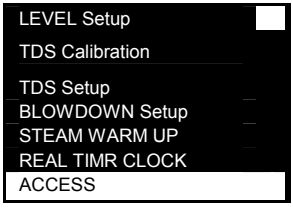


Press ⟳ to scroll to:-	Press ▲ or ▼ to set value
TDS Control SP	10 – 7500PPM
Target OP	0.0 to 100.0% read only
Timebase	0:00:30 to 24:00:00

6. ACCESS LEVELS

The IBC2700 controller can be operated in two levels of access:-
Level 1 is intended for day to day operation
Level 2 is intended for commissioning or other one off settings. Level 2 is protected by a security code which is set to '2' by default.
The controller will start up in the level in which it was left prior to shut down.

6.1 To Select Access Level 2

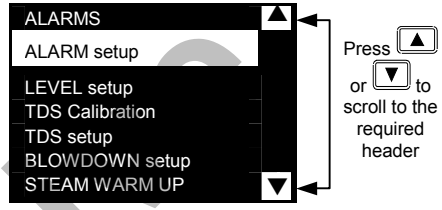
Do this	The display you should see	Additional notes
1. From any display press [D] as many times as necessary to display the page header menu 2. Press [▲] or [▼] to scroll to 'ACCESS'		This view is shown for Level 1. The TDS Calibration can be carried out in this level.
3. Press [↻] to select 'Access Level'		
4. Press [▲] to select 'Level 2' 5. Press [▲] or [▼] to enter the passcode		In a new controller the passcode is defaulted to '2'. When the correct passcode is entered 'PASS' is displayed momentarily. If an incorrect passcode is entered '0' is displayed again
6. Now press [D] (twice) to return to the main menu. A longer list is displayed		

The remainder of this handbook assumes Level 2 operation.

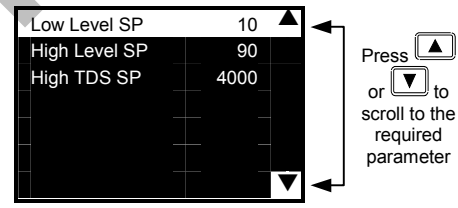
6.2 To Adjust Parameter Values

Press [ ]. to select the Page Header menu
Page headers contain lists of parameters which are associated with a particular subject. For example, the page header named BLOWDOWN Setup contains a list of parameters which allow day, time and duration to be set for up to three blowdown programs.
The headings which are applicable to the boiler controller may be found in the first two levels of access. They are:-

Header	Access level availability
ALARMS	Level 1 and Level 2
ALARM setup	Level 2
LEVEL setup	Level 2
TDS Calibration	Level 1 and Level 2
TDS setup	Level 2
BLOWDOWN setup	Level 2
STEAM WARM UP	Level 2
REAL TIME CLOCK	Level 2
ACCESS	Level 1 and Level 2



Press [ ] to select the parameter list
Parameters associated with the selected header will be listed.
Press [ ] or [ ] to scroll to the required parameter.



Press [ ] to edit the selected parameter.
The highlighted parameter changes to a flashing underscore.
Only parameters preceded by ⬍ are changeable
If the parameter is an analogue value, it will increase or decrease at an accelerating rate.
If it is an digital value its state is changed each time the [ ] or [ ] button is pressed.