Multipoint Blast Eye User Manual

Contents

Document version: 12 February 2025, Hardware V2.5, Firmware V1.20

1. Introduction

Thank you for purchasing the Multipoint Blast Eye system! It has been manufactured to ensure easy and reliable use. Before making use of the system please carefully read through the entire User Manual.

By making use of the system, you hereby confirm that you have read, understood, and accepted the terms and conditions contained herein.

Important Safeguards

When using the Multipoint Blast Eye system, standard safety precautions must always be followed, including the following:

- *The product is not suitable for use by persons (including children) with reduced physical, sensory or mental abilities, or those with a lack of experience and knowledge concerning the use of this product.*
- *Incorrect operation and improper use can damage the product and cause injury to the user.*
- *The manufacturer does not accept responsibility or liability for any damage or injury, howsoever caused by the improper or incorrect use of the system, or by repairs carried out by unauthorized personnel.*
- *Never immerse the product in water or any other liquid for any purpose whatsoever.*
- *Do not use the product for any other purpose than what it is intended for.*
- *The product is designed to assist in measuring temperatures and the operator must always make use of the operator's skills and knowledge to assess and decide in relation to each scenario and its unique facts.*

Terms of Use

This product should always be used in conjunction with other temperature monitoring procedures included in your Standard Operating Procedure (SOP). All holes should be measured with an Infrared temperature probe and/or thermocouple prior to charging.

The Multipoint Blast Eye system is not to be considered lifesaving equipment - it is designed to monitor and display the temperature only at the location of the individual sensors along the cable length and assist the operator in reaching a decision or conclusion and is not designed to override the operator's observation.

Indemnity

By using the Multipoint Blast Eye System, the user shall indemnify and hold Designs Unique cc, any employee, agent and/or director harmless from and against any liability or damages, loss, costs, expenses and claims howsoever arising.

- *Designs Unique accepts no liability for any damage caused by the use of its product or for any negligent act and/or omission by the user.*
- *Designs Unique does not guarantee the accuracy of any reading and further does not guarantee that its product may not in exceptional circumstances, malfunction.*
- *The operator must make their decisions based on the prevailing circumstances and scenario.*

Warranty

1. Designs Unique warrants to the original purchaser of this product that this product will be of good quality and in good working order and free of defects and suitable for its intended purpose and use for a period of 6 months from the date of purchase.

2. In the event that the warranty period has not lapsed, and the product is not of a good quality, or in good working order or is defective, the customer may, subject to paragraph 3 (three) below, return the product to the seller after which it will be repaired if possible, and if not possible, Designs Unique reserves the right to replace the product at no cost.

3. Design Unique will not replace the product or refund the customer in terms of this warranty if the product:

- *has been altered in any manner whatsoever;*
- *has been misused, abused or tampered with;*
- *is defective or not in working order due to ordinary wear and tear;*
- *if damage is the result of gross negligence, recklessness, malicious behavior or criminal conduct on behalf of the customer;*
- *has been used for any other purpose than intended for.*
- *The warranty does not cover corrosion.*
- *The warranty does not cover exposure to explosives in any manner or form.*

4. This warranty only applies to a product that has been purchased from Designs Unique and/or an authorized reseller and which can be supported by the original proof of purchase.

5. Any repaired and/or replaced item will only carry the balance of the warranty period from date of purchase and will not enjoy a new or extended period of warranty.

2. The Multipoint Blast Eye System

The latest Multipoint Blast Eye system is comprised of two parts. The first part is the Reader Unit, which is designed to be economical and reusable. The second part is a disposable Sensor Cable, which is connected when the unit is in use. This system is designed for use in hot-hole blasting applications and is designed to measure multiple temperatures along a single cable with multiple temperature sensors.

The system has the following features:

- Sunlight readable LCD display
- Bright, multicolour LED status indicators, readable in sunlight
- Factory set low and high temperature alarm thresholds (to the client's requirement, for example 80°C and 95°C respectively)
- Replaceable AA batteries - typical life of more 80 hours of continuous running (depending on the alarm state)
- Low battery alert in the form of a bright yellow LED
- Robust water-resistant design
- Glass filled nylon spike for inserting into the ground
- Replaceable sensor cable connector in case the metal connections corrode
- Visual and audible alarms
- Simple, user-friendly operation

