
CONDUCTOR MAINTENANCE MANUAL



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1. Introduction

The Conductor system has been designed as a reliable, high accuracy, hot runner controller. However, regular maintenance is recommended to increase its operational life and reduce down time due to failures.

The purpose of this manual is to provide a backup reference to the main operating manual for all information pertaining to the Conductor System. Within this document there are sections on maintenance, faultfinding and general information.

2. Installation Recommendations

2.1 Fan Filter

The fan fitted as standard to older Conductor mainframes draws air out of the cabinet. It has been found that this arrangement can encourage the ingress of dust and other contaminants into the cabinet. Heavy contamination of the inside of the Conductor mainframe can lead to overheating of parts and possible reduction in reliability. For this reason, the current version of the Mainframe has the fan blowing air into the cabinet through a replaceable fan filter. For older cabinets, where the fan still sucks air out of the Mainframe, we recommend that the fan be re-fitted around the other way (that is – blowing air into the cabinet) and that a filter be fitted to the outside of the fan grill. This will force cool the modules inside the cabinet as well as substantially reducing the amount of contamination inside the cabinet.

2.2 Location

The Conductor system should be located at least 300mm (1 foot) away from any wall or obstruction to the rear of the cabinet. In addition, the mainframe should be located such that air can freely circulate around the cabinet.

Ideally, the mainframe should be mounted on an approved pedestal. This will enable good airflow as well as tilting the cabinet. This has the dual effect of improving the legibility of the front panel as well as preventing anyone from placing items on the top of the case.

Fast Heat have available a suitable pedestal capable of accommodating up to 4 cabinets. The part number is KD010000.

2.3 Module Removal

The power switch on the front panel of the module must always be turned off before removing the unit from the mainframe.

2.4 Mainframe Power Up

The recommended method of powering up the mainframe is as follows: -

1. Ensure that all Conductor modules are turned off.
2. Ensure that the heater and thermocouple cables are connected correctly.
3. Switch on the circuit breaker on the mainframe.
4. Switch on, one by one, the Conductor modules.
5. Observe that the module do not show an error messages – indicated by the yellow LED flashing.
6. Observe that the measured value increases in response to power being applied to the load. Erratic, stationary or reducing values of measured temperature can indicate a fault that will not necessarily be picked up by the error tracking software of the Conductor module.

2.5 Mainframe Power Down

1. Switch off, one by one, all the Conductor modules.
2. Switch off the circuit breaker on the mainframe.

3. Mainframe Maintenance

3.1 Introduction

This section deals with those recommended operations that form part of a regular preventative maintenance schedule. These operations do not take very long but will reduce the likelihood of failure of the Conductor system. It should also be pointed out that part of the main requirements of ISO9000 is that all equipment that can affect the quality of the process is maintained on a regular and defined basis.

This section also details common faults found with the mainframe, module and cables and how to rectify them.

When performing any of the operations given below, the power supply to the cabinet must be removed and the plug detached from the socket to prevent accidental application of power to the cabinet.

3.2 Cleaning

The Mainframe should be regularly cleared of dust and dirt. With the power disconnected, this can be achieved by using an air line.

The standard fan assembly fitted to older Conductor mainframes drew air into the cabinet by blowing air out of the rear. This also encouraged dirt and dust to enter the cabinet and cover the power supplies. Apart from adding a filter to the fan (as detailed above), the system should be cleaned out with the use of an air hose. This can be accomplished by removing the rear access panel. Take care to remove the power leads to the fan and re-attach them when re-fitting the panel.

3.3 Fan Filter

Where fitted, see above, the fan filter should be removed and either replaced or cleaned on a regular basis.

3.4 5V Power Supply

The digital circuitry of the Conductor module is powered by a 5V supply from a power supply in the rear of the mainframe. Older mainframes have a separate PSU for the 5V and +/-15V voltages. Later mainframes have a single power supply for all three voltages.

If the 5V supply is not present, then when power is applied to the modules, they will not perform their diagnostics and will have blank displays. This fault will occur on all the modules within the cabinet.

The 5V power supply has a 2A fuse fitted to it. On some units this is a standard 1-inch glass fuse. On others, it is a black circular fuse.

3.5 +/-15V Power Supply

The analogue circuitry of the Conductor module is powered by the +/-15V power supply. This PSU is also fitted to the rear of the mainframe. In earlier mainframes, the +/-15V power supply was a separate unit to the left of the cabinet (as seen from the rear access panel). In later units, a single power supply provides all the voltages for the modules.

