

MSR1-10 Type 2 Charge Controller

PN:102449 - 24V Common Negative

Product Manual

Issue 3



1. Introduction

The MSR1-10 Charge Controller is designed to provide the charge regulation and supervisory functions necessary in a solar power system. The controller prevents damage to the battery due to excessive charge or discharge and also provides a convenient place to interconnect the solar arrays, battery bank and load equipment.

The MSR1-10 Charge Controller uses fully solid-state switching of Array (charge) and Load (discharge) current and combines this with the flexibility and advantages of microprocessor control. The basic function of a charge controller is to control the transfer of energy from the array to the battery and load. The state of charge of the battery is sensed by monitoring the Battery voltage.

1.1. Technical Specification

| | |
|----------------------------------|---|
| Operating Voltage Range | 24VDC nominal (18-36VDC) |
| System Polarity | Common Negative |
| Operating Temperature Range | 0-65°C |
| Array Input | 1 Array Input rated at 10A continuously (Solid-State MOSFET technology) |
| Load Output | 1 Load Output rated at 5A continuously (Solid-State MOSFET technology) |
| Battery Regulation | 3-Stage Regulation: Boost, Equalisation, Float |
| Battery Voltage Sense | Best accuracy using remote battery sense cables |
| Battery Settings | User Programmable |
| Temperature Compensation | Optional using MSR Temperature Sensor |
| Alarm Relays | 4 Programmable Alarm Relays with LEDs and volt-free changeover contacts |
| User Display | 2 x 16 character LCD Display (High Temperature) |
| User Control | 4 button keypad – Menu, Up, Down, Select |
| Quiescent Current | 15mA at 24VDC (0.36W) |
| Induced Lightning Protection | Metal Oxide Varistors on Battery, Array, Load connections |
| Battery, Array, Load Connections | PCB Terminals - 10mm ² cable entry |
| Alarm Connections | PCB 2-part Terminals – 2.5mm ² cable entry |
| Dimensions | 235mm x 120mm x 55mm |
| Weight | 530g (including DIN rail carrier and fascia cover) |
| Mounting | Carrier to fix to 35mm DIN rail |

1.1. Installation

The unit is designed to be mounted within an appropriate enclosure for the environment.

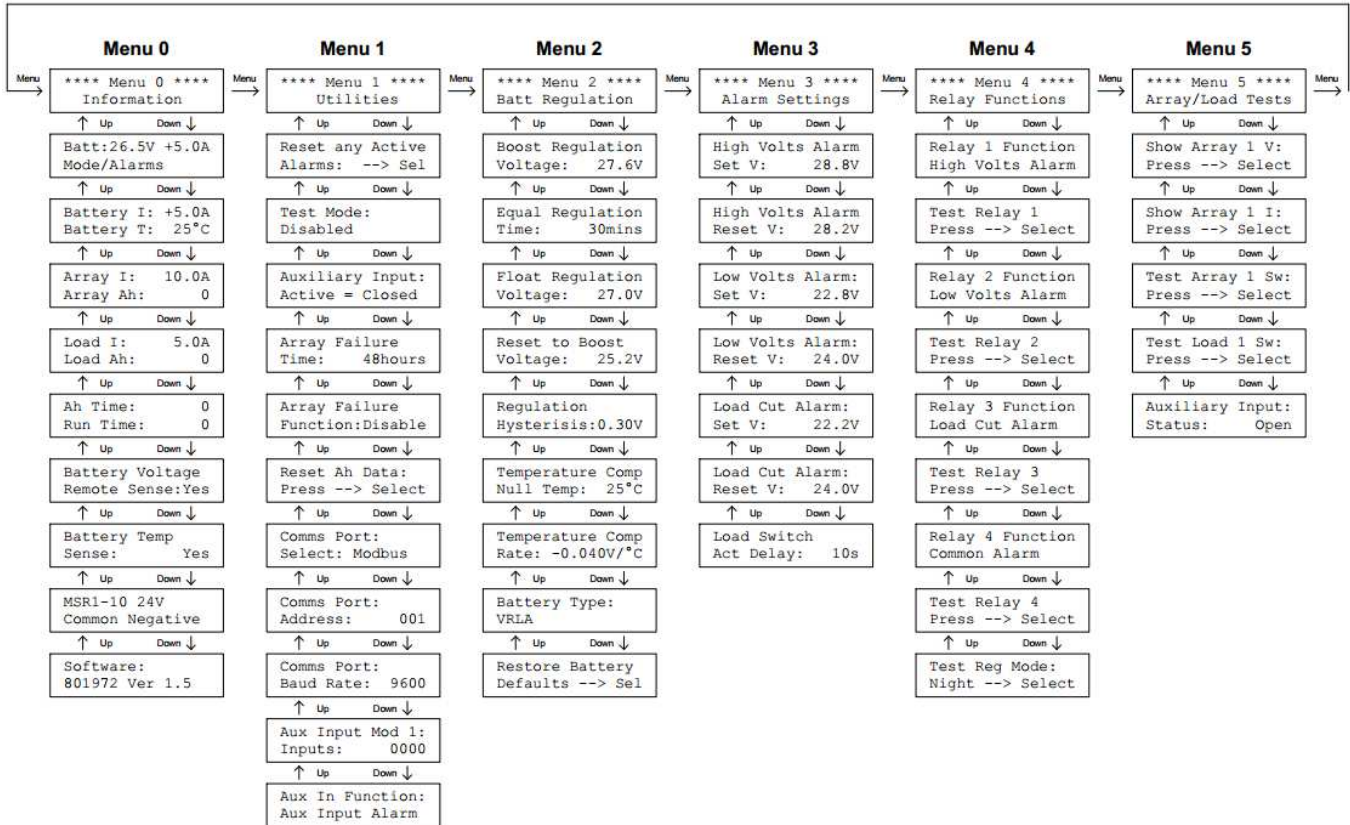
1.2. Connections to be made in this order:

- 1.2.1. Battery Power Connection (power cables to the battery)
- 1.2.2. Battery Sense Connection (2-core screened twisted pair connected to the battery)
- 1.2.3. Temperature Sensor (locate the sensor in the battery enclosure or attached to one pole of the battery)
- 1.2.4. Array Connection
- 1.2.5. Load Connection
- 1.2.6. Alarm Signals

2. Operation

The MSR1-10 Charge Controller uses a microprocessor to provide control and diagnostic features in the unit. A 2x16 alphanumeric LCD Display is used to indicate parameters and set-points as described below. The following diagram describes the various screens available to the user:

Controller Menu Guide:



2.1. Menu Navigation

Navigating the menus is done by using the Menu, Up and Down switches while the Select switch will activate various functions. Pressing Menu and Down together will take the user back to Menu 0 Screen 0 (Home Screen).

Pressing the Menu switch at any screen in Menu 0 will change the display to show the top screen of Menu 1. In a similar manner, the user can move to Menus 2, 3, 4 etc and back to Menu 0, by pressing the Menu switch repeatedly.

The Up and Down Switches will move the user up and down within a menu.

2.2. Parameter and Set-point Adjustment

At the appropriate screen, press Select and the parameter will flash. Use the Up and Down switches to select the desired value. Press Select again to accept and store the value in non-volatile memory.

2.3. Power Up Screen

| LCD Display | Screen | Description |
|---------------------------|----------|---|
| MSR1-10 Charge Controller | Screen 0 | The Power Up Screen is shown for 2 seconds after power up |

2.4. Menu 0 – Information

| LCD Display | Screen | Description |
|-------------------------------------|----------|---|
| **** Menu 0 **** Information | Screen 0 | Menu Identifier (automatically goes to Screen 1 after 2 seconds) |
| Batt:26.5V +5.0A Mode / Alarms | Screen 1 | Battery Voltage and Current (+ for charge, - for discharge) Present Regulation Mode & Alarms shown one after another |
| Battery I: +5.0A Battery T: 25°C | Screen 2 | Battery Current Battery Temperature (T1: Temp Sense Input / T2: MSR RTD Interface) |
| Array I: 10.0A Array Ah: 0 | Screen 3 | Array Current Array Amp-hours |
| Load I: 5.0A Load Ah: 0 | Screen 4 | Load Current Load Amp-hours |
| Ah Time: 0 Run Time: 0 | Screen 5 | Amp-hour Time Total Run Time |
| Battery Voltage Remote Sense:Yes | Screen 6 | Battery Voltage Remote Sense: Yes or No Select user option |
| Battery Temp Sense: Yes | Screen 7 | Battery Temperature Sense: Yes or No Select user option |
| MSR1-10 24V Common Negative | Screen 8 | Unit Model Number, Voltage System Polarity |
| Software: 801972 Ver 1.5 | Screen 9 | Unit Software Number and Version |

2.4.1. Battery Voltage Remote Sense

Battery Voltage Remote Sense = Yes: The MSR1-10 Type 1 will measure the battery voltage on the Battery Sense terminals BS+, BS-, SCR. This is designed for the connection of a 2-core screened cable from the Battery terminals. This option provides the greatest accuracy of operation.