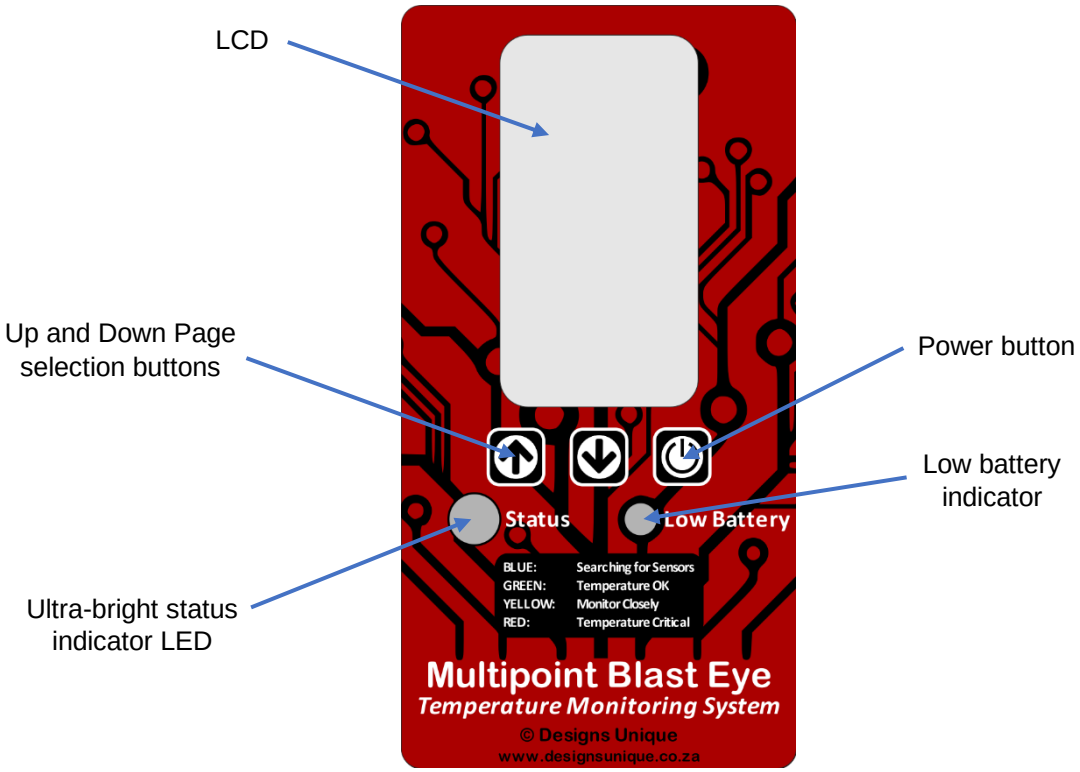


Figure 1 - The Front decal of the Reader Unit

3. How to Use the System

The simple steps required to use the system are outlined below:

1. Select the required sensor cable length (refer to *Table 1* below for the available lengths), lower the cable down the hole, and plug the cable into the connector at the bottom of the Reader unit as shown in *Figure 2* below.

Figure 2 - Sensor connection

2. Turn the device **ON** by pressing and holding the *Power* button (see *Figure 1*) for approximately 4 seconds. The unit will beep, it will display a title page, and then flash ***RED***, ***GREEN***, and then ***BLUE***. If the power button is released before all three colours have been seen, the unit will turn **OFF** again. This is to prevent the unit from being turned on if accidentally bumped.

3. If the sensor cable was not connected first, the units will give short ***BLUE*** flashes together with a beep and will display the *Searching* page to show that it is searching for sensors. When a sensor cable is connected, it will start measuring the temperatures and switch to the *Detail* page and display the status of each of the sensors. The number of lines shown will correspond to the number of sensors on the cable.

4. The unit is now ready and can be inserted into the ground using the spike. The Reader will continuously monitor the temperatures. If all temperatures are below both thresholds and everything is working correctly, a solid ***GREEN*** LED will be seen. If any temperature exceeds the lower threshold, a slow ***YELLOW*** LED flash and buzzer sound will alert the user. If any temperature exceeds the high threshold, a fast ***RED*** LED flash and buzzer sound will be observed.

5. Every ten seconds, the display will automatically switch between three different screens (outlined in the *Display Information* section below). The display page can also be user selected by using the *Up* or *Down* arrow buttons (see *Figure 1*). This can be configured if required, see the *Device Settings* section.

