



# MiST – Multi Sensor Test Unit Reference Manual

Software Version 0.8.4



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# 1 Copyright and Disclaimer

## Copyright

This manual is the original manual for the MiST - Multi-Sensor Test Unit.

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## Operating manual disclaimer

Please refer to the Terms of Sale before use of this product. This can be found at [www.paragraf.com](http://www.paragraf.com)

This user manual provided is for general guidance only and does not expand or otherwise alter Paragraf's warranties as set out in Terms of Sale, and no additional obligations or liabilities arise from Paragraf providing this user manual.

# 2 Revision History

REVISION NUMBER	DATE OF FIRST RELEASE	DETAILS
V 1.0	24/05/2024	Initial version
V 1.1	30/05/2024	Minor updates to formatting and instructions on power supply
V 1.2	30/05/2024	Minor update to formatting
V 1.3	20/11/2024 00:00:00	Minor update to add model number to product information table and update peripheral part numbers

### 3 This Manual

The user must read this manual before using the equipment. All applicable Health and Safety regulations and requirements must be complied with during operation of the equipment to ensure the continued safety of the user and the product. The equipment instructions must be read carefully, and the safety instructions must be carried out.

This manual gives instructions for installation, use and care of the product and is intended for people installing, operating, and servicing the product.

Text mark-ups throughout this manual indicate the following:



- **Bold** = Important information
- *Italics* = References to chapters/sections and menu items.
- Underlined = Instruction: something needs to be done. Read this manual before operating the equipment.



- Carry out the instructions in this manual.
- Ensure that this manual is available to all persons using and maintaining the product.
- Ensure that this manual is available for reference at all times during the service life of the product.
- This manual gives instructions for installation, operation and maintenance of the equipment. These operations must be carried out by trained and competent personnel only. **Please contact Paragraf Ltd at [www.paragraf.com](http://www.paragraf.com) for information about training.**
- Connection of the electrical supply and associated testing must comply with local regulations in the country of operation.
- Service and repair must only be carried out by Paragraf Ltd.
- Paragraf Ltd cannot be held liable for any damage or disturbance of operations caused by non-compliance with the instructions given in this manual.

The proper function of the product is subject to the following requirements having been met:

- The maintenance instructions specified in this manual are carried out and the MiST is maintained in good condition by the user. Any maintenance issues must be reported to Paragraf Ltd.
- The accessories match the specifications stipulated by the manufacturer.
- Replacement parts are approved by Paragraf Ltd.
- The product has not been altered.

## 4 Glossary of Terms

TERM	DEFINITION
MiST	Multi-Sensor Test Unit
GHS	Graphene Hall effect Sensor
SCMT	Spinning Current Modulation Technique
TCP/IP	Transmission Control Protocol / Internet Protocol
GUI	Graphical User Interface
PSU	Power Supply Unit
RNDIS	Remote Network Driver Interface Specification
CDC-ECM	Communications Device Class – Ethernet Control Model
ADC	Analogue-to-Digital Converter
DAC	Digital-to-Analogue Converter
IO	Input / Output
CSV	Comma-Separated Values

## 5 Product Information

Product information:

PRODUCT NAME	MODEL NUMBER	VERSION NUMBER
Multi Sensor Test Unit (MiST)	EGHKA02XXX	V4.0

## 6 Intended Use

The MiST is a data acquisition tool intended to be used to evaluate Paragraf's GHS probes which are used to measure magnetic fields. Paragraf Ltd does not permit modification to the GHS probes or to the MiST itself. The equipment is intended to be operated in a dry, clean, ambient temperature working environment.

### WARNING

#### WARNING: RISK OF INJURY TO USER.



- Do not operate outside the specified operating conditions.
- Any use outside the intended applications is not permitted.
- Any use not specified in the manual requires approval by Paragraf Ltd.
- Paragraf Ltd takes no responsibility for damage caused by incorrect use of the equipment.
- Do not use the equipment if it is damaged. If you suspect any fault that cannot be rectified, contact Paragraf Ltd.
- Avoid direct sun radiation and rapid temperature changes to the MiST as this can affect measurements.
- It is recommended that the equipment is used and maintained under adequate room illumination.

### 6.1 Reasonably Foreseeable Misuse

The equipment is not designed for any of the following environments:

- Used in non-industrial or use in non-research environments.
- Used outdoors.
- Used in wet conditions.
- Used in explosive or combustible atmospheres.

### 6.2 Competent Personnel

- The equipment must only be operated by trained and competent personnel.
- Additional risk assessments which are the responsibility of the end user may also form part of the training.

## 7 Specification

EQUIPMENT/USE	PARAMETER	MIN	MAX	TYPICAL	UNITS
<b>Mains Power Supply Unit</b>					
<b>Power Supply</b>					
<b>Input</b>	Input Voltage	90	264	100-240VAC +/-10%	V AC
	Input Frequency	47	63	50-60	Hz
	Input Current			0.8	A
<b>Output</b>	Output Voltage			12	V DC
	Output Current			3.34	A
	Output Power			40	W
<b>Multi-Sensor Test Unit (MiST)</b>					
<b>Voltage Supply</b>					
<b>Input</b>	Voltage	12	12		V DC
	Current		3.34		A
<b>GHS Inputs</b>					
	Common-mode Voltage	-15	+15		VDC+ACpk
	Full-scale Voltage	-15	+15		VDC+ACpk
<b>Bandwidth</b>	Max ADC Sample Rate		200		kHz
<b>Temperature Inputs</b>					
	Voltage	0	+5		V
<b>Power On</b>					
	Power on			10	s
	Warm up Time	0.5	1	0.45	h
<b>Environmental</b>					
	Storage Temperature	-20	+60		°C
	Operating Temperature	0	+35		°C
	Storage Humidity (Relative Humidity non-condensing)	5	95		%RH
	Operating Humidity (Relative Humidity non-condensing)	10	70		%RH
	Altitude		2000		m
<b>Mechanical</b>					
	Height			84	mm
	Width			195	mm
	Depth			295	mm
	Weight		2		Kg
<b>Electrical Protection</b>	Class		3		

## 8 General Description

The MiST (Multi-Sensor Test Unit) provides a self-contained, turn-key solution for easy configuration and operation of multiple Graphene Hall effect Sensors (GHS) which are used for a wide range of industrial applications for measuring magnetic fields.

The MiST is a compact, remotely controlled unit that powers and acquires data from up to four GHS probes, each providing connection to a GHS.

A computer running Microsoft Windows 10 or above is required to run the MiST software application. This software allows the user to set up and configure the MiST and connected GHS probes, ensuring magnetic field measurements are the best achievable with your GHS probe.

The MiST can:

- Drive current between any two pins of the Hall Sensor.
- Measure voltage between any two pins of the Hall Sensor.

This can be done while simultaneously performing parallel data acquisition for up to four probes.