If the +15V or -15V power is not present, the sensing circuits of the module will operate incorrectly. This will give cause to incorrect temperature readings and possibly incorrect error numbers. As with the 5V power supply, if a fault occurs on the +/-15V power supply, then all modules will show the same fault.

The separate +/-15V power supply has a 1A glass fuse for both the +15V and -15V voltages.

3.6 Triple Power Supply

From 1996 onwards, the mainframe has been fitted with a single power supply to provide all 3 voltage supplies to the modules. This has a single 2A circular fuse fitted to the PCB. If this fuse fails or there is another fault in the power supply then no modules will power up.

3.7 Power Cable Entry

The cable entry clamp for the 3-phase power cable should be checked to ensure that it is clamping the cable firmly and that the cable has not slipped to reveal the inner conductors.

3.8 Power Cable Earth Bonding

Conductor Mainframe cabinets are now fitted with steel braided cable. Within the main cabinet, this braiding should be connected to earth to provide improved safety.

3.9 Tool Connection Cable Entry

The connectors for fitting the heater and thermocouple cables should be checked to ensure that the clamping lever is connected, that there are no damaged pins and that all screws are tight.

3.10 Maintenance Check

The recommended maintenance interval for the Conductor Mainframe is 12 months. Whilst there is no calibration involved with the Mainframe, regular checks will ensure that the unit is working to the best of its abilities.

4. Module Maintenance

4.1 Cleaning

The rear terminals of the module should be cleaned using an alcohol based cleaner e.g. switch contact cleaner. It is also recommended that the circuit boards be cleaned with an air hose. It is important to leave the modules for about 10 minutes before re-inserting back into the mainframe as any moisture in the air supply, which deposits itself on the PCB, could cause incorrect operation of the unit.

4.2 Switches

The Conductor module has two switches fitted to the front panel of the unit. The upper switch changes the LED display between Temperature / Output Power / Error Number. The operation of this switch should be periodically checked to determine that it still operates. If the switch has been damaged, it is possible that the display can 'lock' in one mode causing confusion to the operator.

Please note that the position of this switch does not affect the control of the load.

The lower switch changes the controller from Automatic to Manual mode. On older models, this switch was of the pull out toggle type. This has now been replaced by a conventional changeover switch due to the number of toggle switches that were broken by being forced. The operation of this switch should be periodically checked to determine that it still operates. If the switch has been damaged, it is possible that the controller will 'lock' in either automatic or manual mode causing possible incorrect operation of the controller.

4.3 MOV

The Conductor module is fitted with a number of devices designed to detect incorrect operation and prevent damage to the controller. One such device is the MOV fitted to the rear terminals of the Conductor module. The purpose of the MOV is to absorb the energy from spikes on the mains voltage. However, if too large a spike occurs, the MOV will fail.

Unlike a fuse (which fails open circuit), an MOV fails short circuit. This means that if a potentially harmful spike occurs on the mains input to the module, the MOV can short out, causing fuses elsewhere in the system to blow and possibly causing the circuit breaker on the mainframe to trip. Should this occur, the module should be removed and the MOV checked.

Damaged MOV's may show burn damage but this must NOT be used as a check as failed MOV's do not necessarily show any signs. To check the MOV, use a Digital Multi-Meter to measure the resistance across terminals 3 & 4. This should be >1M Ω . A short circuit or a resistance of less than 100 ohms indicates a failed MOV, which must be replaced.

If the MOV has failed and is not replaced, then fuses will continue to blow every time the power is re-applied. If this happens too many times, the copper tracks on the module can get too severely damaged to repair, causing the module to be scrapped.

4.4 Fuses

The Conductor module is fitted with 2 ABC FF type fuses. These are rated at 15 amps and are designed to prevent earth leakage's or short circuits from damaging the controller. The fuses MUST be replaced with fuses of the same rating and type. Spare fuses are kept on clips mounted to the rear panel of the mainframe. It is recommended that this stock be maintained.

4.5 Triac Output

The heater output of the Conductor module is provided by a triac. This is driven by a special opto-isolated triac driver chip (U23). This normally operates in both the positive and negative directions to provide switching of the mains supply in order to provide the correct amount of power to the load to maintain temperature.

