

MM2 Micro-Seismic Analytical Monitor for the detection of geology faults for use in Mines, TSF and Slopes.

Setup and Configuration Model: MM2Tri

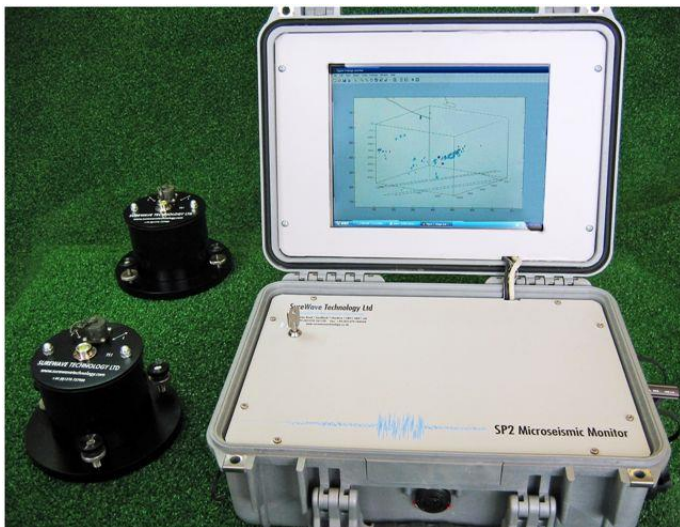


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Introduction

The MM2 is the second generation of SureWave Technology's unique micro-seismic monitoring instrumentation. The MM2 is specifically designed for the detection of seismic signals associated with geology faults and rock stability helping to give advanced warnings of potential collapses. Liquid movement, depending on the nature of the signals, can also be plotted allowing monitoring of TSF.

This is a wide area system capable of monitoring up to 1KM from each sensor. Normally, the usable range in a typical mine / open pit is upto 2KM (6 – channel system), and 3KM (9- channel system).

In addition the proprietary IP can “see through” the majority of surrounding noise associated with a working mine often many times larger from that generated from the activity of interest. The system has detected and provided accurate warning of precursor seismic events detected at a distance of 5.5KM and warnings of 18 weeks before failure of the strata. Actual distances and timing of strata failure or movement will depend on the exact mine / pit conditions and geology. Sensor mounting is critical and must provide coupling to the underlying strata to be monitored.

For permanent installations of rock stability monitoring the MM2 is capable of operating fully automatically in a remote location without user intervention once set up. Data can be remotely monitored via any IP or other wireless system. The remote location monitors the data using a standard web browser. Data is displayed typically using your own site image which is updated by the system in near real time (4-7 seconds) showing all detected activity. This data can also be ‘pushed’ using ftp or other protocols to your own servers / data monitoring solutions. This is the preferred monitoring method as it enables the 3D visualization of events in real time at the monitoring facility.

Overview

This document outlines the basic setup of the MM2, its sensors and cables. It is intended as a guide only and should be read in conjunction with any other MM2 documentation available including documentation on the website at www.surewavetechnology.co.uk

Handling and Unpacking

Please observe all handling and transit warning notices.



IMPORTANT: THE SENSORS ARE FRAGILE AND MUST BE HANDLED WITH EXTREME CARE!

Dropping or subjecting the sensors to any sharp movement may decrease the sensitivity and cause permanent damage.

The MM2 including its peripherals, sensors and interconnecting cables are supplied in a secure aluminum transit box. For larger system configurations multiple containers may be used.



Open the box and carefully unpack it to check the contents are correct. The box contents will vary depending on your individual MM2 system configuration.

Single channel sensor kits include:

Model MM2/6 with 2 x Tri-axis sensors	Model MM2/9 with 3 x tri-axis sensors	Model MM2/12 with 4 x tri-axis sensors
1 x MM2 (Mine Monitoring System) Micro-seismic Monitor 2 x three channel sensors (Tri-axis) in bags 2 x 75M three channel sensor cables on reels 1 x 24V Battery pack 1 x Mains pack 1 x 24V Battery pack interconnect cable 1 x 12V Battery charge lead 1 x USB Keyboard 1 x USB Memory stick 1 x User Guide 2 x Large Steel Spikes 6 x Small (100mm) Steel Spikes 6 x Bolts to attach sensor to the large spikes	1 x MM2 (Mine Monitoring System) Micro-seismic Monitor 3 x three channel sensors (Tri-axis) in bags 3 x 75M three channel sensor cables on reels 1 x 24V Battery pack 1 x Mains pack 1 x 24V Battery pack interconnect cable 1 x 12V Battery charge lead 1 x USB Keyboard 1 x USB Memory stick 1 x User Guide 3 x Large Steel Spikes 9 x Small (100mm) Steel Spikes 9 x Bolts to attach sensor to the large spikes	1 x MM2 (Trapped Miner System) Micro-seismic Monitor 4 x three channel sensors (Tri-axis) in bags 4 x 75M three channel cables on reels 1 x 24V Battery pack 1 x Mains pack 1 x 24V Battery pack interconnect cable 1 x 12V Battery charge lead 1 x USB Keyboard 1 x USB Memory stick 1 x User Guide 4 x Large Steel Spikes 12 x Small (100mm) Steel Spikes 12 x Bolts to attach sensor to the large spikes

If any components of your MM2 system are damaged or missing, please contact us immediately upon receiving the goods. Actual items may change with development, please refer to your delivery note for exact details.

Operating conditions and environment:

This system can be used out in free air anywhere in the world at ambient temperatures of 0 to 50 deg C maximum. Operating in enclosures that prevent free air movement or that raise the air temperature to over 50 Deg. C may cause permanent damage not covered under warranty. External power must be limited to 15.0V maximum on the 12V supply or the system may switch off to protect itself. Power must conform to the requirements detailed in Appendix A.

Locating the MM2 Sensors

The sensors are fragile and need to be handled with extreme care. It is important that the sensors are located correctly as a badly positioned sensor could make the MM2 insensitive and cause activities to go undetected. **There is no need to use bore holes, but the sensors should be mounted on solid rock or other solid material directly connected to the strata. The use of the supplied spikes may assist this process.**

Surewave Technology or its agents will assist in the design of the sensor monitoring locations plan with you. Below is a guide for your information.

The sensors should be located on solid material by use of shallow surface holes which need to be as deep as possible and have an undisturbed base of solid compact material ideally down to clay or heavy compacted sand or rock. At a minimum the hole must be deep enough for the top of the sensor to be a few inches below the surface or if on exposed rock, then the sensors **MUST** be covered by rocks or other solid material. For permanent setups, back filling with any material is fine and recommended for permanent installations. If covered with soil / sand to sufficient depth, this can be directly on the sensor.

Tri-axis (3-channel) sensors can be placed in an area of interest on your site to determine if activity is present. The system works on changes to the background seismic activity and is really designed for long term deployment to allow trends in seismic activity to be monitored.

It is important that the sensor is level on its surface. If fine adjustment is required, the leveling screws of the sensor can be adjusted so the visual leveling indicator aligns with its center position.