6. The unit can be turned off, by pressing and holding the *Power* button. After a short while, the display will show the *Shutdown page* and count down from three to one, after which it will prompt the user to release the button to turn the unit off (see *Figure 7*). Release the button, and the unit will power down.

4. Display Information

The LCD display allows the unit to display a host of information to the user. Below is a description of the contents of each screen. The user can step through the different screens, when the unit is on, by using the *Up* and *Down* arrow buttons (see *Figure 1*).

Detail Page

The Detail page shows the depth (level), temperature, and status of each of the connected sensors. *Figure 3* below shows an example of the detail page.

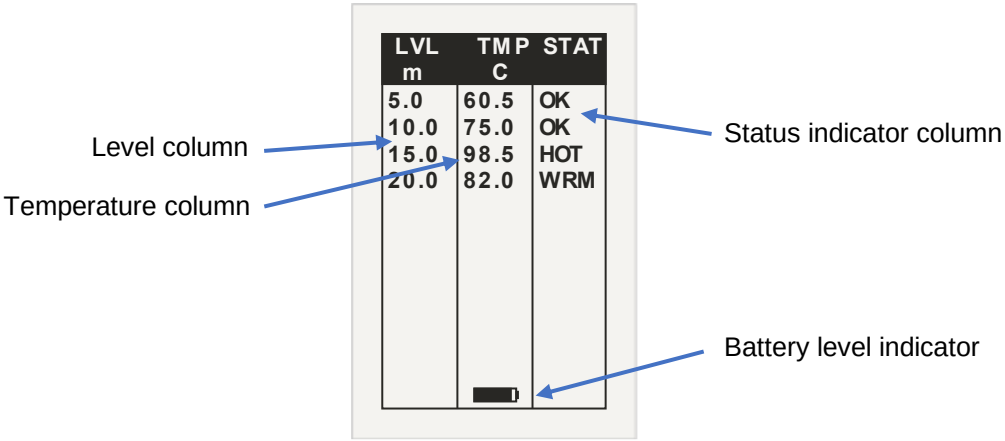


Figure 3 - Detail page

Each row in the table refers to a single sensor. The ***LVL*** column shows the depth of the sensor in meters, and the ***TMP*** column shows the corresponding temperature (in °C). The ***STAT*** column shows the status of the sensor, and the following statuses are possible:

- ***OK*** – Temperature is below both thresholds. If ALL temperatures on ALL levels are OK, this will be accompanied by a continuous ***GREEN*** LED.
- ***WRM*** – Temperature is above the LOW threshold, but below the HIGH threshold. This will also show with a slow pulsing ***YELLOW*** LED and the buzzer.
- ***HOT*** – Temperature is above the higher threshold. This will show a fast-pulsing ***RED*** LED and the buzzer.
- ***OVR*** – Temperature has exceeded the maximum range of the sensor. This will show a fast-pulsing ***RED*** LED and the buzzer. The temperature reading will show as “>128”.
- ***ERR***, ***CONF, CRC*** – An error has occurred while reading the sensor. More information on errors is given in the *Error Sources and Indications* section below.

Maximum Page

The Maximum page displays the maximum temperature at the corresponding depth at which it occurs. *Figure 4* below shows an example of what can be found on this page. It shows a maximum temperature of 98.5°C occurring at the 15.0m point/depth.