## 9 What's Included

Your MiST is supplied with the following items:

ITEM	QUANTITY
MiST Multi-Sensor Test Unit	1
Universal Mains Power Supply Unit	1
2m Cat5e Ethernet Lead	1
IEC C13 UK Lead	1
IEC C13 EUR Lead	1
IEC C13 US Lead	1

## 9.1 Accessories and Peripherals

Your MiST may be used with any of the following GHS items:

ITEM	ORDER CODE		
	Probe (3m cable, 20cm probe length)*	PCB only (200 mm)	Sensor only
General Purpose Graphene Hall Sensor 3mm QFN	EGHKM01P05		EGHSM01Q02
Cryogenic mK High Magnetic Field Graphene Hall Sensor 3mm Ceramic QFN		EGHKX01P05	EGHSX01Q02
Cryogenic 4K Mid Magnetic Field Graphene Hall Sensor 3mm Ceramic QFN		EGHKX02P05	EGHSX02Q02
Cryogenic mK Low Magnetic Field Graphene Hall Sensor 3mm Ceramic QFN		EGHKX03P05	EGHSX03Q02

\* specification for the probe is shown below:

EGHKM01P01				
Connection	9 Way Sub D Male Connector			
Cable	Length	2900	2900	mm
GHS Sensor	Height		1.23	mm
	Width		3	mm
	Depth		3	mm
Tolerance			+/-0.13	mm
Flexi PCB	Length		140	mm
	Width		5	mm
	Depth		0.4	mm
Assembly length	Length		3050	mm
Tolerance			+/-5	%

For more information on how to order accessories for use with your MiST, please visit [www.paragraf.com](http://www.paragraf.com).

## 10 Safety Information

Read this safety information before attempting to install or use this product, to prevent electric shock, fire, injury, or damage to the user or product. Follow best safety practices and procedures for working with and near electricity.

This product left the factory in a safe working condition.

### 10.1 Safety Descriptions

Various symbols are used in this manual to identify residual risks of different hazard levels. The symbols help the user detect and memorise risks more efficiently.

#### 10.1.1 Safety Meanings

SIGNAL WORD	MEANING
 <b>CAUTION</b>	Signal word used to indicate a potentially hazardous situation which, if not avoided, could result in minor or moderate injury
 <b>WARNING</b>	Signal word used to indicate a potentially hazardous situation which, if not avoided, could result in death or serious injury
 <b>DANGER</b>	Signal word used to indicate an imminently hazardous situation which, if not avoided, will result in death or serious injury

#### 10.1.2 Prohibition, Mandatory Action, and Warning Symbols

GEOMETRIC SHAPE	MEANING	SAFETY COLOUR	CONTRAST COLOUR TO THE SAFETY COLOUR
 Circle with diagonal bar	Prohibition	Red	White
 Circle	Mandatory Action	Blue	White
 Equilateral triangle with radiused outer corners	Warning	Yellow	Black

## 10.2 Safety Symbols

### 10.2.1 Warning Symbols

HAZARD SYMBOL	MEANING	HAZARD SYMBOL	MEANING
	<b>Generic warning</b> Obey the safety instructions		<b>Electric shock</b> Obey the safety instructions Do not touch
	<b>Hot surface</b> Obey the safety instructions Do not touch		<b>Strong magnetic field</b> May affect pacemakers or ICDs

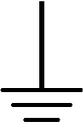
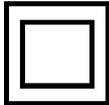
### 10.2.2 Mandatory Action Symbols

HAZARD SYMBOL	MEANING	HAZARD SYMBOL	MEANING
	Read the manual		Instructions on how to achieve optimal safety and functionality

### 10.2.3 Prohibition Symbols

SYMBOL	MEANING
	No access to persons with a cardiac device

### 10.2.4 Electrical Symbols

SYMBOL	MEANING	SYMBOL	MEANING
	Direct current		Alternating current
	Earth (ground) terminal This terminal is NOT a safety or protective earth.		Equipment protected throughout by double insulation or reinforced insulation

## 10.3 Safety Information



### WARNING

#### WARNING: RISK OF ELECTRIC SHOCK TO USER.



- Only use the supplied Mains Power Supply Unit with the MiST, ensure the IEC C13 lead has an earth connection. Otherwise damage may occur to Power Supply or MiST.
- Turn off mains supply before disconnecting the MiST.
- Inspect the equipment for damage before use, if there are signs of damage to the equipment stop using immediately.
- If you observe or experience any abnormal operation stop using the equipment immediately.
- Connections to the MiST requires that the connection device maintains the double/reinforced insulation from the mains/hazardous voltages to the MiST.



### CAUTION

#### CAUTION: STRONG MAGNETIC FIELDS.



- GHS Probes are for use with external equipment for evaluation purposes only via the MiST. The user should understand the application and evaluate for fitness for purpose.
- The user should further employ best practises to avoid unwanted electromagnetic fields that may degrade the performance of the MiST and GHS Probe.



### CAUTION



#### CAUTION: MAGNETIC FIELDS TO USERS.

- GHS Probes are for use to measure magnetic fields. If you have an Implantable Cardioverter Defibrillator (ICD) or pacemaker avoid close or prolonged contact with the magnets or their magnetic fields.



### CAUTION



#### CAUTION: RISK OF HOT SURFACE TO USER.

- Do not cover or stack the MiST as the surface of the enclosure may get hot during continuous operation.



### CAUTION



#### CAUTION: RISK OF INJURY TO USER.

- To prevent injury, do not use in or near explosive gases or vapor, or in wet or damp conditions.