The orientation of the 'L' and 'T' channels is very critical if accurate locations are required, and must be arranged as follows:

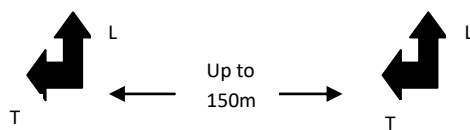


Fig1.sensor orientation

Additional sensors would be orientated as above using the supplied cables. The GPS position of these sensors can be taken and used to calculate the XYZ positions on the 3D image. Once the X Y positions are known, these should then be input into the CustomoptionsM.info file. This will then ensure that the sensors automatically appear on the 3D model in the correct places. Please use the application pre setup on your desktop to position the sensors and adjust the image as required.

Please note the sensors should be positioned above the area to be monitored and for example, in an open pit would not normally be able to see seismic Activity around the corners or across the pit from one side.

Avoid placing the sensors adjacent to vibration sources, normally placing the sensors 10 meters or so away is adequate.

The sensors should be at a suitable distance for the area to be monitored, limited by the cables supplied. For accurate location, each event needs to be detected by at least three sensors, sensors should be at least 30 meters apart for optimum location.

In certain conditions, the supplied spikes (either the long steel spikes or the short steel legs), can be used if not mounting on rock.



WARNING – UNDER NO CIRCUMSTANCES MUST THE SENSORS BE ATTACHED TO THE SPIKES BEFORE KNOCKING THE SPIKES IN THE GROUND. IF THIS IS DONE THE SENSORS WILL BE DAMAGED BEYOND REPAIR AND THIS IS NOT COVERED UNDER WARRANTY. ALWAYS POSITION THE SPIKE WITHOUT THE SENSOR AND THEN BOLT THE SENSOR FROM THE TOP.

Connecting the sensor cables – DO NOT CONNECT with the power on!

Run a cable from each sensor back to the MM2. The cables connect to the Block A, Block B, Block C* and Block D* connectors on the left side of the MM2 – see figure 2.



Figure 2. Left side socket connectors on the MM2 unit

Each connector can handle up to 3 channels, six, nine or twelve channel models are available. The sensors are three channel arranged in a standard tri-axial format giving Vertical, Longitudinal and Transverse directions.

Remove the protective dust caps from each end of the sensor cables and connect one end to the TS1 sensor and the other end to the MM2, ensure the cables are aligned and twist the outer edge of the connector to lock into place.

Connecting the power supply

Once the sensors have been connected to the MM2, connect the 24V battery pack (or external supply for permanent installation) to the 24V power connector on the right side of the MM2. Remove the dust caps from the MM2 and the rear of the battery pack. Align the connector then push in, rotate the body of the connector clockwise to screw the connector into place at each end.



IMPORTANT: ENSURE THE CORRECT VOLTAGE IS SET WHEN CONNECTING THE BATTERY PACK TO THE MAINS SUPPLY!
To prevent damage ensure the voltage selector on the battery pack is set to the correct voltage this can be 110V or 230V

Note: Do not charge the 24V battery pack whilst the MM2 is monitoring, the battery pack will last approximately 35 hours from a full charge.

If the MM2 is used as a portable device, the internal battery will supply power for a limited time (approximately 2.5 hours). For longer use connect the 12V power connector on the back of the MM2 to a suitable 12V battery for extended temporary use. **Do not connect to a flat internal battery or the in line fuse will blow.** The current must be limited externally to 3A. First charge the internal battery limiting the current to <8A. For a permanent installation use an external regulated power supply giving a 13.8V DC output (12.3 to 14.8V Maximum working range). Solar power for both 12 and 24 volts can be arranged as a chargeable option. It is essential that both the 12V power connector and the 24V lead is connected directly to an external battery regardless of how that battery is charged (solar, wind or other). Do Not connect these leads to the 'load' terminals of solar or other charge controllers the system is susceptible to power supply noise and will not function correctly unless connected as indicated above. Ensure the connection is made directly at the battery terminals – not at the charge output.

For full wiring details refer to appendix B.



IMPORTANT: IF USING AN EXTERNAL POWER SOURCE ENSURE THE POLARITY IS CORRECT!
Incorrect polarity can cause permanent damage to the MM2 system, see figure 3 for correct polarity.

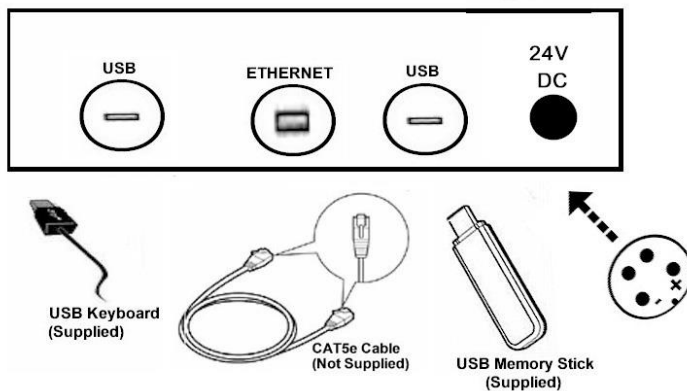


Figure 3. Right side socket connectors on MM2 unit

Network Connection – (not normally required for rapid deployment in an emergency)

The MM2 can be connected to a network using Cat5e cabling, this will enable the MM2 to be remotely monitored. Remove the dust cap from right hand side of the MM2 by unscrewing it in an anti-clockwise direction. Plug in a Cat5e cable to your network or router. See figure 3 above.

The MM2 is configured by default to pick up an IP address automatically from a DHCP server on your network or from your internet service provider, a static IP address can be used if required. See Advanced Configuration elsewhere in this user guide for information on network settings.

For sites that do not have a wired network connection a USB Wi-Fi or 3G USB modem can be used. Follow the manufacturer's instructions for installing such devices. They must be compatible with Microsoft Windows 10™ or later. This IP connection will be used to send HTTP data to your server, or to enable a remote connection to the system if that is preferred.

Keyboard Connection

A USB keyboard (supplied) can be connected to the MM2 system. The keyboard makes it easier to change the configuration of the MM2.

Remove the dust cap from one of the USB connectors on the right hand side of the MM2 by unscrewing it in an anti-clockwise direction. Plug in the USB keyboard, after a short delay the USB keyboard will be functional. See figure 3 above.

Powering on the MM2

Open the lid on the MM2 by lifting the two clips in an upward direction.

Press the power button for 1 second then release (see figure 4).

After about 10 seconds the MM2 will begin to boot up and proceed to load its operating system software.

The MM2 unique software application will begin to load automatically and the system will start monitoring.



Figure 4: Power button location

Shutting Down the MM2

To shut down the MM2 press and release the power button. After a short delay the MM2 will switch off.

For portable deployed systems unplug all cables and ensure all dust caps are refitted to the cable ends and connectors when not in use and remember to recharge the batteries if required.

Advanced Configuration


Other than setting the site image file, the advanced configuration does not need to be changed. The system automatically configures itself during its use. As part of the maintenance contract and provided the user connects the system to a valid public network connection, SureWave will configure the system for you during hands on training.

The advanced configuration settings allow initial setup of the MM2 during its commissioning. The settings should not normally need to be changed once setup except in the event of portable deployment to a new site where adjustments may be required.

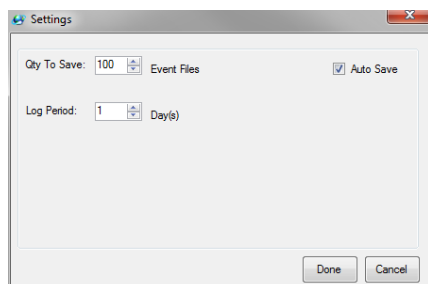


IMPORTANT: CHANGES MADE TO THE ADVANCED CONFIGURATION MAY PREVENT THE MM2 SYSTEM FUNCTIONING.
Only proceed if asked to change these parameters by SureWave Technology.