If damage occurs to this chip, then it is possible for it to fail in one direction. When this happens, the module will appear to operate as normal and no error number will be reported. However, the triac is only operating in one direction and twice as much power will be required to maintain the temperature. This can lead to long warm up times and less accurate control. If the chip fails on a manifold zone, the manifold heater may never reach setpoint.

To determine whether U23 is working on the module. Check the output power of the unit by switching the top switch on the front panel to the centre, output power, position. Monitor this when the load is at temperature and note the average power required, say 25%. If the zone is a tip zone, then examine and note the power on a zone with a similar load. If this reads around 25% then it is probable that there is no problem. If the output power is around 12%, then it is likely that the first module has a fault with U23. The module should be returned for repair.

4.6 Calibration

The recommended calibration interval for the Conductor module is 12 months. This is because the thermocouple calibration is performed by potentiometers and these can drift over time. It is recommended that the Conductors be calibrated on a regular basis, not only to meet the requirements of ISO9000 that you may have, but generally to maintain the quality of the end product.

5. Cable Maintenance

5.1 Cleaning

It is important that the connection between the contacts in all the connectors in the link between the tool and the mainframe are clean and undamaged. The connectors in the terminal blocks in the junction box, inter-connecting cable and mainframe, should be cleaned with an alcohol based cleaner e.g. switch contact cleaner. This is especially true of the thermocouple cable where poor contact between terminations can cause an incorrect temperature reading.

5.2 Condition

The inter-connecting cables between the mainframe and the tool should be checked for damage. Cables with cuts in insulation and exposed conductors should be replaced.

Always use thermocouple extension cable for the connection between the tool and the mainframe. This cable has the same thermal characteristics as the thermocouple. If standard copper cable is used, errors in the value of the temperature will occur, leading to poor temperature control.

5.3 Earth Cable

It is important that the earth connection between the tool and earth potential is checked for short circuit. On rare occasions, a poor earth can lead to erratic temperatures being displayed on the controller. Equally, a poor earth can mean a greater potential for damage occurring to the Conductor controller if a heater fails.

5.4 Mains Power Cable Earthing

It is standard practice for the metal woven shroud of the 3phase power cable to be earthed within the mainframe. This is to reduce the potential for electrical shocks should the cable become damaged.

During maintenance checks of the mainframe, the earth connection of the shroud should be checked.

If there is no connection, it is recommended that one be made.

6. Error Codes & Troubleshooting

6.1 E00: No Faults

This is the normal operating condition of the Conductor module and indicates that there are no errors being reported.

6.2 E01: Thermocouple Open

This fault is caused by there being an open circuit in the thermocouple sensing circuit. Because of the very small voltage produced by thermocouples, it is relatively easy to get interruptions in the thermocouple cable. Areas to check for such a fault are: -

1. Check the connection between the Conductor Mainframe and the cable connecting it to the junction box. Check that the crimp connectors have not been pushed back. This can happen when a cable is connected and the pin, being off-centre, is pushed back as it inserts into the female connector. The male connector being pushed back is far more common than damage to the female connector. If the male crimp is pushed back, then undo the four screws holding the connector insert inside the hood and gently pull forward. Remove the pushed back crimp, use small pin nose pliers to open the locking wings and re-insert. Damage to female pins can be observed by looking inside the hood to determine whether any of the contact leafs are pushed over. Damaged female crimps will require replacing. It is recommended that the removal and replacement of crimps be performed with aid of the correct insertion tool. Periodic cleaning of the crimps using contact cleaner spray is also recommended.
2. Occasionally, breaks can happen in the cable. This is best checked by leaving the cable connected to the mainframe and disconnecting the cable at the tool end. Using a pair of small, pin nose metal pliers or equivalent, short across the two pins of the zone causing problems. If the cable is undamaged, the module for that zone will display ambient temperature.
3. Check that the thermocouple is functional. If there is access to a thermocouple simulator, connect the thermocouple to the simulator input and read the signal to ensure that the reading is present and approximately the correct value. Alternatively, remove the thermocouple connection from the junction box wiring and short the connection out back to the controller. This link will now act as a crude thermocouple and show ambient temperature. If there was a fault in the thermocouple, the E01 will now be replaced by a temperature reading.

6.3 E02: Thermocouple Reversed

This fault indicates that the module has detected that the thermocouple has reversed connections.

In the first instance, the wiring of the thermocouple should be checked.