Battery Voltage Remote Sense = No: The MSR1-10 Type 1 will measure the battery voltage at the Battery Power terminals. This option is less accurate as the charge and discharge current on the power cables creates a voltage drop which means the MSR1-10 cannot measure the true battery voltage.

2.4.2. Battery Temperature Sense

Battery Temperature Sense = Yes: The MSR1-10 Type 1 will look for an MSR Temperature Sensor connected to terminals TS+, TS-, SCR. If no temperature sensor is found it will look for an RTD Temperature Sensor if an MSR RTD Interface is fitted. If no valid temperature sensor is found it will indicate an alarm and there will be no temperature compensation of battery settings.

Battery Temperature Sense = No: The MSR1-10 Type 1 will not look for a temperature sensor and there will be no alarm or temperature compensation of battery settings.

2.5. Menu 1 – Utilities

| LCD Display | Screen | Description |
|-------------------------------------|-----------|---|
| **** Menu 1 **** Utilities | Screen 0 | Menu Identifier |
| Reset any Active Alarms: --> Sel | Screen 1 | Reset any Active Alarms |
| Test Mode: Disabled | Screen 2 | Test Mode: Enable or Disable (Auto disable after 30 minutes) Test Mode: Array ready to charge / Equalisation Time = 30 seconds |
| Auxiliary Input: Active = Closed | Screen 3 | Auxiliary Input Active Select: The Auxiliary Input is "Active" when the contact is Closed / Open |
| Array Failure Time: 48hours | Screen 4 | Array Failure Time: Set the number of hours |
| Array 1 Failure Function:Disable | Screen 5 | Array Failure Function: Enable or Disable |
| Reset Ah Data: Press --> Select | Screen 6 | Reset Amp-hours data (and resets Amp-hour Time) |
| Comms Port: Select: Modbus | Screen 7 | Communications Port Selection: Standard (Micha Protocol), Modbus , or SNMP1 |
| Comms Port: Address: 001 | Screen 8 | Communications Port Address: Address can be set from 001 to 247 (Modbus range) |
| Comms Port: Baud Rate: 9600 | Screen 9 | Communications Port Baud Rate: Baud Rate can be set to 9600 or 19,200 |
| Aux Input Mod 1: Inputs: 0000 | Screen 10 | 4-Channel Auxiliary Input Module Inputs 1-4 are shown as inactive (0) or active (1,2,3,4) |
| Aux In Function: Aux Input Alarm | Screen 11 | Auxiliary Input Function Select: Aux Input Alarm / Disable Array / Disable Load / Disable Array & Load |

2.5.1. Auxiliary Input Function = Auxiliary Input Alarm

This determines what the controller does when the Auxiliary Input is active:

Aux Input Alarm: This is the default setting – it provides a simple alarm when Auxiliary Input is active

Disable: Array: If Auxiliary Input is active, then the Array power switch will be disabled

Disable: Load: If Auxiliary Input is active, then the Load power switch will be disabled

Disable: Ay & Ld: If Auxiliary Input is active, then the Array and Load power switches will be disabled

2.6. Menu 2 – Battery Regulation

| LCD Display | Screen | Description |
|--------------------------------------|----------|--|
| **** Menu 2 **** Batt Regulation | Screen 0 | Menu Identifier |
| Boost Regulation Voltage: 27.6V | Screen 1 | Boost Regulation Voltage Set-point |
| Equal Regulation Time: 30mins | Screen 2 | Equalisation Regulation Time |
| Float Regulation Voltage: 27.0V | Screen 3 | Float Regulation Voltage Set-point |
| Reset to Boost Voltage: 25.2V | Screen 4 | Reset to Boost Voltage Set-point |
| Regulation Hysterisis:0.30V | Screen 5 | Regulation Hysterisis |
| Temperature Comp Null Temp: 25°C | Screen 6 | Temperature Compensation Null Temperature |
| Temperature Comp Rate: -0.040V/°C | Screen 7 | Temperature Compensation Rate (Volts per °C) |
| Battery Type: VRLA | Screen 8 | Battery Type Selection: NiCd KL65 19cell, Vented, VRLA, Absolyte, Gel/OPzV |
| Restore Battery Defaults --> Sel | Screen 9 | Restore the Battery Default Settings to the factory settings: Press Select to restore Battery Defaults (see sections 2.7 & 2.9) |