To change the configuration settings double click on the 'Configure' icon on the desktop. After a short delay the configuration screen will be displayed, next click Configuration then Settings (see figure 5).

To exit the configuration program without making changes click the Cancel button or click the  'Close' icon at the top of the window.

The MM2 Configuration options control the MM2 software operating parameters. Please note that some settings may be 'Locked Out' this is to prevent some factory settings from being changed. Please proceed with caution when changing any parameters here, if in doubt please contact us.



Parameter	Function
Qty To Save	Number of historic events to save
Auto Save	Enable automatic saving
Log Period	Number of days to rotate log file

Once the parameters are set as desired click the Done. The MM2 software application will now restart with the new settings applied.

Figure 5. Configuration tab

The Network Settings options control the remote networking parameters of windows. The network settings can be found in the Windows control panel under Network connections. Right click "Local Area Network" which is the in-built 10/100 Cat 5e Ethernet port and select Properties. Select Internet protocol (IPv4 TCP/IP) the following dialog box will be shown.

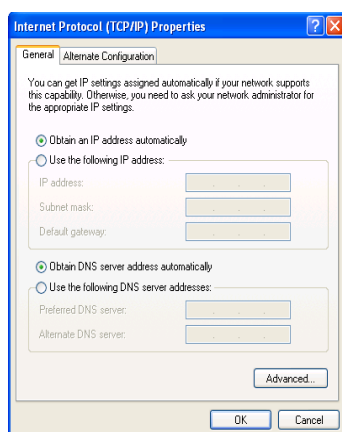


Figure 6 Network settings tab

Parameter	Function	Note
Obtain an IP address automatically	Pick up an IP address from a DHCP server	If checked, the static IP address is ignored. The MM2 will attempt to obtain its network settings from a DHCP server on your network or from your internet service provider. In most cases this option should be checked.
IP Address	Static IP address in IPV4 notation	If you have been given a static IP address from your system administrator or your internet service provider enter it here
Subnet Mask	Network subnet mask	For use with a static IP address, this is your network or internet service providers subnet mask
Default Gateway	Gateway IP address	For use with a static IP address, this is your networks or internet service providers gateway address
Primary DNS	DNS server IP address	For use with a static IP address, this is the address of the primary DNS server on your network or internet service provider
Secondary DNS	Backup DNS IP address	For use with a static IP address, this is the address of the backup DNS server on your network or internet service provider

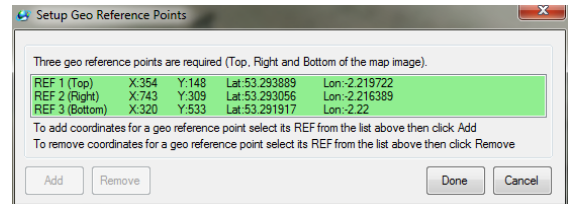
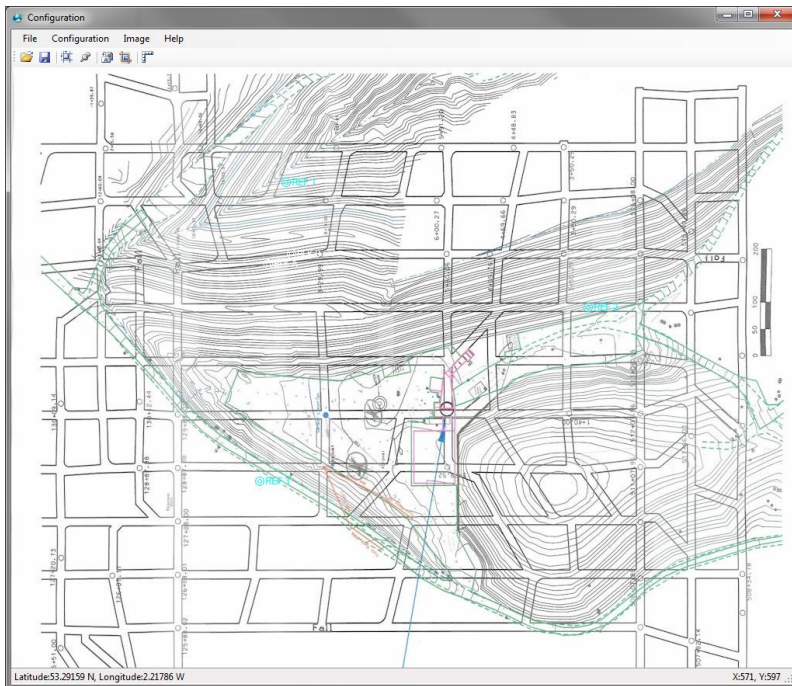
Once the parameters are set as desired click the Update button. The settings will take effect next time you restart your MM2 system.

The remote monitor uses TCP port number 8080; ensure this port is not blocked by your network or internet service provider. Contact your system administrator if in doubt.

User Configuration

If the GPS position of the TS1 sensors is known, they can be entered into the configuration settings. When using GPS positions the site image requires at three known fixed GPS points (top, right and bottom of site image) to ensure the site image calibration is set.

These GPS fixes should point to known landmarks on the site image. If the sensor GPS positions have been defined the software will prompt the user for two or more fixed known GPS positions for site image calibration. If GPS positions of the sensors have not been defined the software will prompt for the location of the TS1 sensors. Simply follow the on screen instructions to set the sensor positions on your site image using the touch screen interface.



To configure the GPS geo-reference points, load your site image (the site image must be in a mercator projection for GPS to work) click Configuration then click 'Geo Reference Map Image'. Follow the on screen instructions and select three known points.

To remove a geo-reference point, select the point from the list then click Remove. The screen background will show green if all the geo-reference positions are set or red if a position is missing.

There are 2 ways to position sensors, either by clicking on the site image where the sensor is located or using GPS coordinates of the sensor.

To add a sensor position, first geo-reference your site image (if using GPS coordinates) click Configuration then click 'Position Sensors'.

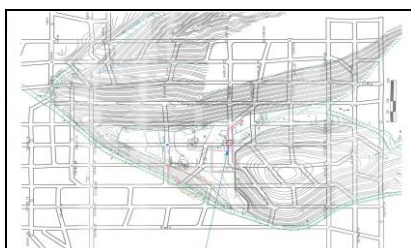
To manually position a sensor by clicking on a map click Position, you will then be prompted to click the site image for the sensors position. To position the sensor with GPS coordinates click Add, you will then be prompted to enter the latitude and longitude coordinates.

To reposition a sensor, click the sensor in the list then click Remove, reposition the sensor by clicking Add or Position.

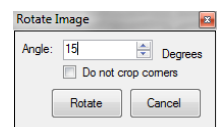
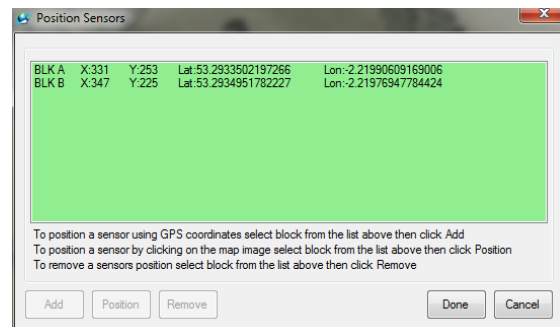
The screen background will show green if the sensor positions are all set or red if a position is missing.