However, it is possible to confuse the logic of the module, especially with manifold zones on warm tools. Ideally, all tools should be started from cold. However, this is frequently impractical. As a result, the temperature of the tool is dropping as the Conductor system is turned on. During the diagnostics phase of the power on sequence, the Conductor applies to short pulses of power to the load and measures the temperature. After a period of approximately one minute, the Conductor measures the temperature again. If the temperature has dropped, the Conductor determines this as being a reversed thermocouple. However, a warm manifold zone can be of a sufficiently large thermal mass that the small amount of power applied by the Conductor is not sufficient to change the downward trend of the temperature and E02 is displayed.

To confuse matters, frequently, turning off the Conductor module and turning it back on again removes this problem. This is because the downward trend of the zone has slowed or reversed due to heat having been applied to the tool and a repeat of the diagnostics shows an increasing temperature.

If E02 (or E03) error continue to occur on power up with large manifold zones, then the recommended procedure is to switch the module into manual power for a period of time, say 5 – 10 minutes, and then back to automatic. This ensures that sufficient heat has been applied to the load to start the temperature increasing.

6.4 E03: Thermocouple Short

This fault indicates that the module has detected that the thermocouple has shorted.

In the first instance, the wiring of the thermocouple should be checked.

However, it is possible to confuse the logic of the module, especially with manifold zones on warm tools. Ideally, all tools should be started from cold. However, this is frequently impractical. As a result, the temperature of the tool is dropping as the Conductor system is turned on. During the diagnostics phase of the power on sequence, the Conductor applies to short pulses of power to the load and measures the temperature. After a period of approximately one minute, the Conductor measures the temperature again. If the temperature has remained the same +/- 1 degree, the Conductor determines this as being a shorted thermocouple. However, a warm manifold zone can be of a sufficiently large thermal mass that the small amount of power applied by the Conductor is not sufficient to change the steady state of the temperature and E03 is displayed. It is also possible that whilst the small pulse of power has started the manifold zone to warm up, at the moment of measurement, the second temperature is the same as the first and a thermocouple short is determined.

To confuse matters, frequently, turning off the Conductor module and turning it back on again removes this problem. This is because the downward trend of the zone has slowed or reversed due to heat having been applied to the tool and a repeat of the diagnostics shows an increasing temperature.

If E03 (or E02) error continue to occur on power up with large manifold zones, then the recommended procedure is to switch the module into manual power for a period of time, say 5 – 10 minutes, and then back to automatic. This ensures that sufficient heat has been applied to the load to start the temperature increasing.

6.5 E15: Heater Failure

If no heater is connected to the module, or the heater is faulty, then the module will show E15. The cable connections between the mainframe and the tool and within the junction box should be checked.

It is also possible for E15 to be shown if the +/-15V power supply fails in the Mainframe. This is easily spotted as all modules show the same error and the display will also show the error 'or'.

6.6 E16 & E17: Heater Low Current / Heater Current High

Once the Conductor module has brought the load up to setpoint, the amount of current being drawn by the heater is monitored. Over time a history is built up. If the amount of current deviates from the average value recorded in the history, then this is determined by the Conductor module as a failure of one or more heaters in the load.

If E16 or E17 is shown, then in the first instance, the system should be turned off and disconnected from the tool and the resistance of the heater checked to ensure that it is consistent with the wattage. This can be checked as follows: -

Assuming a 240V system

A heater of 250W has a resistance of 230R.

This is calculated as follows: -

Watts = Volts x Current

Current = Volts / Resistance

Therefore:

$$\text{Watts} = (\text{Volts} \times \text{Volts}) / \text{Resistance}$$

Or:

$$\text{Resistance} = (\text{Volts} \times \text{Volts}) / \text{Watts}$$

$$230R = (240 \times 240) / 250$$

So 57600 divided by the wattage of the heater will give the expected resistance. By measuring this with a meter it is possible to determine whether a fault has occurred.

Please note that most heaters have a tolerance of up to 10% and so due consideration should be given to this when performing this calculation.

As mentioned previously, the Conductor module monitors the amount of current being drawn by the heater. This is achieved by converting the analogue signal of the measurement into a digital signal readable by the processor. This is a calibrated process. Early versions of the Conductor module did not account for small mass loads below around 200W and occasionally misread the value incorrectly, displaying E16 or E17. A later version of the module has a modification to reduce the smallest load capable of being controlled by the Conductor to 150W. This modification is covered in depth elsewhere in this document.