### CAUTION

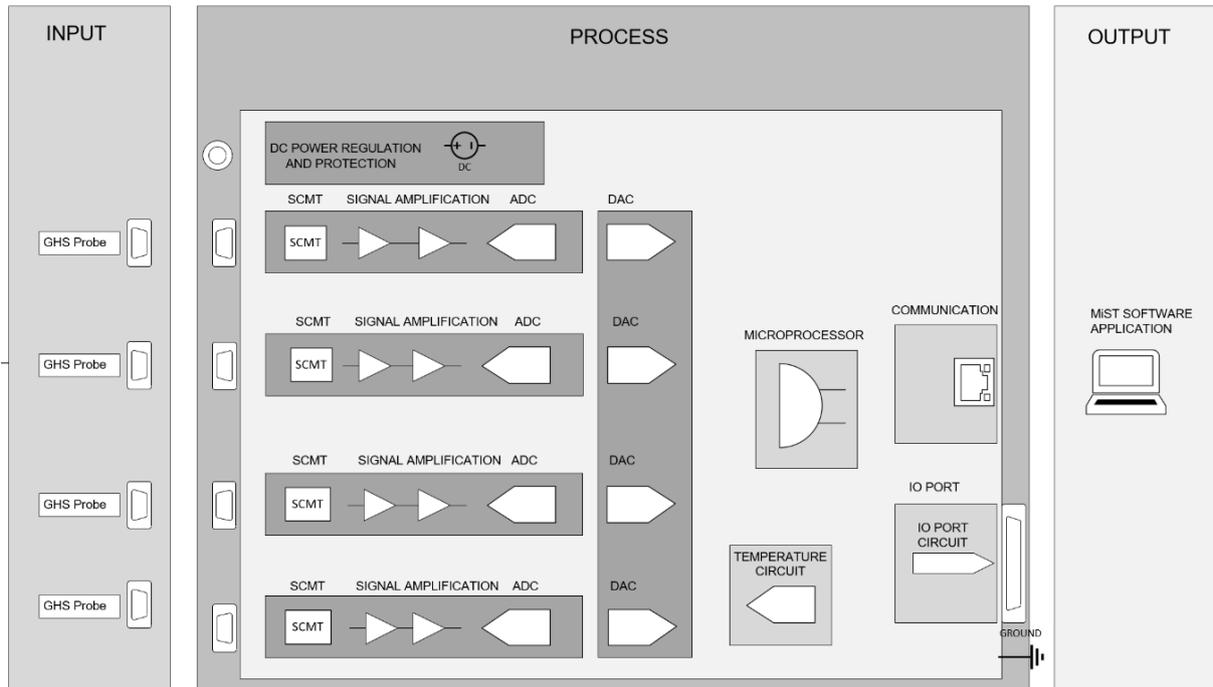


#### CAUTION: RISK OF DAMAGE TO EQUIPMENT.

To prevent damage to the product, always use and store in an appropriate environment as specified in this manual.

# 11 MiST Block Diagram

## Multi Sensor Test Unit



The MiST Multi-Sensor Test Unit is powered from a standard universal 90-240VAC to 12VDC regulated power supply (supplied).

The MiST provides four GHS probes connection ports which are used to provide the necessary power and measurement signals for the MiST to process the raw analogue data. The signals are acquired and passed through a SCMT circuit that suppresses the offset and low-frequency noise contributions from the GHS sensing element and its preamplifier which is dependent on the spinning frequency. It can also be used to suppress the parasitic signals, such as pick-up noise and thermal electromotive force contributed by the interconnects with the remote GHS probe head.

The signals are passed to the ADC after being amplified via a two-stage amplification and offset process and are then averaged before being transmitted to the MiST software application.

The measurement subsystem supports measuring the Hall effect voltage.

A host computer running the MiST application communicates with the MiST hardware via the TCP/IP protocol using a standard ethernet lead (supplied). The user can interrogate the MiST to display the GHS readings, set operating parameters to configure the GHS and log the resulting measurements to a binary file that may be subsequently exported as a CSV file.

Many facets of the MiST can be configured in the application. For details see the MiST Software Application section below.



There are different types of error correction for the MiST:

- Probe correction: sensitivity, linearity coefficients.
- MiST plus probe correction: offset and gain.

NOTE: The MiST carries out a self-check to a known resistance every time the measurement is started. This ensures that the MiST is checked even if the probe is disconnected and connected again.

An I/O port on the rear of the MiST provides an external +5 or +/-15 VDC for the user if required.

 **CAUTION**



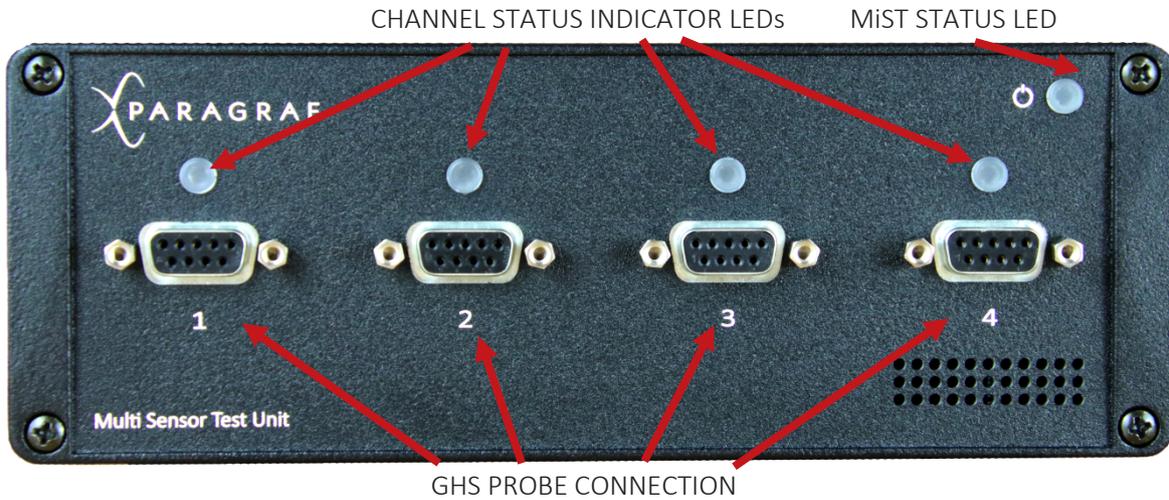
**CAUTION: MAGNETIC FIELDS TO USERS.**

Using the MiST within large magnetic fields could cause permanent damage to the MiST or cause interference to the measurement. Use the approved probe accessories locate the MiST away from the magnetic fields such that only the sensor probe end is exposed to the measured fields.

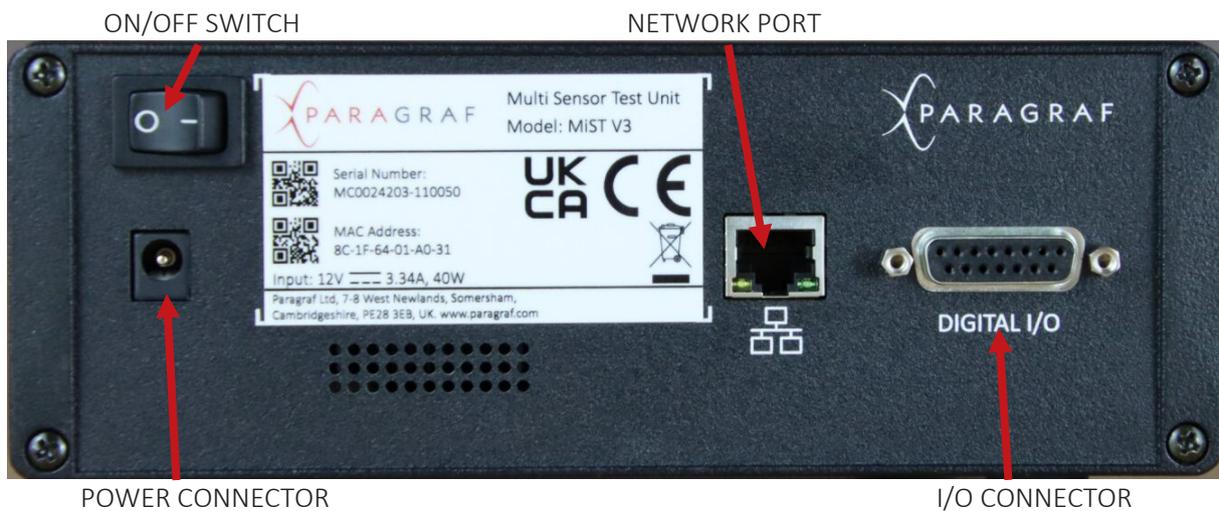
---

## 12 MiST Connections

### 12.1 Front Panel



### 12.2 Rear Panel



### 12.3 Grounding of MiST

Ensure the MiST Mains power supply is connected with the supplied IEC C13 Lead, Earthing of the MiST is via the power supply. Contact Paragraf if the IEC C13 lead isn't suitable for your country.