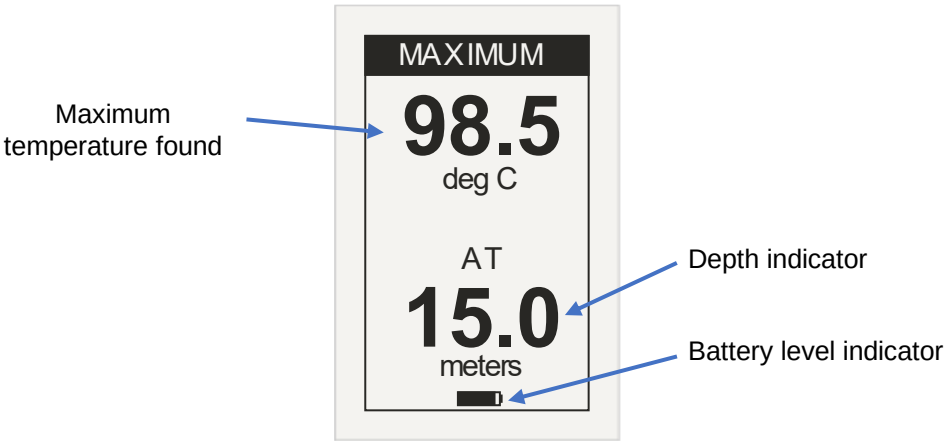


Figure 4 - Maximum page

Bar Graph Page

The Bar graph page (*if enabled*) gives a simple visual indication of the temperature profile down the hole. It shows the temperature at each level in the hole as a bar graph. If a bar is 'hollow,' the temperature is OK, but if a bar is solid, then it has exceeded one or both temperature thresholds. The example in *Figure 5* below shows four sensors. The first two are below the thresholds, but the third is above the high temperature threshold and the fourth is above the low temperature threshold but still under the high temperature threshold.

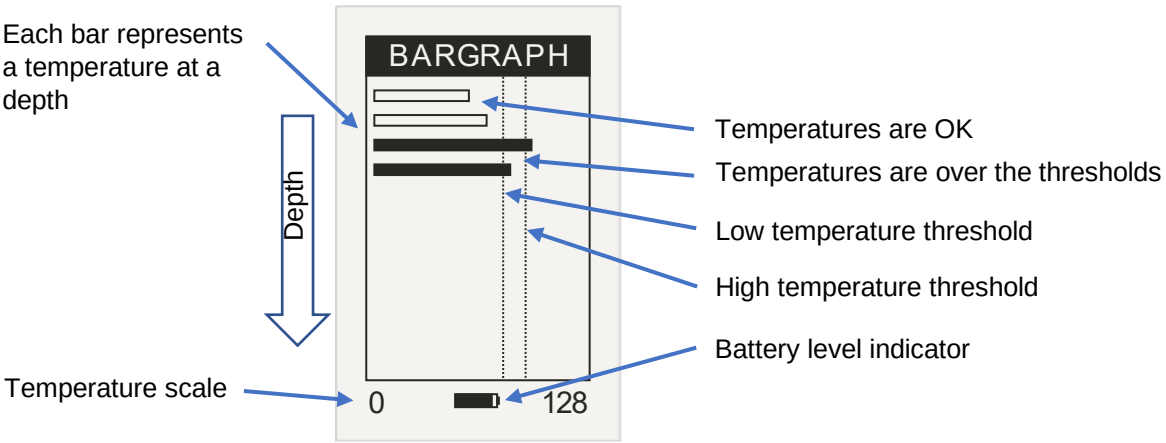


Figure 5 – Bar graph page

Device Info Page

The Device Info page displays relevant information about the Reader unit such as its serial number, the temperature thresholds, and the battery voltage. When the unit automatically steps through the pages, it does not enter this page, and this can only be entered using the arrow buttons. *Figure 6* below shows an example of the Device info page.

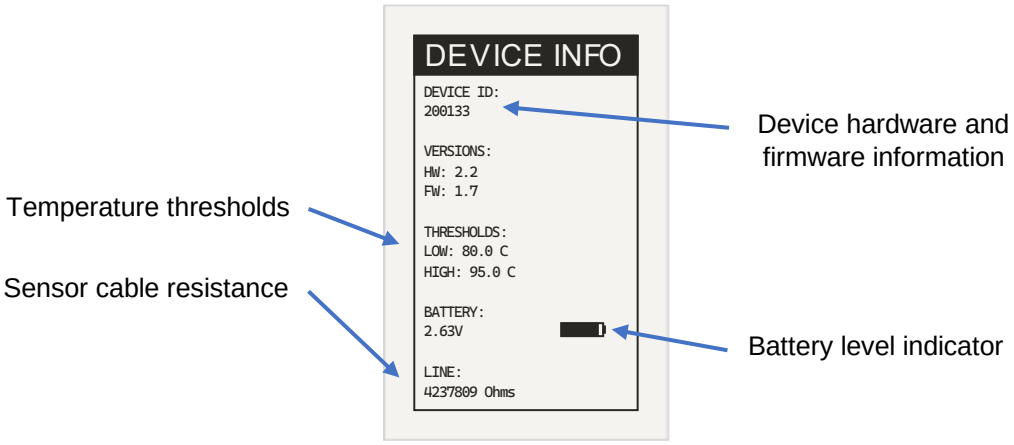


Figure 6 - Device Info page

Shutdown Page

When the *Power* button is held for a few seconds, the Shutdown page is displayed. The number shown will count down from three after which it will ask the user to release the button to turn the unit off. If the button is released at any point during this time, the unit will not power off. This is to prevent the unit being turned off by accident. *Figure 7* below shows examples of the first and last screens of this process.