These errors can take up to 20 minutes to occur. If repeated E16 and E17 occur and the heater checks out fine and is over 150W then it is possible that either the low mass modification has not been performed or the heater current needs recalibrating. In either case, it is necessary to return the module to Fast Heat for modification.

From V2.9 of the software onwards E16 & E17 error codes have been removed. Conductor modules can easily be upgraded to V2.9 software, if required.

6.7 E20: Triac Faulty

This error is caused by the output triac becoming faulty. Should this happen, the module should be returned for repair.

It is possible for another fault to occur within the module that also shows E20 and also fails to detect that a heater is not fitted and, therefore, display E15. Whilst the triac is not at fault in this case, the module is still faulty and should be returned for repair.

6.8 E23: >100% Manual Power

This error is caused when the module is placed into manual power and the setpoint is set to a value greater than 100. In Manual power mode, the setpoint changes from the value of the desired temperature to the required percentage output power. It is quite common to be controlling at say 250C, change over to Manual power mode and forget to set the setpoint to below 100%, resulting in the display of E23.

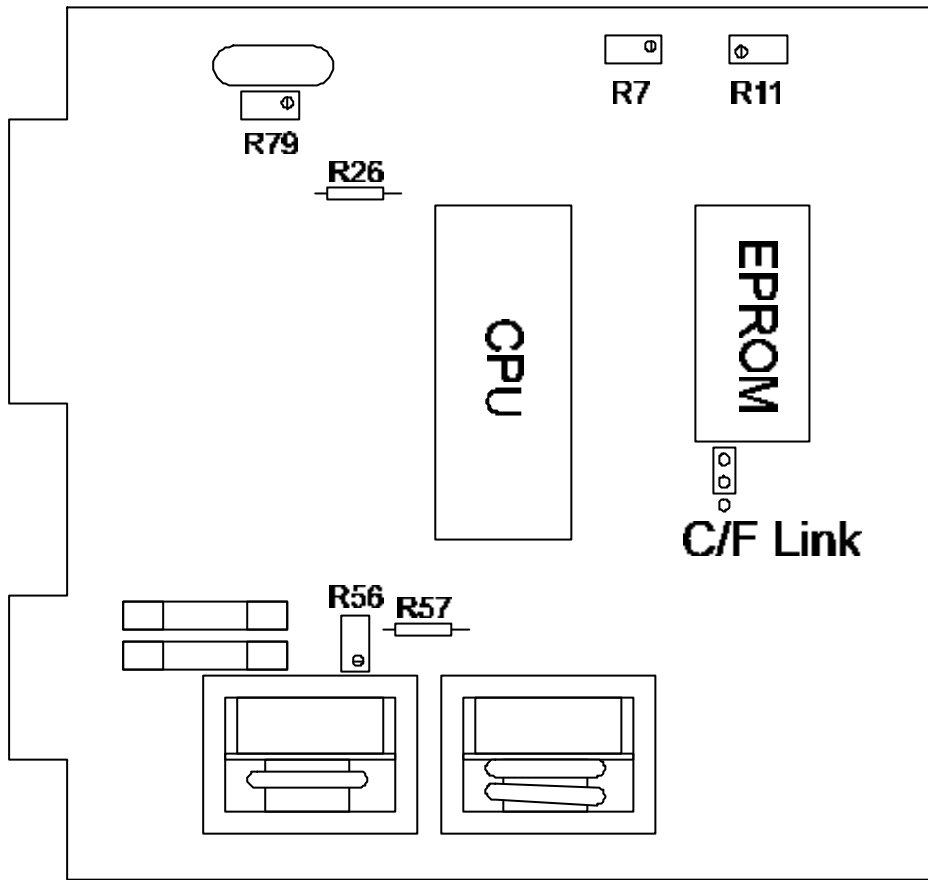
6.9 or: OverRange

This message indicates that the measured value exceeds the maximum display range of the module. This is 635C (999F).

This can be caused by an open circuit thermocouple. Under these circumstances, the heater output is turned off.


If all the modules in the mainframe show 'or' on the LED display, there is a fault with the -15V power supply. Please refer to the sections on power supply faults.