#### WARNING



#### WARNING: RISK OF ELECTRIC SHOCK TO USER.

Only use IEC C13 leads supplied, as these have an earth connection to the mains earth within the plug. The ground connections through the ethernet are for measurement purposes only.

## 12.4 Input/Output Port

The MiST provides 3 power supply rails for you to use with external equipment depending on your application. +/-15V power can be used to provide operational power supply rails to ensure external equipment is compatible with signal range of the MiST. +5V power can be used for digital power supply or low-power supply to external test equipment.

The I/O port voltages are deemed SELV (Safety Extra Low Voltage) which describes a voltage that is set so low that in the event of direct touch either during proper operation or in the event of a single fault there is no danger of electric shock due to touch current.

Connections to the I/O port requires that the connection device maintains the double/reinforced insulation from the mains/hazardous voltages to the MiST.

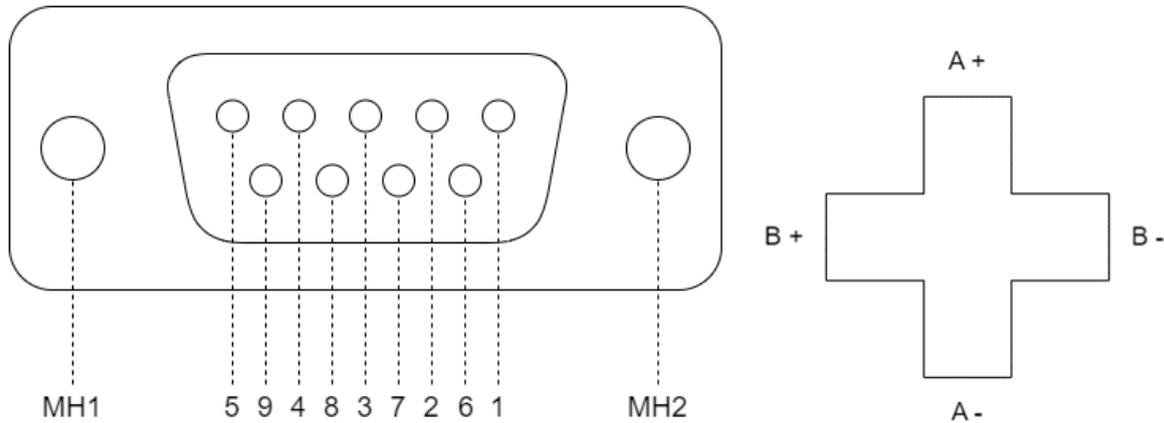
OUTPUT SUPPLY	MIN	MAX	UNITS
+/-15V Maximum Current		100	mA
+5V Maximum Current		200	mA

DIGITAL INPUTS/OUTPUTS	MIN	MAX	UNITS
Voltage	0	+5	VDC

PIN NUMBER 15W FEMALE D SUB	SIGNAL
1	Internal Use Only
2	Internal Use Only
3	Internal Use Only
4	Internal Use Only
5	Internal Use Only
6	Internal Use Only
7	Internal Use Only
8	Internal Use Only
9	-15VDC
10	+15VDC
11	+5VDC
12	+5VDC
13	0VDC
14	0VDC
15	0VDC

## 12.5 Probe Connection Ports

The MiST provides 4 probe connection ports labelled Channel 1 – 4 using standard 9 way sub D Female connectors. Below is the pinout connection diagram detailing the functions of each pin.



PIN DESIGNATOR	SIGNAL	DESCRIPTION
1	GHS A+	Hall Sensor Channel A+
2	GHS B+	Hall Sensor Channel B+
3	NC	Not Connected
4	Reserved	
5	Reserved	
6	GHS A-	Hall Sensor Channel A-
7	GHS B-	Hall Sensor Channel B-
8	Reserved	
9	Reserved	
MH1, MH2	Chassis GND	Chassis ground connection for connector

## 12.6 ESD Protection

The MiST inputs and outputs are designed to protect against electrostatic discharge.

### CAUTION

#### CAUTION: RISK OF ELECTROSTATIC HAZARD TO EQUIPMENT.

All external input and output connections on this product are ESD protected. However, excessive overvoltage during an ESD strike, can cause permanent damage to the product and connected equipment. Standard ESD precautions should be implemented and maintained when using this product.



## 13 Connection Setup of the MiST

### WARNING



#### **WARNING: RISK OF ELECTRIC SHOCK TO USER.**

Only use the supplied Mains Power Supply Unit and C13 lead with the MiST otherwise damage may occur to Power Supply or MiST, turn off mains supply before disconnecting the MiST.

---

### WARNING



#### **WARNING: RISK OF INJURY TO USER.**

Only use and connect Paragraf Ltd GHS probes to the MiST. Use of any alternative connectors or equipment may cause damage to the equipment or measurement errors and will invalidate the warranty.