The site image needs to be rotated in order that the top of the picture aligns with the 'L' longitude direction on the tri-axial sensors. When using single channel sensors they should be positioned in a horizontal pattern across the site from left to right. The horizontal line of the sensors should correspond to the 'T' latitude direction of the site image.

To rotate the site image, click rotate, enter the angle of rotation then click Rotate.



Each event and source location will be identified by the placement of a color dot overlaid on your site image.



Remote Monitoring (The following instructions are an example and subject to change depending on your network/site configuration and method of connection to the internet). Please see ADDENDUM section for the version of software installed for your system.

Remote monitoring will not normally be required for a rapid deployment setup, however it is available if required and may be more useful in installations where the system is permanently setup for monitoring the mine for potential stability faults.

Ensure the MM2 system is connected to your network or internet via your ISP. If you know the IP address of your MM2 you can connect via any web browser using TCP port 8080 for example <http://192.168.0.1:8080>

If you are using a Dynamic DNS service you will have been given a domain name, enter it in your web browser address bar for example <http://MM2001.surewavetechnology.com> alternatively other Dynamic DNS services can be used such as TZO.com or DynDNS.com instructions and pricing is available on their websites.

Once connected to the remote web server within the MM2 you will be prompted for your login credentials, enter your username and password then click the Login button to continue.

The default username is **admin** with the default password as **admin**

Once logged in the user will have the option to view live data, review the MM2 system status and change their remote admin password.

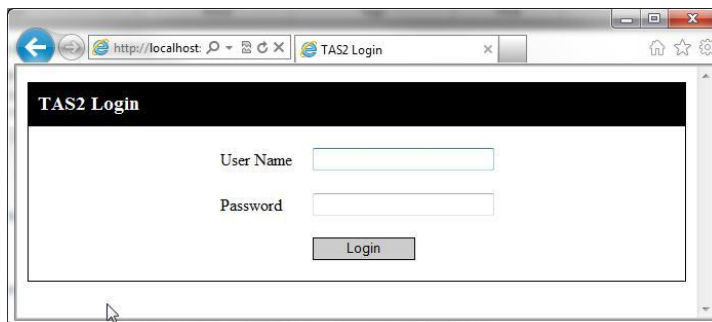


Figure 7. Remote monitor login screen

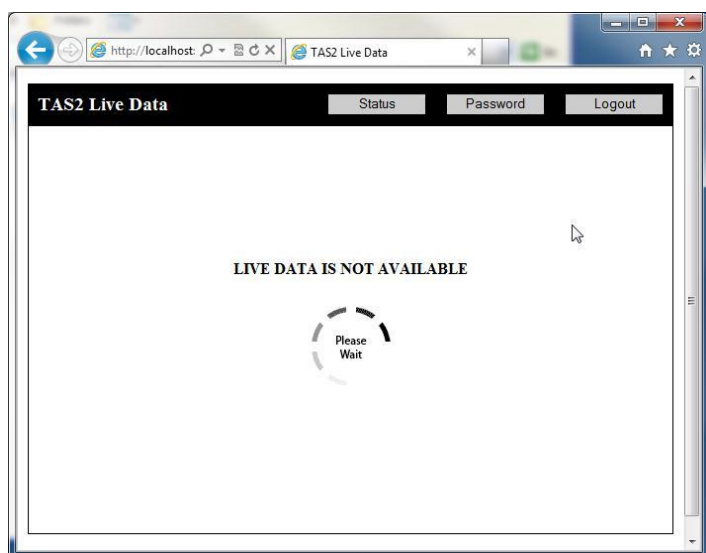


Figure 8. Remote monitor live data (event) screen

The live monitoring data image will appear on screen as soon as monitoring data becomes available.

The screen is refreshed automatically every few seconds and event images are updated in near real time.

Each event source type will be identified by the placement of a colour dot overlaid on the user site image. There will be a key to these indicating the source event (where known) on the screen of the MM2 and remote monitor screen.

To navigate to a different page click one of the buttons on the top right of the page; Status gives battery state, CPU temperature and network IP address and Password allows the user to change their remote access admin password.

Click Logout when finished remote monitoring, the login screen will be shown again.

The status window give up to date information on battery state, CPU temperature and network address.

If the battery is below 25% it is recommended to charge as soon as possible. In the unlikely event the CPU temperature runs above 176°F (80°C) it is recommended switch off as soon as possible to allow the MM2 to cool down.

Click the Back button to return to the live data screen.

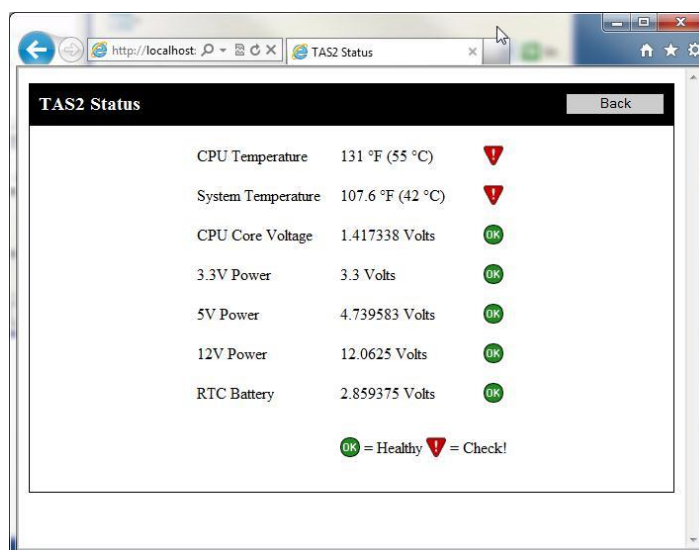


Figure 9. Remote monitor status screen

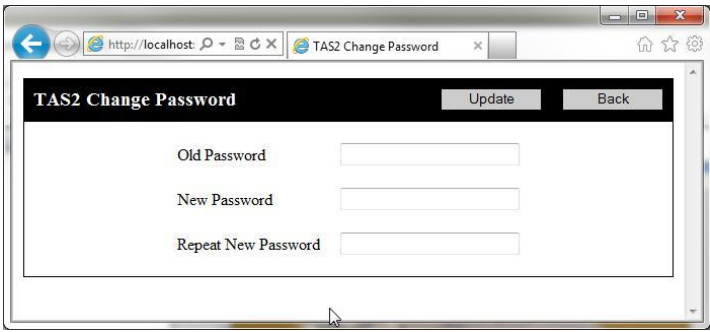


Figure 10. Remote monitor change password screen

The admin password can be changed, enter your current password followed by a new password. Repeat the new password again then click the Update button to make the changes.

The new password will be applied next time the user remotely logs in.

Click the Back button to return to the live data screen.