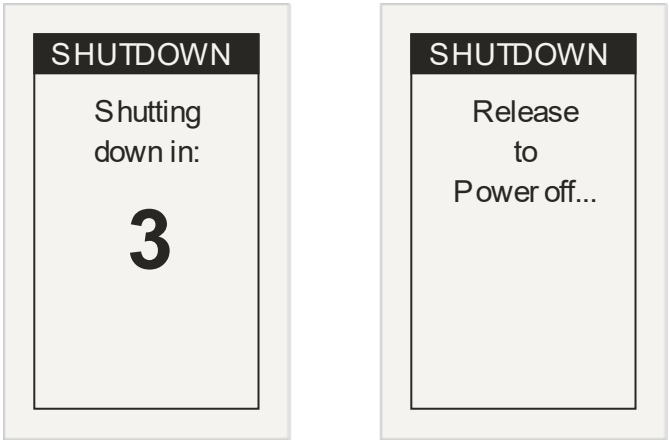


Figure 7 - The Shutdown process

5. Error Sources and Indications

As there is an LCD display on the reader unit, it is possible to display more comprehensive information about what the unit is observing on the sensor cable. *Figure 8* below shows some example error messages.

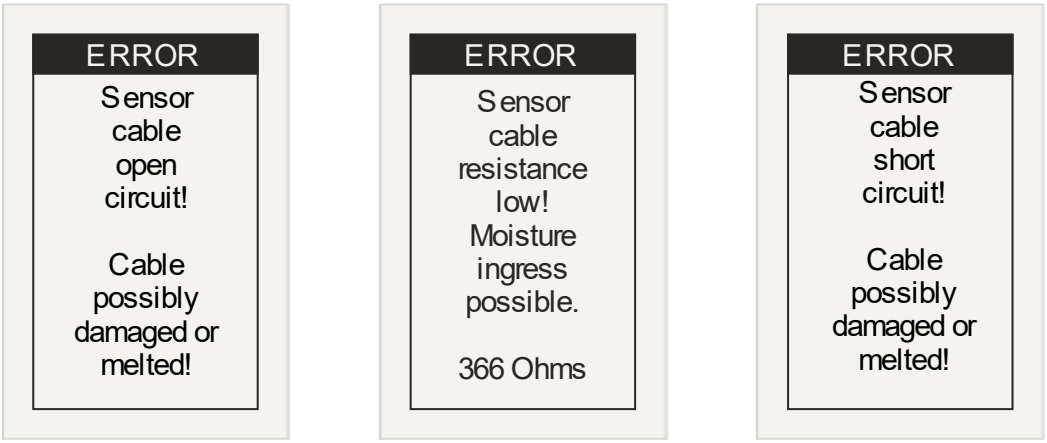


Figure 8 – Error messages

The mining environment is a very harsh and dirty environment in which dust and corrosive elements can affect electrical connections. While the error messages do suggest possible problems, they are based on the assumption that the cable is connected properly. Therefore, the first thing to check if an error is indicated is that the sensor cable is free of dirt and corrosion and is **connected correctly and securely**. If in doubt, disconnect the cable for a few seconds, ensure that the connectors both on the Reader unit and the Sensor cable are clean and free of corrosion and dirt, and then reinsert the cable into the Reader Unit to see if the error has cleared. If the problem persists, try connecting the cable to another Reader unit. If the different Reader Unit gives the same error, then replace the Sensor cable.

*It is important to understand that if an error is indicated it is because the Reader unit is **unable** to measure the temperature and is therefore unable to give feedback about the temperature to the user. In the event of an error indication, the user should **always** follow the Standard Operating Procedure (SOP) of the mine. If the hole has not been charged, another Sensor cable can be lowered down the hole. If the hole has already been charged, it is suggested that a single point Sensor cable (7m cable) is dropped into the top of the emulsion column to at least monitor the temperature at the top of the column. Even in this situation, consider the hole as dangerous as the temperatures lower in the column are not known and by following this procedure it is done completely at the operators' risk.*

Possible Error Sources

Below are the possible error sources:

During operation, the reader is continuously monitoring the resistance of the Sensor cable. The resistance gives an indication of whether there has been damage to the cable, or if moisture / emulsion has come into contact with the wire inside the sensor cable or the sensor itself. The errors will be accompanied by an error message like those shown in *Figure 8*.