---

### 13.1 Initial connection

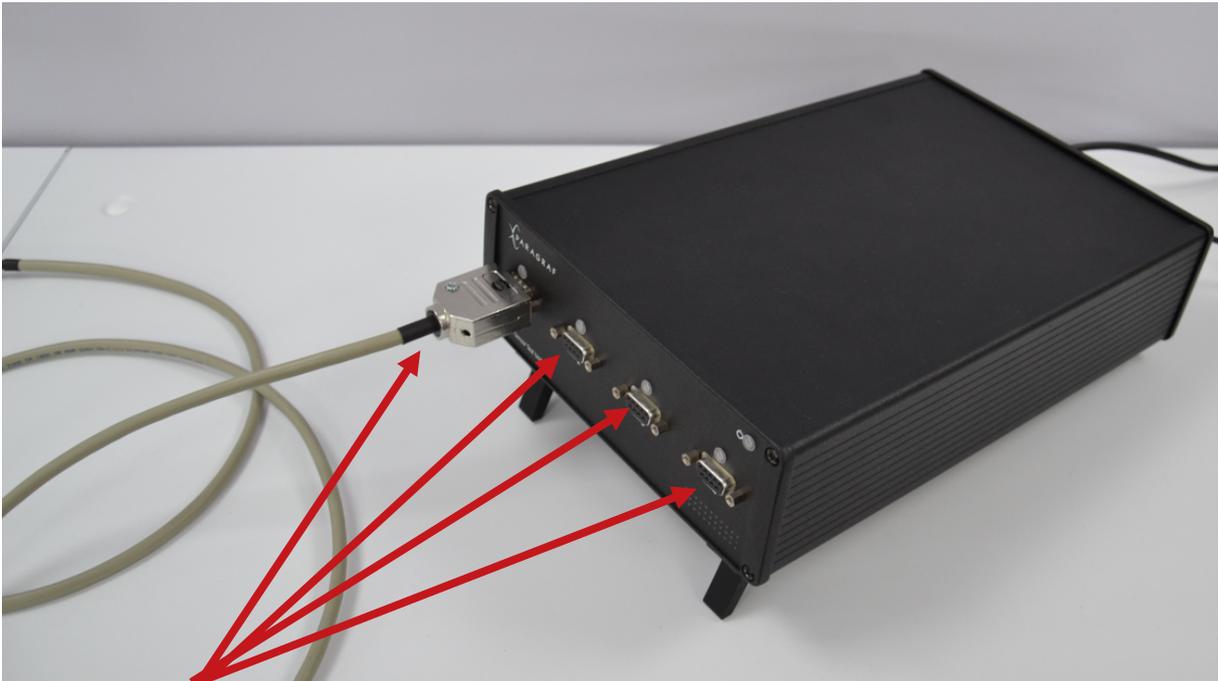
1. Ensure that the MiST is located on a stable surface and not covered.
2. Connect a GHS Probe to the input connector and ensure that the connector screws are tightened to stop the connector falling out of the socket.
3. Connect one end of the ethernet lead to the rear panel socket on the MiST, and the other to your computer.
4. Connect the mains power supply cord 2.1mm barrel connector to the MiST rear panel socket.
5. Connect the power supply adaptor to the mains power supply.
6. Press the power switch on the rear panel of the MiST.
7. Locate the GHS Probe tip in the measurement area.
8. Connect to the MiST using the MiST Controller Application. Details for installing and operating the software interface can be found in section 15 of this document.

### 13.2 Disconnection

1. To turn off the MiST, push the power switch on the rear panel to the off position.
2. To disconnect the power supply during normal operation, use the power switch on the rear panel of the MiST, and then disconnect the power supply adaptor from the mains. Then remove the power supply cord from the MiST.

In the case of an emergency or if, in the unlikely event that you suspect there is a fault with the product, disconnect the mains power supply from the power supply adaptor first.

### 13.3 Probe Connections



Probe

#### 13.3.1 Rear Connections



Power lead

Ethernet lead



### 13.3.2 Complete Setup



### 13.4 Channel Status Indicator

LED STATUS COLOUR		DESCRIPTION
OFF	○	MiST not powered, no ethernet connection, or channel disabled
Blue	●	Ethernet connection established; no data streaming
Green	●	Data is streaming and measurements are not saturated
Red	●	Data is streaming and measurements are saturated above the maximum voltage level

### 13.5 MiST Status Indicator

LED STATUS COLOUR		DESCRIPTION
OFF		MiST not powered
Blue Flashing	●	Awaiting ethernet connection
Blue	●	Ethernet connection established; no data streaming
Green	●	Data is streaming and measurements are not saturated
Red Flashing	●	Data is streaming and measurements are saturated above the maximum voltage level; or the data rate is too high for the number of enabled channels

## 14 Ethernet Connection

A PC may be connected to the MiST using a point-to-point Ethernet lead (provided), or a USB to Ethernet adaptor.

### 14.1 IP Network

Both types of Ethernet connection above are supported by the MiST, but the network must be IPv4 capable. The MiST must be on the same DHCP network as the PC or directly connected to it.

#### 14.1.1 DHCP-Enabled networks

If the PC and MiST are connected to an existing network which has a DHCP server, the MiST and PC will obtain a unique IP(v4) address from the server.

#### 14.1.2 Direct connections

When the MiST is directly connected to the PC, the DHCP connection sequence will time out after 15 seconds (because there is no DHCP server available), at which point the MiST will adopt a link-local (automatically assigned) IP address of the form:

169.254.x.x

with subnet mask 255.255.0.0.

#### 14.1.3 MiST Identity

Both the network address and MAC address of the MiST are shown in the software application to identify the MiST connected.

## 15 MiST Software Application

To ensure correct operation of your MiST, you must use a computer satisfying the following system requirements:

Operating System	Microsoft Windows 10 or higher, 64-bit
------------------	--

### 15.1 Obtaining the MiST Software Application

The MiST Software Application will be supplied by Paragraf Limited; please contact us at [productsupport@paragraf.com](mailto:productsupport@paragraf.com) for the latest version compatible with the firmware on your MiST.

### 15.2 Installation dependencies

The MiST Software Application depends on the following third-party (Microsoft) software:

1. .NET Framework 4.8
2. Visual C++ Redistributable package

.NET Framework 4.8 must be installed before the application can be installed.

The Visual C++ Redistributable package will be installed alongside the application if it is not already present.

### 15.3 Running the installer

1. Run the installer (**MiST Control App\_install\_x64\_0.8.4.exe**) supplied by Paragraf.
2. Follow the on-screen instructions to install the application.

For technical support, please contact Paragraf Limited at [productsupport@paragraf.com](mailto:productsupport@paragraf.com).

## 16 Using the MiST Software Application

These instructions are written for application version **0.8.4**. Later versions may look different.