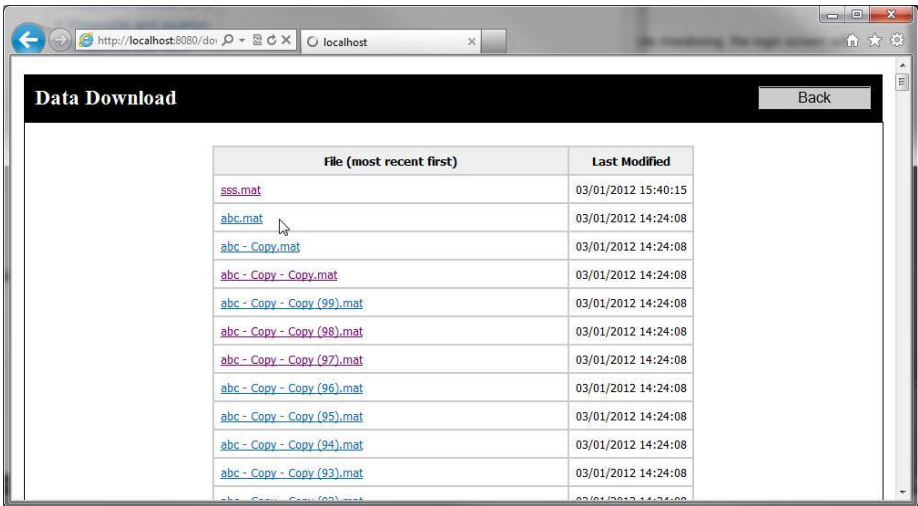


Figure 11. Remote monitor data download

Data can be downloaded if required by clicking the Download Data button on the top of the screen. Click the file name click Save, choose a location to save the file to.

Troubleshooting ip connections:

Problem	Possible Cause
I can't connect remotely to the MM2 system	<p>Ensure the network cable or USB Wi-Fi / Modem is connected and that the MM2 is connected to the network / internet.</p> <p>Ensure your remote computer is connected to the network / internet.</p> <p>Ensure that TCP port 8080 is open on your network firewall and that your internet service provider is not blocking this port.</p> <p>If using Dynamic DNS check with your service provider.</p> <p>Ensure the IP address is visible to the public network.</p>

MM2 Technical Specifications

Features

- Portable – for rapid deployment, or permanent installation
- Multi-channel seismic inputs (6, 9 or 12 channels)
- Unique proprietary intellectual property “Sees through background noise”
- Extreme dynamic range up to 130dB
- Stable embedded platform using Microsoft Windows™ operating system
- Built in 12 inch backlit TFT monitor with touch screen technology
- Powerful user interface software makes the MM2 effortless to use
- Multiple sensor heads cover a wide area up to 1 Mile
- Full remote monitoring via wired or Wi-Fi* network connection
- Tough and rugged design. IP67 (with lid closed)
- Designed and manufactured in the UK

* Requires a USB Wi-Fi adaptor or Wi-Fi bridge when using on Wireless networks.

Available Models

MM2/6S	MM2 base unit with 6 monitoring channels
MM2/9S	MM2 base unit with 9 monitoring channels
MM2/12S	MM2 base unit with 12 monitoring channels

Portable systems are supplied with intelligent charger battery pack and battery pack interconnecting cable.
Fixed systems will require a permanent power supply of 12V DC @ 2.5A and 24V DC @ 200mA.

Specifications (when used with TS1 family of sensors)

OS Platform	Microsoft™ Embedded Windows 10™
Display	12" diagonal, 16.8million colour TFT with touch screen XGA standard option for 800MCD for daylight operation.
Power Ports	1x 12V charge input, 1x 24V battery pack input
Sensor Ports	Channel 1 thru 6, *Channel 7 thru 9, *Channel 10 thru 12
External Ports	2x USB 1.1 and 1x CAT5e Ethernet
Dynamic Range	Up to 130dB
Power Supply	Internal 12V 7AH battery with 12V charging cable and external 24V battery pack with built in intelligent charger If powered externally 12V DC @ 2.5A and 24V DC @ 200mA
Dimensions	412 x 330 x 175mm
Weight	132lbs (60 kg) Full system with three sensors, cables / reels, Battery pack and accessories.

* Channels 7 thru 9 only available on the MM2/9S and MM2/12S models. Channels 9 thru 12 only available on the MM2/12S model.

TS1 Technical Specifications

Features

- Manual levelling with visual levelling guide
- Single-axis or Tri-axis sensor arrangement
- Multiple sensor heads cover a wide area up to 1 KM
- Tough, rugged IP67 design
- Designed and manufactured in the UK

Available Models

TS1/1	Sensor head with single sensor for vertical only axis monitoring
TS1/3	Sensor head with three sensors mounted Tri-axially Vertical (z), Longitudinal (x) and Transverse (y)

Specifications (when used with MM2 Micro-seismic Analytical Monitor) upto:

Activity	Surface Distance
Pre cursor rock stability	Up to 2 KM in perfect conditions
Pre cursor gas outburst	Up to 5 KM in perfect conditions
Dimensions	130mm x 120mm diameter mounted on a 180mm base plate
Weight	10lbs (4.6kg)
Detection Radius	1km Typical

Standard Cables (depending on configuration) additional lengths on request

CABLE REEL 3	cable reel 75 meters (10 pin male to male)
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Appendix A

The MM2 system is supplied in 1 of 2 configurations:

Multiple single channel sensors spaced equally along the area to be monitored to give advanced warning and lateral location.

Tri-axial sensors positioned either as rapid deployment or permanent mounted to give accurate location.

The TS1 sensors are supplied in 2 configurations:

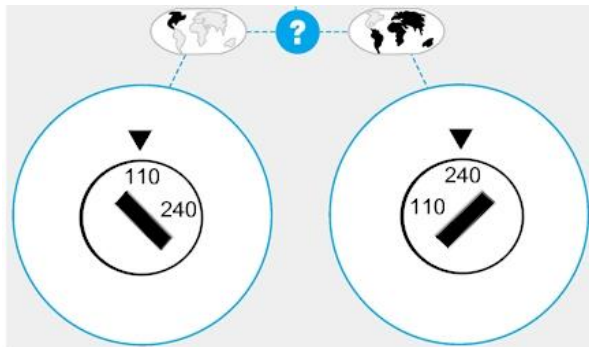
Single channel with 2 connectors suitable for “daisy-chaining” to reduce cabling requirements

Tri-axial (three) channels

Further information is available via our website www.surewavetechnology.com

Ensure that the 120/240 voltage selector switch on the battery pack is set to the correct voltage for your region.

If you change the switch position, make sure to unplug the battery pack first.



Warning: Applying 240 volts to a system set at 110 will damage the power supply.

The battery pack is designed to operate from 100 – 120 V AC 50 – 60 Hz or 220 – 240 V AC 50 – 60 Hz

Appendix B

Important Instructions for SP2 range of Products Dated July 2016 Rev 1.0

The SP2 range of products are very sensitive scientific instruments and as such require very stable, electrically quiet, power. This document discusses the typical power arrangements suitable for the system.

The basic power requirements are:

12V at 3 Amps peak, average power (display off) at 1A

24V at 0.3 to 0.5 Amps depending on seismic activity.

The 12V and 24v supplies must not be connected together at any point and must be floating with respect to mains earth and each other.

Batteries

The supplied internal batteries, 12V 2x 7AH, in the CPU unit will enable day time running of a few hours. It is strongly recommended that an external 12V battery is connected at all times. Suitable sizes for the external battery are 12V 85AH and higher.

Likewise the supplied 24V battery pack will run for a day or so and has 2 x 12V 7AH in series to make 24V at 7AH.