- *Low resistance on the Sensor cable*: If too much moisture enters the sensors or cable, the Reader unit detects this as a communication error and displays this error with a flashing ***PINK*** LED and beep.
- *Cable short circuit*: Similar to the error above, the Reader unit detects this and displays this error with a flashing ***PINK*** LED and beep.
- *Cable open circuit:* If, after monitoring the temperatures for some time, the connection goes open circuit but the cable is still connected to the Reader Unit, a ***LIGHT BLUE*** LED will flash together with a beep. This would be due to the connection to the sensors being either cut or having melted loose while the Sensor cable plug is still connected, or if the Sensor cable is only partially plugged in.

If any of above errors occur after at least one threshold has been exceeded, the unit will alarm with a continuous/solid ***RED*** LED and buzzer. This could indicate that the temperatures are high enough to have potentially melted or damaged

the sensor cable. This is intended to attract immediate attention to the fact that the temperatures were above the thresholds before the Sensor cable became unreadable.

If the Reader unit displays a **WHITE** LED flash and beep when a Sensor cable is connected, this means that no sensors have been detected at all. An error message will also be displayed. It is likely that the cable has been damaged or cut, or that there is a low resistance or short circuit.

The last potential error source is due to a sensor configuration error if a sensor has not been configured correctly. This is highly unlikely as each Sensor cable is tested at several points during the manufacturing process.

6. Sensor Cable Shrink Sleeve Colour Indicator

The Blast Eye Sensor cables consist of a length of wire with one or more sensors along its length, spaced 5m apart. Each cable either has a small piece of coloured shrink sleeve that is placed next to the connector, or the connector itself is colour coded for easy cable length identification. An example is shown in *Figure 9* below together with an example of one of the sensors, and *Table 1* below outlines the colour coding. Various methods of encapsulation are used for the sensors, so they may differ from that shown in *Figure 9* below. Each cable has an additional two meters of cable to the connector to allow the reader to be placed away from the hole. For example, a 17m cable is a 15m cable with two meters on the surface, and three sensors, one at 5m, 10m, and 15m. Each cable is delivered with a 56g weight already attached to the end to help feed it down a hole. The Sensor Cables can be ordered tied into a blasting sleeve, ready for use. However, this option needs to be ordered directly from your blasting sleeve supplier.

If a different cable configuration is required (length, sensor spacing, etc.), please feel free to contact us.

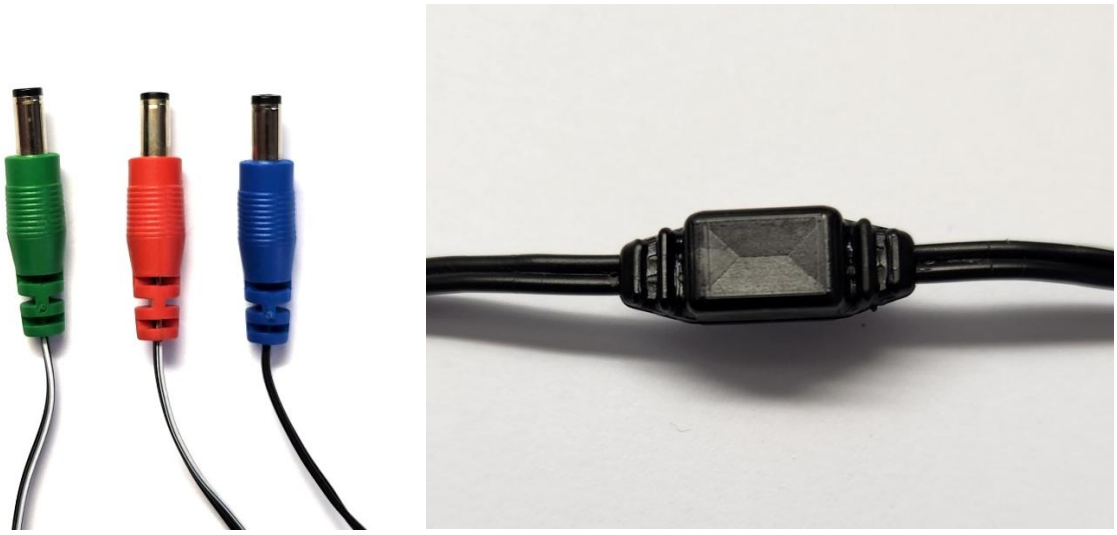


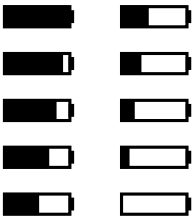
Figure 9 - Cable length identifier and Sensor examples

Connector Colour		Cable Length (m)	Sensors
White		7	1
Green		12	2
Black		17	3
Blue		22	4
Red		27	5
Purple		32	6
Yellow		37	7
Brown / Gold		42	8

Table 1 - Cable length colour codes

7. Battery

The Reader unit uses 2 x AA batteries. These will last for more than 80 hours of continuous operation, depending on the number of sensors connected and the alarm status, if any.