**Note:** this version of the software will only work for a single MiST connection at any given time.

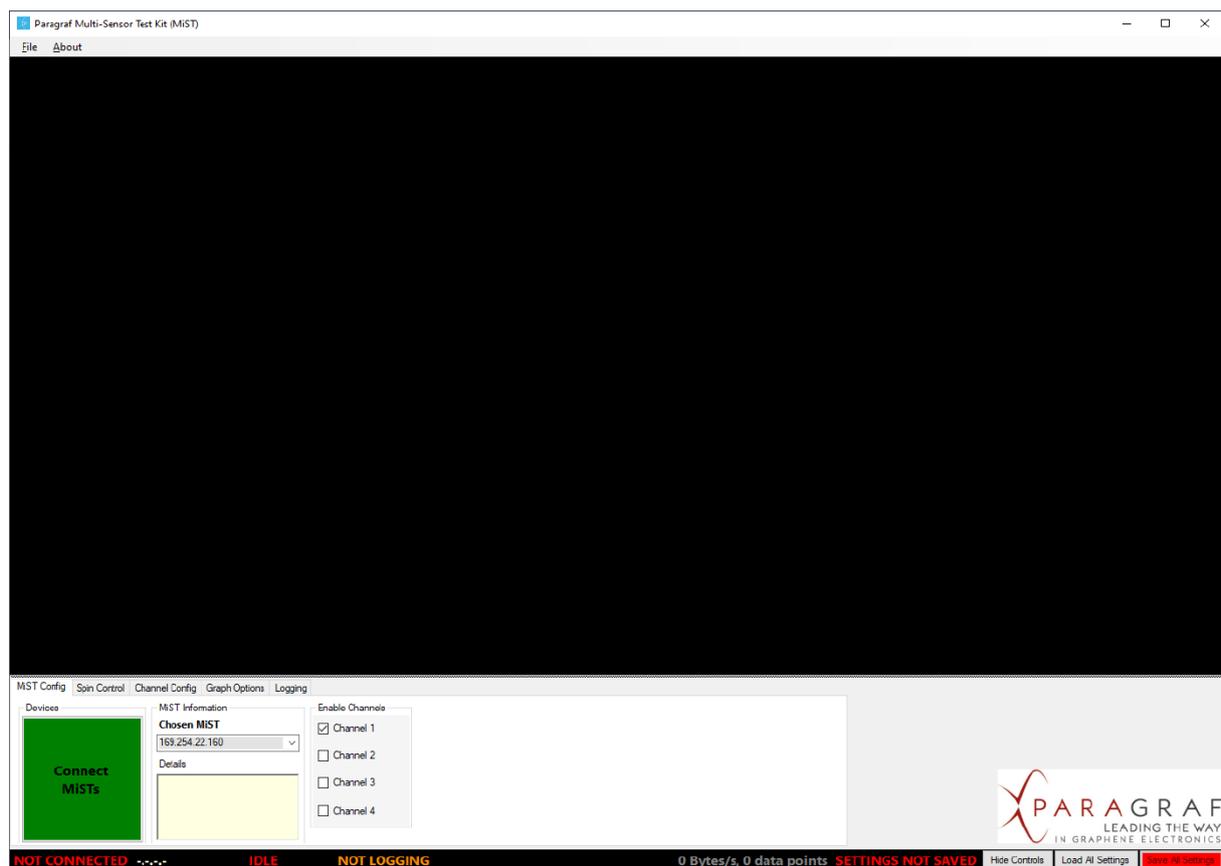
### 16.1 Recommended screen resolution

The MiST Software Application is best displayed at a resolution of 1920 x 1080 (or higher) and a scale of 100%.

### 16.2 Starting the software application

Run the MiST Software Application by clicking the newly added MiST icon on your Windows desktop. If this is not present, go to **C:\Program Files\Paragraf Limited** in Windows Explorer and double-click the file called **MiSTController.exe**.

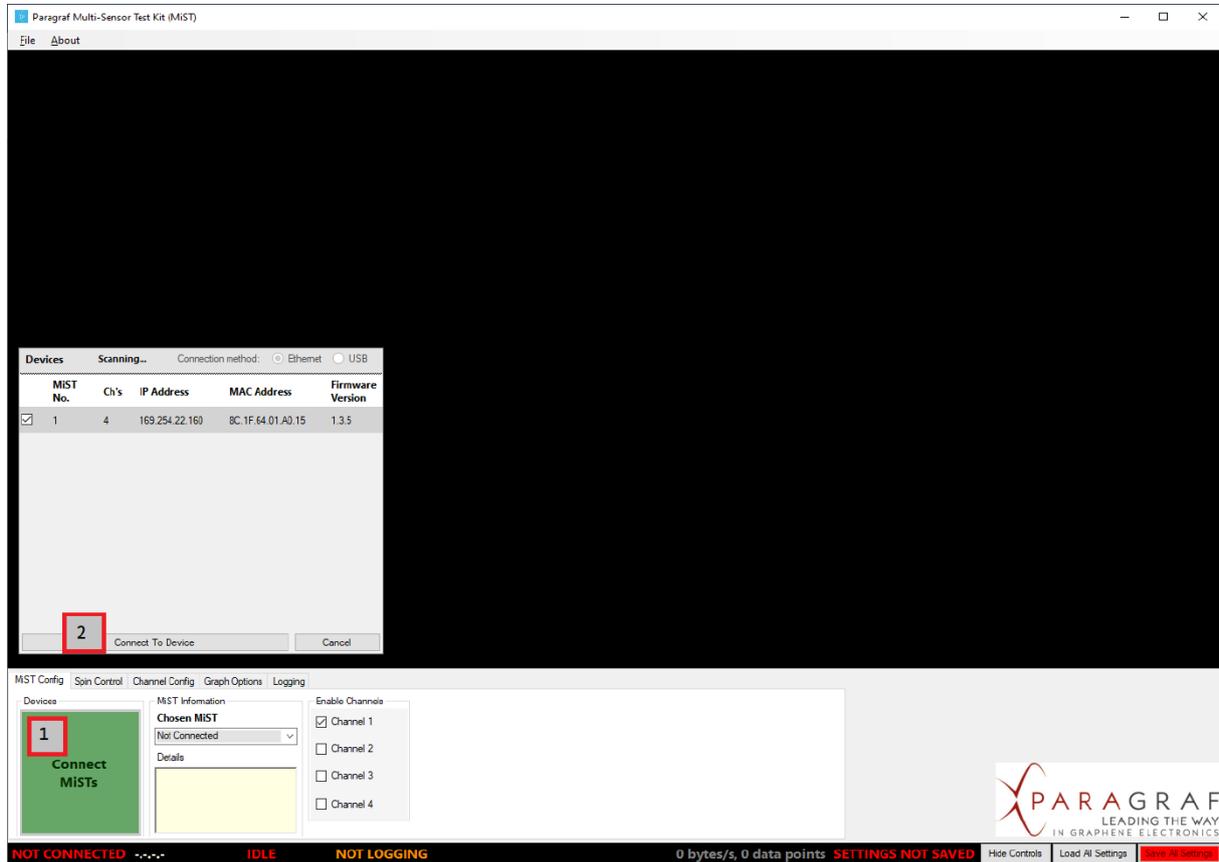
The screen below appears, along with a console window giving a detailed log of all actions the application carries out).