To recharge the 12V CPU batteries: Connect the external battery lead and connect to a suitable 12V battery charger with a maximum current of 8A. The in line fuse will blow if more than 8 amps is allowed.

To charge the 24V battery pack, simply connect the mains lead to suitable mains outlet ensuring the 110 / 220 V selectors is in the correct position. This will be set before shipping for the destination country.

Mains Power

This gives the greatest number of support calls to SureWave staff. The issue is that most if not all battery chargers are simply not suitable for a variety of reasons including:

Having one single charge cycle and then switching off allowing the batteries to discharge;

Over charging beyond 16V at which point the system will protect itself by switching off;

Having very electrically noisy outputs which prevents seismic event detection.

Suitable options for mains power:

- 1 Use a stable LINEAR bench Power supply capable of 12V at 3A and 24V at 1 Amp. Set the 12V output to 14.8V – this will also charge the internal battery when connected via the external battery lead. The 24V needs to be set between 26V and 28V using a suitable lead to the 24V connector on the CPU. The outputs MUST be isolated from each other – floating with respect to mains ground.
- 2 Use the optional SureWave SP2 Mains PSU. This is a linear very low noise power converter providing suitable 24V and 12V power to run the system permanently. In case of mains failure, the user should ensure that the power has a battery backup in parallel. The mains voltage selector must be set to 110 or 220V ac to match your mains supply voltage – Price on application.

Solar panels

Whilst Solar Power is ideal as a power source when used semi permanently on site, this must always be via a large battery to remove the electrical noise from the Solar Power converters (controller).

The panels need to charge suitable 12V and 24V batteries. These batteries should have the capacity to run the system without charge for at least two days to ensure permanent power in poor weather conditions.

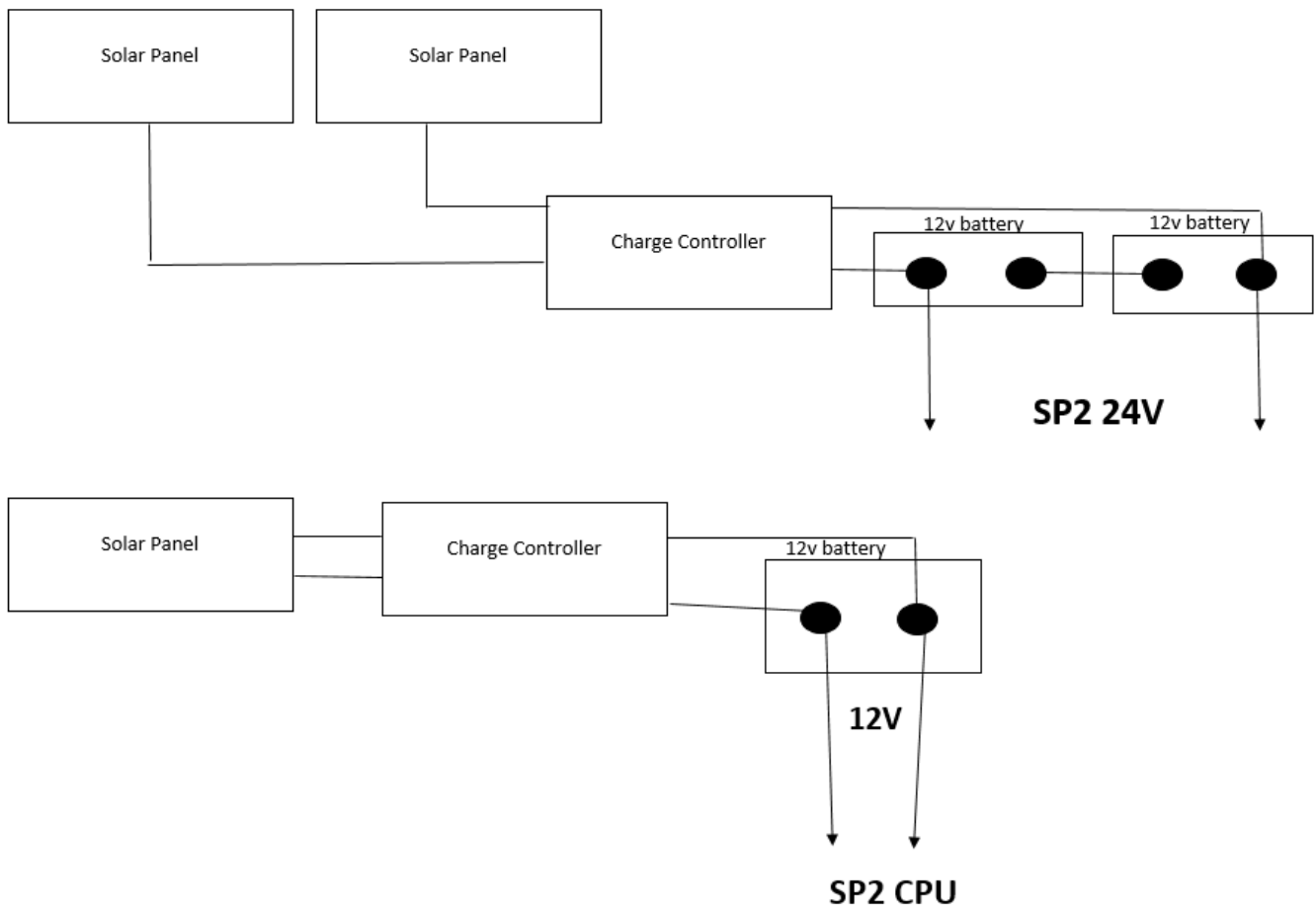
The 12V panel should be 100W. This should charge a 110aH Battery. We supply the cable from the battery to the SP2 system.

The 24V panels are made using 2 x 12V 30W panels and charge the supplied Battery Pack. We supply an open-ended Cable from your charger to the battery pack and the cable from the battery pack to the SP2 system.

The 24V is arranged from two 12V batteries and two separate panels in series.

The wiring overview MUST be as shown on the next page:

SP2 Solar Power Wiring



The SP2 must be wiring directly to the battery and not the charge controller as detailed above.

MM2 Setup and Configuration

ADDENDUM

PRECISE INSTRUCTIONS FOR RUNNING AND OPERATING MM2Tri WITH Sp2ServerLocal

SP2 Addendum includes server applications and remote data monitoring.

Housekeeping and directories:

SP2 programs **install** from a user directory (for example my documents). On the first run, they create a '**Working directory**' normally found here:

SP2 example:

C:\DOCUME~1\ADMINI~1\LOCALS~1\Temp\Administrator\mcrCache8.1\MM2Tri0\MM2Tri

Windows7 example:

C:\Users\PhilipShaw\AppData\Local\Temp\PhilipShaw\mcrCache8.1\Sp2Ser0\Sp2ServerLoc

Please note the limited disk space on the SP2 system. This is not designed to run any user software. Remove unused images / files not used and remove csv and .mat files to an archive regularly. If updating any of the SP2 programs, first remove the **working** directory for example:

C:\DOCUME~1\ADMINI~1\LOCALS~1\Temp\Administrator\mcrCache8.1\MM2Tri0. Before starting the update for the first time, copy any image / customoptionM.info files first, and then copy back to the **working** directory after the first run.

MM2Tri:

This application runs **ONLY** on the SP2 system. It should be copied to 'my documents' (or administers documents) by SureWave – the **install** directory.