7. Conductor Module PCB Layout



8. Rear Terminals

+5V DC [1]	<input type="checkbox"/>	<input type="checkbox"/>	[A] +5V DC
+5V DC [2]	<input type="checkbox"/>	<input type="checkbox"/>	[B] +15V DC
DC Ground [3]	<input type="checkbox"/>	<input type="checkbox"/>	[C] -15V DC
DC Ground [4]	<input type="checkbox"/>	<input type="checkbox"/>	[D] DC Ground
Chassis Ground [5]	<input type="checkbox"/>	<input type="checkbox"/>	[E] Chassis Ground
RS485 [6]	<input type="checkbox"/>	<input type="checkbox"/>	[F] RS485
Board Address 2 [7]	<input type="checkbox"/>	<input type="checkbox"/>	[H] Board Address 0
Board Address 3 [8]	<input type="checkbox"/>	<input type="checkbox"/>	[J] Board Address 1
Triac Logic [9]	<input type="checkbox"/>	<input type="checkbox"/>	[K] Heater Current
Alarm Signal [10]	<input type="checkbox"/>	<input type="checkbox"/>	[L] Heater Current Trigger
Thermocouple + [11]	<input type="checkbox"/>	<input type="checkbox"/>	[M] Idle/Run Trigger
Thermocouple - [12]	<input type="checkbox"/>	<input type="checkbox"/>	[N] Not Used

	[1] AC Power Input
	[2] AC Power Input
	[3] AC Heater Output
	[4] AC Heater Output

9. Mainframe Options

9.1 Idle

All Conductor modules are fitted with an EPROM that contains software to permit an Idle function.

The standard mainframe is not fitted with the wiring and switch to activate this. Also, the Idle function is disabled as standard on modules.

EPROM's can be provided which have the software activated. Also, it is possible to retrofit the Idle wiring to a mainframe. However, it is recommended that this operation be carried out by the factory.

When activated, the temperature on the module will drop to 107C (225F). If operating in manual mode, the percentage power will change to 25%. On releasing, the module will return to the previously set values.

To activate the Idle feature, it is necessary to: -

1. Install software on the module with the Idle facility activated (location 1FE3 set to FF).
2. Link pin M of the low voltage connector for each slot in the mainframe together and then to one side of a SPST switch. Connect the other side of the switch to 5V (pin 1 or 2 of the low voltage connector).
3. When pin M is connected to 5V, the Idle feature will be activated.

9.2 Alarm Output

All Conductor modules are fitted with alarm software that produces a trigger signal.

The standard mainframe is not fitted with an alarm relay that responds to this trigger.

However, it is possible to purchase the Conductor mainframe with an alarm output, or to purchase a kit that enables a competent engineer to retrofit an alarm relay, if required.

The part number of the alarm kit is: KD-ALARM-KIT

9.3 Current Meter

All Conductor modules are fitted with an output that provides a voltage proportional to the current being drawn by the load.

The standard mainframe is not fitted with a current meter.

It is possible to purchase 5, 9 and 12 Zone mainframes with a current meter fitted. Due to the complexity of the wiring, it is not currently possible to retrofit this meter to existing mainframes.

10. Spare Parts

Item	Part Number
1A ABC Fuse	314001
15A ABC Fuse	314015
2A Power Supply Fuse	314002
1A +/-15V PSU Fuse	362001
Fan Filter	566-748
30 Amp Module Mains Neon	518-031
Module MOV	521-015
Auto/Man Switch	542-007
Temp/Diag Switch	542-006
Mainframe Fan	540-820
C/F Jumper	566-950
5V Power Supply	567-100
New Triple PSU	ASKS2076
Module Card Guide	576-404
Mainframe Spare Feet	576800
15A Conductor Module	KM010004
30A Conductor Module	KM010005
Conductor Single Zone	KS010029
2 Zone Mainframe	KSX10399
5 Zone Mainframe	KS020042
9 Zone Mainframe	KS020041
12 Zone Mainframe	KS020049
5 Zone Junction Box	KJ010000 (Available in Long or Short styles)
9/12 Zone Junction Box	KJ010008 (Available in Long, Fused or Short styles)
Mainframe Pedestal	KD010000
Mainframe Equipment Shelf	KD010000-SHELF
Mainframe Blanking Plate	KD010003

11. Documents

Title	Part Number
Thermocouple Extension Cable Colours	FHD084
Conductor Installation Manual	802-003
Toggle Switch Label	FHD046
Conductor Information Label	FHD062
Pedestal Assembly Information	FHD215