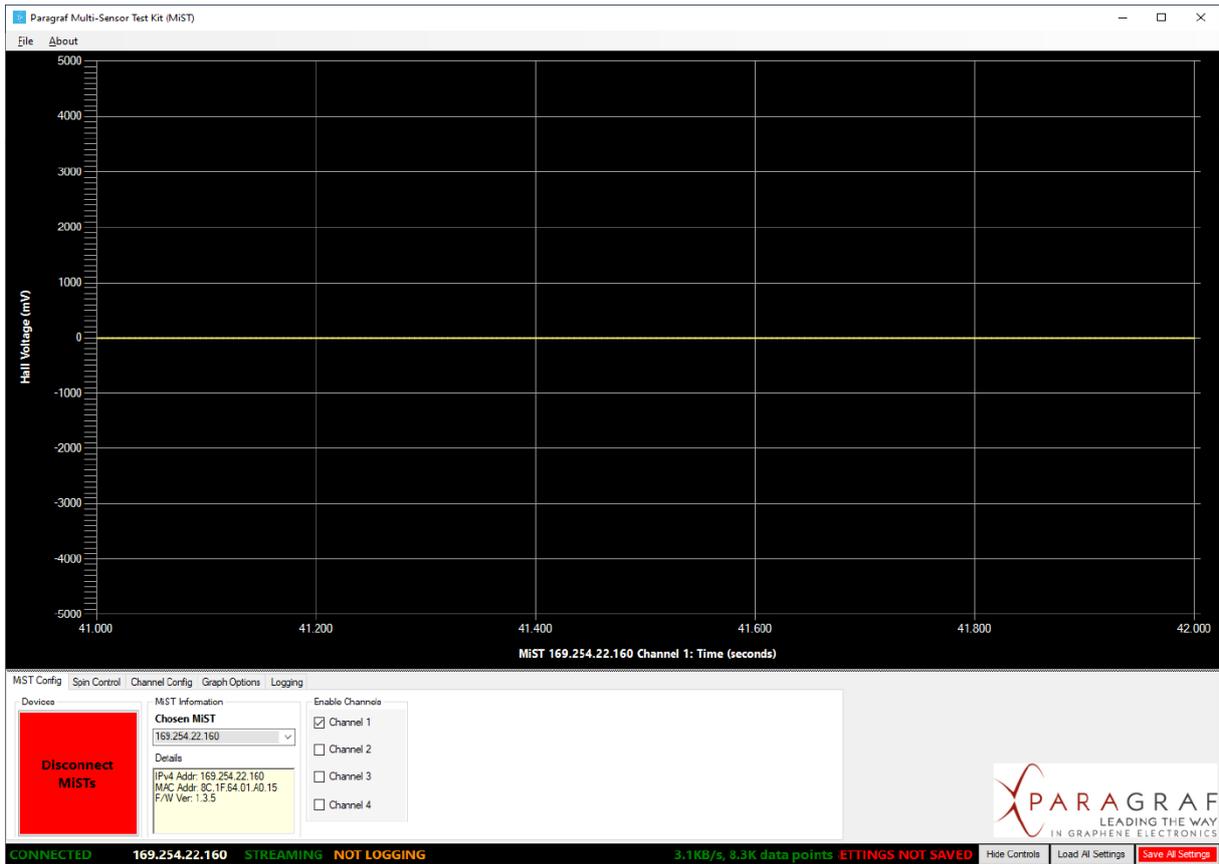
## 16.3 Connecting to the MiST

Turn the MiST unit on.

1. Once the status LED is solid blue, click the green box labelled “Connect MiSTs”.
2. If the MiST has been discovered, it will appear (selected) in the list of devices; click “Connect To Device”.



Once connected to the MiST, the application will look like this (notice the connection information now present):



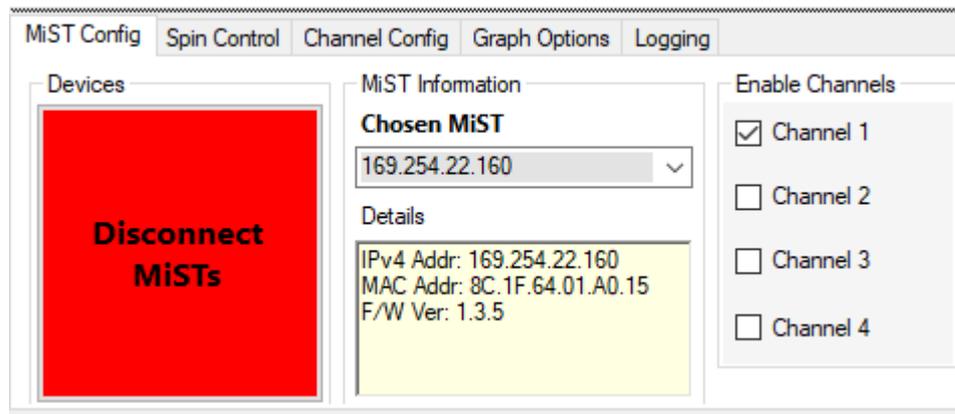
The console window will show low-level information useful for debugging purposes (and to report to Paragraf in the event of an error):

```

Discovery service stopped
Connecting to 169.254.22.160 len 14
New device number 0
Sending time-out value for all control messages set to 10 seconds.
Receiving time-out value for all control messages set to 10 seconds.
Control socket 676 connected
Channel 0 Data socket 1420 connected
Added data socket 1420 to listener
Channel 1 Data socket 1432 connected
Added data socket 1432 to listener
Channel 2 Data socket 1424 connected
Added data socket 1424 to listener
Channel 3 Data socket 1492 connected
Added data socket 1492 to listener
configRegisterCallback ...
Set device 0 callback function
DLL Listener Service thread running
configStartStreaming: sent {"start":"0"}
configStartStreaming: received {"result":"OK"}
configSetSpinning: sent {"spin":"on"}
configSetSpinning: received {"result":"OK"}
configSetSettlingTime: sent {"settlingtime":"1245"}
configSetSettlingTime: received {"samples":"1"}
configSetDataRate: sent {"datarate":"200"}
configSetDataRate: received {"samples":"1"}
configGetHallOffsets: sent {"get":"halloffs"}
configGetHallOffsets: received {"result":"OK","channels":[{"chnum":"0","gainoffs":"250","halloffs":"10719","fieldoffs":"0","ph0resoffs":"0","ph1resoffs":"0","ph2resoffs":"0","ph3resoffs":"0","ph0offserr":"0","ph1offserr":"0","ph2offserr":"0","ph3offserr":"0"}]}

```

## 16.4 MiST Config tab



### Devices

This enables connecting to or disconnecting from a (single) MiST.

### MiST Information

This shows connection details for the MiST, namely the IP(4) address, the MAC address and the version of the firmware running on the MiST.

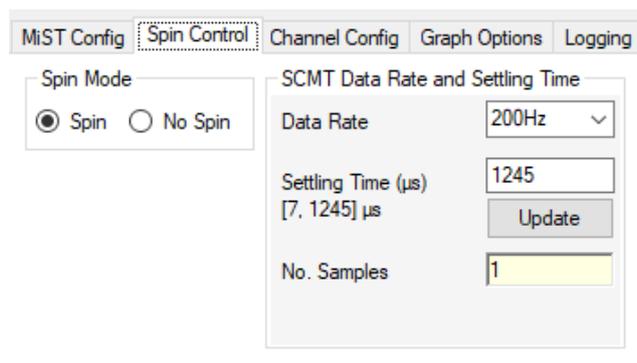
### Enable Channels

This enables measuring signals from up to four GHS probes simultaneously. By default, Channel 1 is enabled, which assumes the presence of a GHS probe in Channel 1 of the MiST. Tick other boxes to monitor more (or different) probes.