2.7. Battery Regulation Default Settings (selected in Menu 2 Screens 8 & 9)

Factory Default = VRLA Battery Settings (unless other battery settings are requested by the customer)

| Regulation Setting | NiCd 19cell | Vented | VRLA | Absolyte | Gel/OPzV |
|----------------------------------|-------------|----------|----------|----------|----------|
| Boost Regulation Voltage | 29.45V | 28.8V | 27.6V | 28.2V | 28.2V |
| Equalisation Time | 30 mins | 30 mins | 30 mins | 30 mins | 30 mins |
| Float Regulation Voltage | 27.0V | 28.2V | 27.0V | 27.0V | 27.3V |
| Reset to Boost Voltage | 25.65V | 26.4V | 25.2V | 25.2V | 25.3V |
| Temperature Compensation Null °C | 20°C | 25°C | 25°C | 25°C | 20°C |
| Temperature Compensation Rate | -66mV/°C | -66mV/°C | -40mV/°C | -36mV/°C | -60mV/°C |

2.8. Menu 3 – Alarm Settings

| LCD Display | Screen | Description |
|------------------------------------|----------|--|
| **** Menu 3 **** Alarm Settings | Screen 0 | Menu Identifier |
| High Volts Alarm Set V: 28.8V | Screen 1 | High Voltage Alarm Set (Trip) Voltage Set-point |
| High Volts Alarm Reset V: 28.2V | Screen 2 | High Voltage Alarm Reset Voltage Set-point |
| Low Volts Alarm: Set V: 22.8V | Screen 3 | Low Voltage Alarm Set (Trip) Voltage Set-point |
| Low Volts Alarm: Reset V: 24.0V | Screen 4 | Low Voltage Alarm Reset Voltage Set-point |
| Load Cut Alarm: Set V: 22.2V | Screen 5 | Load Cut Alarm Set (Trip) Voltage Set-point |
| Load Cut Alarm: Reset V: 24.0V | Screen 6 | Load Cut Alarm Reset Voltage Set-point |
| Load Switch Act Delay: 10s | Screen 7 | Load Switch Activation Delay Time (seconds) (Time between the alarm being activated and the load being cut) |

2.9. Alarm Default Settings (selected in Menu 2 Screens 8 & 9)

Factory Default = VRLA Battery Settings (unless other battery settings are requested by the customer)

| Alarm Setting | NiCd 19cell | Vented | VRLA | Absolyte | Gel/OPzV |
|--------------------------------|----------------|------------|------------|------------|------------|
| High Volts Alarm Set Voltage | 31.0V | 29.4V | 28.8V | 29.4V | 28.8V |
| High Volts Alarm Reset Voltage | 27.0V | 28.8V | 28.2V | 28.8V | 25.8V |
| Low Volts Alarm Set Voltage | 23.5V | 22.8V | 22.8V | 23.4V | 22.8V |
| Low Volts Alarm Reset Voltage | 26.5V | 24.0V | 24.0V | 27.6V | 27.0V |
| Load Cut Alarm Set Voltage | 21.85V | 22.2V | 22.2V | 22.8V | 22.2V |
| Load Cut Alarm Reset Voltage | 26.0V | 24.0V | 24.0V | 27.0V | 27.0V |
| Load Switch Activation Delay | 10 seconds | 10 seconds | 10 seconds | 10 seconds | 10 seconds |