Once run, the **working** directory will be created. This will contain the image to use, customoptionsM.info and additional files used by the system.

To run:

Double click or tap the icon 'MineMonitor'. You are presented with two options:

- 1 'Click to change map image, sensor positions or mm2tri configuration'

Use **ONLY** for 2d jpg images to geo reference the sensor positions and manipulate the image file as required.

Follow the on screen instructions as required. For all monitoring, add the sensor positions to the customoptionM.info file as required – see below.

- 2 'Click to launch mm2tri'

Select to start the application. Once the program starts, the version number will be shown, followed by a window with the image referred to in the customoptionsM.info file in the working directory.

During monitoring, the image will update automatically to show the event locations in real time. In addition, csv files will be created containing details for the server app, running on a Local PC system.

To stop:

Create '**appstop.txt**' in the **install** directory – this is for full remote management. Alternatively, close the image window (this may result in an error which can be ignored).

Changing the image:

Images are used by the system to display the location of events. Images can either be 2d (jpg images) or 3d (figures).

2d. These are simple jpg images obtained by the user. Google earth images can often be suitable.

Copy the image to the **working** directory. Change the customoptionM.info file to the same name.

CustomoptionM.info settings required for 2d are:

map/plan name: coordinated.jpg

plotmap: 1

3d. These are 3d 'cube' figures used to show the events in 3d. These must be made from a suitable file – for example dxf compatible drawing packages. The procedure is as follows:

Output from the CAD package a dxf.CSV file in the correct format (see bench.CSV for an example).

Use Readdxfall.exe (supplied on SP2) to convert this file to a 3d.fig

Copy this 3d.fig to the **working** directory.

CustomoptionM.info settings required for 3d are:

map/plan name: 3d.fig

plotmap: 2

If a mine plan is not available in 3d from a dxf file, use 'blank.fig' as the image name instead.

MM2 Setup and Configuration

Recommended test procedure after a new installation:

Once the system is fully setup and running, it is recommended you tap each sensor (with your finger only) in the three directions at one second intervals. Do this for each sensor head fitted. These results (the .mat files) should be kept to show SureWave if requested.

Change user settings:

Additional settings available to the user to change are as follows. DO NOT CHANGE the RED lines unless instructed by SureWave for special monitoring requirements:

```
Instructions 0=off, 1=on set 0 or 1      1
sensor distance: 50      Can be set to 1 to test the sensors or must be set to 50 for normal use. The display will show the Sensor nearest the stamp
trigger: 1      If=1, automatic, or >1 ignore small activity
map/plan name: coordinated.jpg      image name and type. .fig=3d, .jpg=2d
plotmap: 1      2d=1, 3d=2
ploton: 0
debugp: 0
do not change below here      no!
sensorpos: 1      sensor positions read from this file(1) 0 user input at runtime
Number of sensors: 3
SN001: 0
qtytosave: 210      number of raw events to save (FIFO)
autosave: 1      save events
readold: 0
speciala: 1
security: 0
pansswave: 0      1=p and s waves only 3d, 0= surface (2d) waves
sitespeed: 7
Channels: 9
Log Period: 24      new log file (csv) after this number of hours
hits: 1
2,0,0,0,2,3,1,5,6,4,8,9,7      sensor orientation first 4 fields ONLY
294,538,0,334,335,0,411,189,0,4,4,4,5,5,5,6,6,6,7,7,7,8,8,8,9,9,9,10,10,10,11,11,11,12,12,12 **
end:      end
** sensor positions. 1x,1y,1z,2x,2y,2z,3x,3y,3z,4,4,4,5,5,5,6 etc
Do not change this file unless you fully understand and have read the instructions above. If in doubt, contact support for advice.
Modify this file in notepad only and do NOT change / delete / add tab spacing. Always make a copy of a working file first!
```

Sp2ServerLocal:

This application runs ONLY on a PC – do not run on the SP2 system.

Note the image must be the same used on the SP2 system and therefore copy the customoptionM.info and image files to the **working** dir.

Before running for the first time, set the correct directories in the file 'ServerITFile.info as follows:

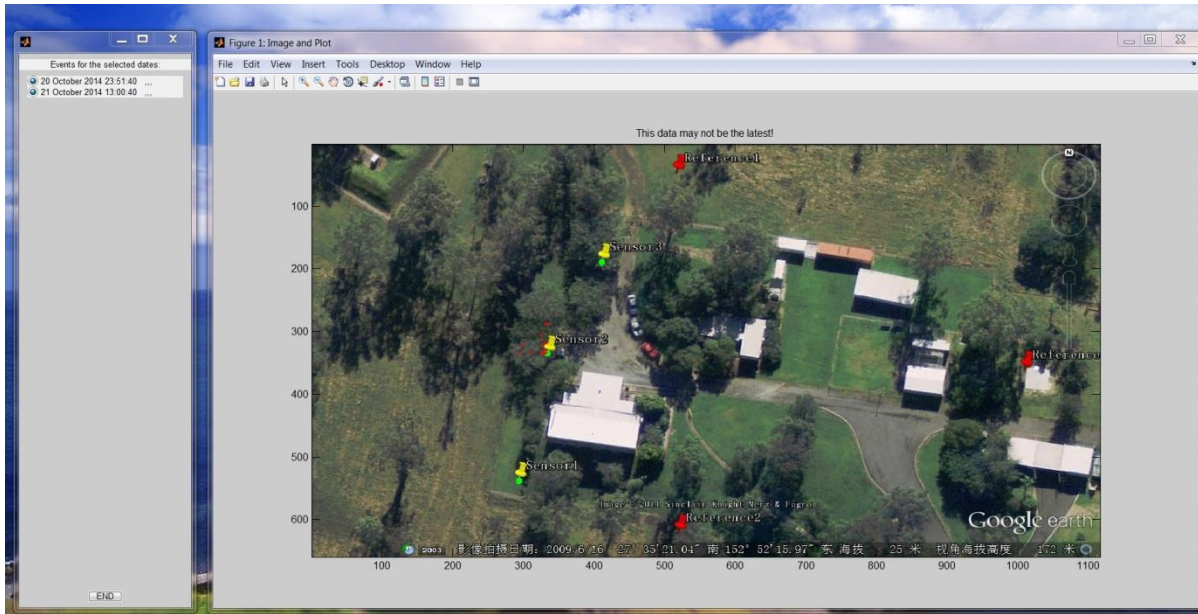
```
Instructions 0=off, 1=on set 0 or 1 1
Path: c:\Users\PhilipShaw\Documents\remote\ Path to live SP2 *see below
Email: 1
SMS: 0
Email Address: yyyygooglemail.com
Password: xxxx
Recipient: andrea@surewavetechnology.com
Email Message: Alert!
Email Subject: SP2 Alert!
end: end
```

*If this is a path to a live SP2 system, make sure it works and is live. Data will be automatically found in real time and moved to the local **install** dir.
If not a path to a live SP2, this is a local dir where you put the data. It MUST be a different directory to the **install** directory.

MM2 Setup and Configuration

To run:

Double click the Sp2ServerLocal icon or the .exe file directly.



Any csv files in the install directory will be available and shown in the left panel.

To add data file when there is no live ip connection to the remote systems:

If the Path specified in the ServerITFile.info is correctly pointing to a live SP2 system, data will be found and added automatically. Alternatively, for systems not connected to the server, copy (and delete from the SP2) the csv file and paste into the Path dir specified above on the local PC. When the file has been added, create a blank file 'dateready.txt'. The system will automatically list the new data and move to the **install** dir. The file 'dateready.txt' will be deleted by the application.