Each display page also shows the battery level at the bottom of the screen with a typical battery level indicator icon (as shown on the left). If the batteries are getting low, a short low battery alarm (***YELLOW*** LED) will flash once every 5 seconds together with a short audible alarm, indicating that the batteries are nearly flat. The unit will still operate for a few hours with low batteries (once again, the lifetime will depend on the number of connected sensors and the temperature status).

When replacing the batteries, any 1.5V AA batteries can be used (alkaline or rechargeable). However, do **NOT** use Li-Ion 14500 batteries.

To change the batteries (refer to *Figure 10* below):

1. Unclip and remove the battery cover on the back of the unit. It is intentionally difficult to remove and may require a screwdriver or similar tool to loosen the clips.
2. Remove the old batteries from the device and dispose of them in a responsible manner in the relevant waste container and in accordance with your company's disposal protocols.
3. Insert the new batteries by first inserting the negative terminal against the spring contact, and then pushing it down into place. Repeat with the second battery.
4. After making sure that the neoprene seal is still in place, replace the battery cover by inserting the short sides in first, and then clip the other side in by pressing down firmly on the battery lid. Two clicks should be heard as the clips spring into place. Turn the device on to make sure that they have been inserted correctly.

The device has reverse polarity protection and will not be damaged if the batteries are inserted incorrectly, however the unit will not power up if the batteries are incorrectly inserted. If no power is observed after the batteries have been changed, redo steps 1 to 4 above, and ensure the batteries are correctly inserted, according to the required polarity.

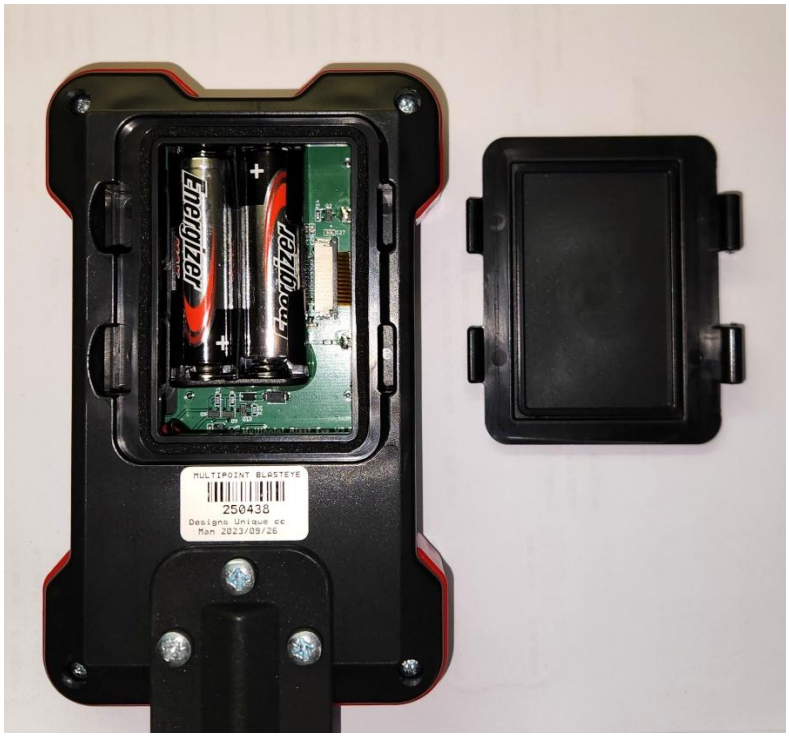


Figure 10 - Battery compartment with the cover off

8. Device Settings

The Reader unit has three settings that can be configured on the device by the user.

To enter the *Setup* page as illustrated in *Figure 11* below, turn the Reader unit off. Press and hold both the *Up* and *Down* buttons together and then hold the *Power* button to turn the unit on again. Continue holding until the settings page is displayed.