2.10. Menu 4 – Alarm Relays Function and Test

| LCD Display | Screen | Description |
|--------------------------------------|----------|---|
| **** Menu 4 **** Relay Functions | Screen 0 | Menu Identifier |
| Relay 1 Function High Volts Alarm | Screen 1 | Set Alarm Relay 1 Function: Set to desired function (default High Voltage Alarm) |
| Test Relay 1 Press --> Select | Screen 2 | To Test Alarm Relay 1 – press Select Pressing Select changes the state of the alarm relay |
| Relay 2 Function Low Volts Alarm | Screen 3 | Set Alarm Relay 2 Function: Set to desired function (default Low Voltage Alarm) |
| Test Relay 2 Press --> Select | Screen 4 | To Test Alarm Relay 2 – press Select Pressing Select changes the state of the alarm relay |
| Relay 3 Function Load Cut Alarm | Screen 5 | Set Alarm Relay 3 Function: Set to desired function (default Load Cut Alarm) |
| Test Relay 3 Press --> Select | Screen 6 | To Test Alarm Relay 3 – press Select Pressing Select changes the state of the alarm relay |
| Relay 4 Function Common Alarm | Screen 7 | Set Alarm Relay 4 Function: Set to desired function (default Common Alarm) |
| Test Relay 4 Press --> Select | Screen 8 | To Test Alarm Relay 4 – press Select Pressing Select changes the state of the alarm relay |
| Test Reg Mode: Night --> Select | Screen 1 | Test Regulation Mode Relays / Contacts Press Select repeatedly to cycle through Night, Boost, Equal, Float |

List of Alarms available on each Programmable Alarm Relay:

| | |
|------------------|--|
| Not used | Alarm Relay not used |
| High Volts Alarm | High Voltage Alarm |
| Low Volts Alarm | Low Voltage Alarm |
| Load Cut Alarm | Load Cut Alarm (Battery Failure) |
| Aux Input Alarm | Auxiliary Input Alarm (If Auxiliary Input is active) |
| Batt Sense Alarm | Battery Sense Alarm (if Battery Sensor is faulty or disconnected) |
| Temp Sense Alarm | Temperature Sense Alarm (if Temp Sensor is faulty or disconnected) |
| Common Alarm | Common Alarm (if any Alarm is active) |
| System Normal | System Normal (if no Alarm is active) |
| Array Fail Alarm | Array Failure Alarm (no voltage from Array for number of hours) |

2.11. Menu 5 – Array and Load Tests

| LCD Display | Screen | Description |
|--------------------------------------|----------|--|
| **** Menu 5 **** Array/Load Tests | Screen 0 | Menu Identifier |
| Show Array 1 V: Press --> Select | Screen 1 | To show the open circuit Array Voltage – press Select |
| Show Array 1 I: Press --> Select | Screen 2 | To show the closed circuit Array Current – press Select |
| Test Array 1 Sw: Press --> Select | Screen 3 | To Test Array 1 Switch – press Select Pressing Select changes the state of the array switch |
| Test Load 1 Sw: Press --> Select | Screen 4 | To Test the Load 1 Switch – press Select Pressing Select changes the state of the Load Switch |
| Auxiliary Input: Status: Open | Screen 5 | Auxiliary Input Status: Shows the status of the Auxiliary Input as “Open” or “Closed” |

2.12. Power Up and Configuration Screens

| Display | Screen | Description |
|------------------------------------|----------|--|
| MSR1-10 Charge Controller | Screen 0 | Power Up Screen is shown for 2 seconds after power is turned on |
| Configure Unit: Voltage: 24V | Screen 1 | The unit is designed to work at 24V only This cannot be changed |
| Configure Unit: Common Negative | Screen 2 | The unit is designed to work as a Common Negative System This cannot be changed |
| Calibrate PCB Temp: 23.4°C | Screen 3 | This screen is used to calibrate the individual controller during the factory testing procedure. |
| Calibrate Zero Current: Select | Screen 4 | This screen is used to calibrate the individual controller during the factory testing procedure. |
| Calibrate Array Current: 0.00A | Screen 5 | This screen is used to calibrate the individual controller during the factory testing procedure. |
| Calibrate Load Current: 0.00A | Screen 6 | This screen is used to calibrate the individual controller during the factory testing procedure. |

2.12.1. Power Up Screen

The Power Up Screen is shown for 2 seconds after power is applied to the Unit.

To enter the Configuration Screens, the Menu and Select switches should be pressed and held down when the Power Up Screen is shown. When the first Configuration Screen is shown, the switches may be released.

Under normal circumstances (when the Menu and Select switches are not pressed) after showing the Power Up Screen for 2 seconds, the unit will automatically go to Menu 0 Screen 0.

2.12.2. Configuration Screens

IMPORTANT: The Configuration Screens should ONLY be used by authorised persons.