Click the radio button next to the date file name to select / deselect the files for viewing.

The MM2Tri application will make a csv file containing the following information depending on the settings in the customoptionsM.info file:

Pandswaves=0 setting:

site.jpg SensorB SensorB Y=345
X=373

Date Time	Category	X	Y	Z	Aazem	Aelem	Bazem	Belem	Cazem	Celem	AMag	BMag	CMag
30-Oct-2014 09:39:15	Unknown	2.98E+02	3.44E+02	0	-4.88E-01	2.78E-02	7.50E-03	8.25E-02	4.70E-01	2.87E-02	4.11E+05	4.86E+05	9.63E+05
30-Oct-2014 09:39:22	Unknown	2.98E+02	3.42E+02	0	-1.39E+00	3.74E-03	4.28E-02	3.20E-02	7.40E-04	3.47E-02	4.18E+05	2.76E+05	7.37E+05

Pandswave=1 setting:

SensorB X=334 SensorB Y=335 SensorB Z=0

Date/Time	loc_x	loc_y	loc_z	seismic_moment	magnitude	sourceradius	stressdrop	slip
31/10/2014 14:09	3.50E+02	5.24E+02	-2.58E+01	3.39E+12	2.35E+00	6.15E+01	6.38E+06	3.61E-02

Note that only true P and S wave events will generate the extra source mechanic parrameters.

MM2 Setup and Configuration

Dual Use (set up for two different types of monitoring):

Version 1.13 onwards allows Dual function monitoring by a second setting under the following parameters: Trigger, Hits, pandswaves and dist. To use this option, set the SplitUse value to 1 or 0 if not required. The second function locations are plotted in Blue on the image.

Here is an example CostomptionsM.info file with the second use values in RED

```
Instructions 0=off, 1=on set 0 or 1 1
sensor distance: 50 20
trigger: 1 1
map/plan name: SecondMT.jpg
splitUse 1
plotmap: 1
ploton: 0
debugp: 0
do not change below here no!
sensorpos: 1
Number of sensors: 2
SN001: 0
qtytosave: 210
autosave: 1
readold: 0
speciala: 1
security: 0
pansswave: 1 0
sitespeed: 7
Channels: 6
Log Period: 24
hits: 1 2
2,0,0,0,2,3,1,5,6,4,8,9,7
294,538,0,334,335,0,411,189,0,4,4,4,5,5,5,6,6,6,7,7,7,8,8,8,9,9,9,10,10,10,11,11,11,12,
12,12
end: end
```

MM2 Setup and Configuration

Trouble shooting:

1 Image not correct on SP2

Make sure the customoptionM.info file in the **working** dir has the same file name and plotmap is 1 (2d jpg) or 2 (3d fig).

2 Image not correct on the server

Make sure the same image is used as on SP2. Check the image is in the server **working** dir.

3 Locations not showing on the server when new csv files added to the **Path** dir.

Check that the sensor locations are correct for the image x and y scales used. These can be any scale and do not have to include a zero in the scale.

4 Applications not standard mine / slope monitoring or surface stamps to test, do not appear to work correctly.

The system can be used for several other types of seismic monitoring but may need special configuration or in extreme cases, custom changes. Contact your support channel for expert guidance on this. Do not attempt the make changes yourself.

5 Surface testing does not appear to locate correctly.

The system is a strata stress Micro seismic monitoring system. P and S waves are used to accurately locate the event source. A surface wave 'test' setup can be used for simple tests with limited accuracy for the event location. In the customoptionM.info file:
Set the pandswave field to 0;
Use a 2d jpg file with plotmap=1;
Arrange the sensors such that sensor A and B **both** pick up the events.

6 SP2 stops working unexpectedly:

- a. Flat battery – charge the system and ensure a permanent supply from an external battery 12V. Check the fuse in the external lead. Replace only with a 6.3A 20mm fast blow fuse.
- b. The system **MUST** be connected to an external 12V battery NOT a generator or similar. Solar panels are ideal to provide permanent power, however, connect the solar panels to a battery and SP2 to the battery **not the load terminals** of the charge controller.
- c. The system will create 'events' if the 24V battery pack is on charge from a mains supply. Only use with an external battery (2x12V=24V) and solar panels as above.
- d. The system has run out of disc space. Ensure csv files are removed to the server or USB achieve. Do NOT put user applications on SP2 unless SureWave approve.
- e. Any other unexpected system errors should be noted (try and get a screen dump – alt print screen and paste into a word document or paint image using a USB device to copy of the system) and send details to: philip@surewavetechnology.co.uk
- f. Check the sensors are correctly seated on solid material and covered as described on page 4 otherwise wind noise will prevent operation.
- g. Ensure all connectors are fully connected and have 'clicked' into place without dust or other material preventing a full connection.
- h. Ensure the sensors have not been damaged due to dropping or sharp knocks.
- i. Contact SureWave support (philip@surewavetechnology.co.uk) for support.

7 Locations do not match the known mine locations

- a. Make sure the sensor positions are correct. The sensors must be arranged as A on the left, B on the right and C further to the right. 'L' should point from the sensor line towards the area to be monitored. \if this is not possible / 360 coverage is required, the sensor fields may need additional info including the angle each sensor is in (L to the Y axis). Try and get the L lined up with the \Y axis to avoid this.
- b. The trigger value is incorrect. Unless set to '1' (Automatic), make sure the value is not set so low its constantly being exceeded by background man made events.
- c. Report any other issues to SureWave asap.

MM2 Setup and Configuration

SOFTWARE RELEASE HISTORY: MM2Tri.exe

version	Date	Details
1.08	May 2014	Release version for Australia
1.09	22 nd October 2014	Allow local data without live connection to remote SP2, Allow surface wave tests (limited on location accuracy)
1.10	27 th November 14	Provide a clean shutdown window
1.11	29 th November 14	Provide sensor test (set Sensor Distance=1)
1.12	9 th January 2015	Improved Low Frequency drift under extreme temperatures
1.13	28 th March 2015	Dual Function added.
1.14	29 th April 2015	Welcome Box includes channel and sensor info
1.15	10 th November 2015	Improvements to general use
1.16	17 th January 2016	Improvements to general use
1.17	13 th February 2016	Sensor position for alternate mode improvements, event saved to sub directory of date/time.
1.18	5 th July 2016	Replay of events improved - LATEST VERSION
1.19	01.11.2016	Tidy up csv file format
1.20	08.12.2016	"
1.21	15.12.2016	Read site speed from info file, save figure
1.22	10.01.2017	Allow save once, limit distance
1.23	12.01.2017	60Hz and low cutoff added security=1
1.24	14.03.20	12 channel, major changes to P&S auto pick
1.25	25.06.2017	Release version 2020

SOFTWARE RELEASE HISTORY: Sp2ServerLocal.exe

version	Date	Details
1.01	May 2014	Release version for Australia
1.02	21 nd October 2014	Allow local data without live connection to remote SP2, Allow surface wave tests (limited on location accuracy)

MM2 MANUAL VERSION HISTORY:

version	Date	Details
1.5	17.08.16	Latest version
1.6	02.01.20	2020 version includes solar and power details.

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