Press the *Power* button to step through the different settings and adjust the relevant settings using the *Up* and *Down* buttons.

When ready, using the *Power* button, step through the menu until *Save & exit* is highlighted and then press either the *Up* or *Down* button to save an exit. Similarly with *Set Defaults* to restore the factory defaults and *Exit* to exit without saving the settings.

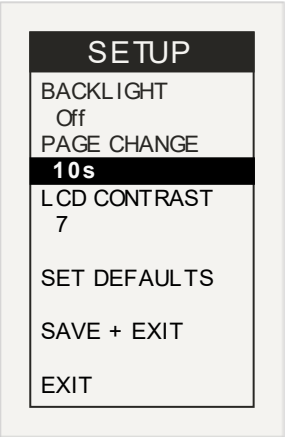


Figure 11 - Setup page

Backlight - the backlight time can be used to enable the backlight on the LCD display. It is disabled by default to maximise the battery life, but it can be changed from *Off* to over *6000* seconds. This time is counted from the most recent press of a button.

Page Change – by default the Reader is configured to automatically switch between the pages every 10 seconds, but this can be changed from *Disabled* to over *6000* seconds between page changes.

LCD Contrast - the LCD contrast setting can be adjusted in the case of extreme operating temperatures. The operating temperature of an LCD affects its display contrast and therefore its readability. The setting has a range of *0* to *20* and is set at a default of *7*. In most cases this will not require adjustment, but if operating in extreme cold conditions, the contrast can be increased, and conversely, if operating in very hot conditions, the contrast can be decreased.

9. Quick Reference

LED and Buzzer	Status
BLUE flash with a short beep	Unit is searching for sensors.
Solid GREEN, no sound	Sensor cable is connected and temperatures are below the alarm thresholds.
Slow YELLOW flash and beep	Sensor cable is connected and at least one temperature is above the low alarm threshold.
Fast RED flash and beep	Sensor cable is connected and at least one temperature is above the high alarm threshold.
Solid RED LED and beep	Cable error occurred after one or more thresholds were exceeded.
WHITE flash and beep	Cable connected but no sensors were detected
PINK flash and beep	Sensors were detected but then the cable resistance went too low
LIGHT BLUE flash and beep	Sensors were detected but then the cable went open circuit
YELLOW Battery low flash and short beep	Batteries are getting low and should be replaced.

10. Specifications

Specification	Value	Unit
Sensor cable operating temperature range	-50 to 125	°C
Temperature measurement range	-50 to 128	°C
Temperature sensor type	Digital sensor	
Temperature Error (maximum)	±2 (Sensor manufacturer specification)	°C
Sensor cable PVC insulation operating range	Specified to 125, Tested to 150 at which point it is soft	°C
Batteries	2 x AA Alkaline batteries, with reverse polarity protection	
Dimensions: Housing only With spike	144 x 90 x 34 257 x 90 x 42	mm
Housing material: Housing Spike	PC ABS with UV stabilization additive 30% Glass filled Nylon	
Default temperature alarm thresholds: Low High	80 95	°C
Temperature units	Celsius	°C

11. Troubleshooting

Problem	Likely causes and solutions
Reader won't turn on	- Batteries are flat. Replace the batteries. - Sensor cable may be shorted out. Disconnect the sensor cable and try again.
Sensor cables often give a cable error with a flashing WHITE LED	Connector is dirty or corroded. Clean the connector out and try again. If the problem persists, the reader unit connector can be replaced.
LCD screen has a large black mark in the middle	The LCD has been damaged and will need to be replaced. LED and buzzer should still operate correctly unless they were also damaged.
LCD screen is difficult to read at extreme cold / hot operating temperatures	The LCD contrast needs to be adjusted. Increase in colder conditions and decrease in hotter conditions. See *Device Settings* section.
PINK, WHITE or LIGHT BLUE flash and beep	Sensor cable communication error. Check the error message displayed on the LCD screen and refer to the *Error Sources and Indications* section.
Solid RED LED and beep after operating for some time	Cable error occurred after one or more thresholds were exceeded. Check the error message displayed on the LCD screen and refer to the *Error Sources and Indications* section.
YELLOW Battery low flash and short beep	Batteries are getting low and should be replaced.

Designs Unique Electronics

The Multipoint Blast Eye System was designed and is manufactured by Designs Unique cc in Johannesburg, South Africa.

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