The Configuration Screens are intended to be used at time of manufacture to configure the software depending on Unit Voltage and Unit Type.

CAUTION: Setting the Configuration Screens incorrectly may cause incorrect operation.

WARNING: Setting the Configuration Screens incorrectly may result in damaging the unit.

2.12.3. Configure Unit Voltage and Polarity (Screens 1-2)

These screens do not cause any change to the controller.

The design is fixed for 24V Common Negative operation.

2.12.4. Calibration Screens (Screens 3-6)

These screens are used for calibration purposes during the factory test and should not be used unless the user understands the purpose of the screens.

2.12.5. Exiting the Configuration Screens

Pressing Menu at any time will take the user to Menu 0.

If no switches are pressed for 60 seconds then the unit will move to Menu 0.

3. Software

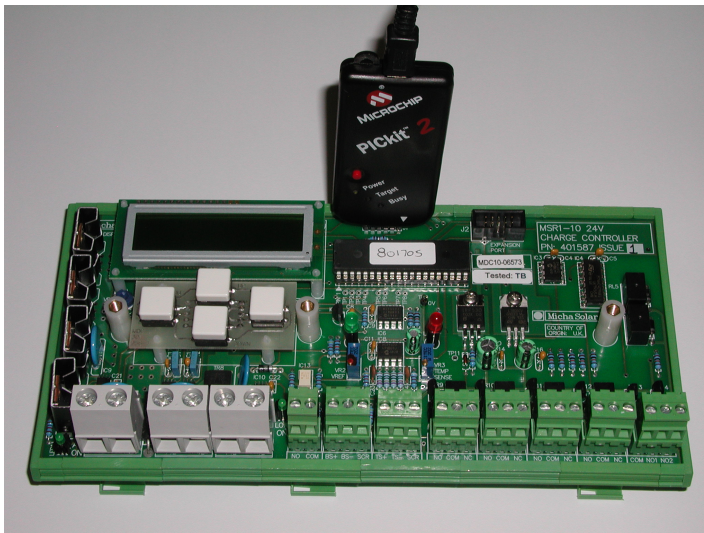
3.1. Software History

| Software Version | Date Released | Manual | Comments |
|------------------|---------------------------|----------|---|
| 801 972 Ver 1.3 | 6 th Sept 2013 | 801973-1 | Production Release |
| 801 972 Ver 1.4 | 26 th Nov 2013 | 801973-2 | Added Battery & Temperature Sense Selection Options Added RTD Interface on Expansion Port Added Com Port Baud Rate Selection: 9600, 19200 |
| 801 972 Ver 1.5 | 17 th Dec 2013 | 801973-3 | Changed Auxiliary Input Active Select (Menu 1 Screen 3) Added Auxiliary Input Function Select (Menu 1 Screen 11) Changed Relay Function Select: Aux Input Alarm |

3.2. Program Port

The Microcontroller can be programmed without removing it from the PCB by using the Program Port J1.

The Microcontroller can be programmed with or without power connected to it.



(1) Remove the fascia cover and connect a PICkit2 or PICkit 3 Programmer to J1 (Note the arrow indicating Pin1 on the programmer and J1) as shown:

(2) Follow the normal programming instructions.

(3) When programming is successful, disconnect the programmer from the unit and replace the fascia cover.

3.3. Installation / Replacement of the MCU

Ensure that anti-static precautions are taken to avoid damage to the Microcontroller when handling (i.e. touch a conductor that is connected to earth before carrying out the following):

Turn off all power to the Controller.

Remove any Fascia Cover using the plastic thumbscrews. Identify the Microcontroller (the 40 pin integrated circuit with a label on it showing the software number and version) on the PCB Assembly. Carefully lever out the Microcontroller presently located there by using a small flat screwdriver on both ends equally. Do this carefully.

Identify the device to be installed. Carefully handle the device without touching the legs of the device. Note the orientation of the semi-circular notch at one end of the device. Note which end on the PCB socket has a similar notch. Now insert the Microcontroller into the PCB socket so that the notch in the device is at the same end as the notch in the socket. Before pressing down on the device to mate it fully in its socket, check that all pins are properly lined up with the pins in the PCB socket. Press the device fully home into the socket and check that no leg has been bent or missed its socket.

Replace any Fascia Cover using the plastic thumbscrews.

Restore power to the Controller.