## 16.5 Spin Control tab

### Spin Mode

This determines the measurement technique used: *spinning* (SCMT) or *non-spinning*.



### SCMT Data Rate and Settling Time

*(Spinning mode only)*

This specifies the **data rate** (the number of aggregate measurements, or data points, sent per second from the MiST) and the **settling time** (the number of microseconds the MiST should wait before restarting measurements during each phase of SCMT) in spinning mode. It also reports the number of measurement samples used to compute each data point returned by the MiST.

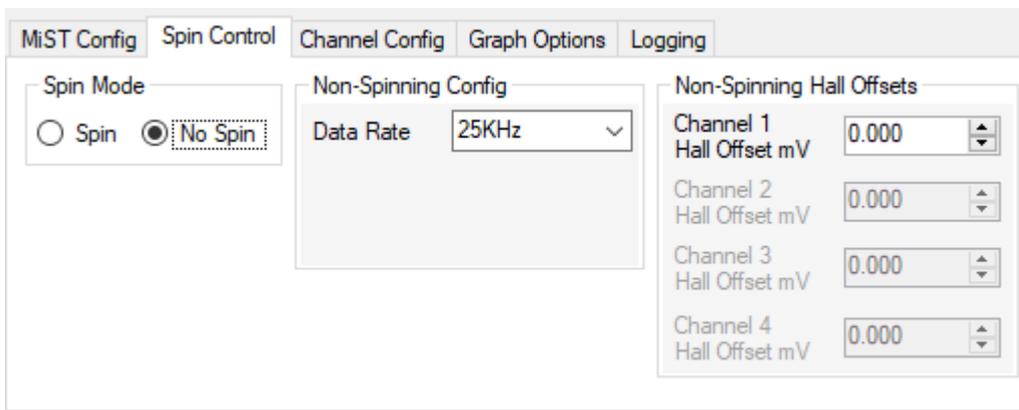
These settings are common to all enabled channels.

**Note:** The data rate will be changed automatically when the value in the drop-down box is changed. However, the settling time will not be changed until the **Update** button is pressed.

**Note:** There is a mathematical relationship between the data rate and the settling time (or rather, a constraint binding the two).

The data rate determines the length of time of each phase of SCMT. The settling time must therefore be small enough to fit within a single phase, and also to leave enough time during the rest of the phase for at least one sample measurement to be taken. There is also an upper limit on the number of samples that may be used to compute each data point. The result is that only certain combinations of data rate and settling time will be valid.

The range of valid settling times for the specified data rate is shown in the software. In the picture above, it is [7, 1245]  $\mu$ s. Attempting to set a settling time outside this range will be rejected by the software, which will instead use the nearest valid value.



### Non-Spinning Config

*(Non-spinning mode only)*

This specifies the **data rate** (the number of aggregate measurements, or data points, sent per second from the Mist) in non-spinning mode.

### Non-Spinning Hall Offsets

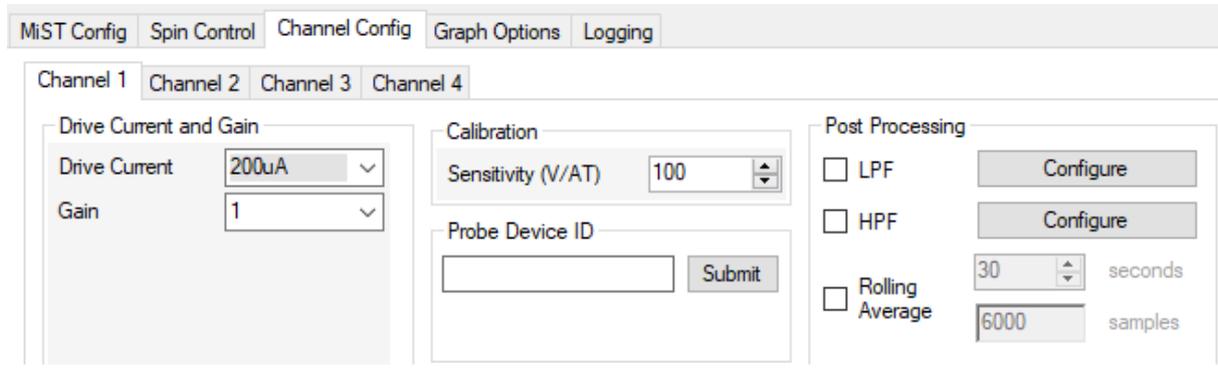
*(Non-spinning mode only)*

This specifies the voltage offset (in millivolts) applied to each channel of the MiST in order to correct for measurement errors. (In spinning mode, this happens automatically as part of SCMT.)

**Note:** The measurement frequency is fixed at 200 kHz in non-spinning mode, so a data rate of 25 kHz (as shown in the picture above) implies that eight sample measurements are used to compute each data point.

## 16.6 Channel Config tab

This tab configures the settings for each enabled channel individually.



### Drive Current and Gain

This specifies the **drive** (or **bias**) **current** supplied to the GHS probe and the **gain** used by the MiST to amplify the signal.

**Note:** If the gain is too high for the signal being measured, i.e. if the resulting amplified signal is outside the range  $\pm 4.096$  V, a **saturation error** will be indicated by the MiST (red status and channel LEDs) and also in the software on the Graph Options tab (see below).

### Calibration

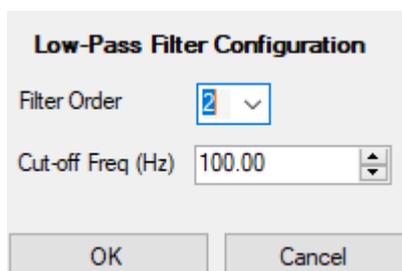
This specifies the **probe sensitivity**, which is used (along with the drive current) to convert measurements from Volts to Tesla.

### Probe Device ID

This is an optional field to label the probe under measurement. It will be saved in the settings and visible in the CSV log file (see below) for later identification.

### Post Processing

The **LPF** and **HPF** tick-boxes enable **low-** and **high-pass Butterworth filters** of **even orders** (2, 4, 6, 8, 10 and 12) for the data points in the software. These are calculated in the application and can hence be applied to all data points in the current graph. Clicking “Configure” allows the details of the filters to be specified, as shown below.



The **Rolling Average** tick-box enables a rolling (or moving) average of the last  $n$  seconds of data as specified by the user (up to 600 seconds). This effectively applies a first-order filter to the (unfiltered) data.

## 16.7 Graph Options tab

These settings affect the presentation of the data points (i.e., the graphs); they do not affect the data points themselves (e.g., what is written to the log file). Unless otherwise stated, they are common to all enabled channels.

**Note:** The graphs are updated four times per second (or once every 0.25 s).

### Show Hall Type

This toggles between displaying voltage and magnetic field (Volts and Tesla).

### Show Graphs

For the current release of the software, only Hall measurements (voltage and magnetic field) are available.

### Graph Control

This determines how much historical data (up to 1,000 seconds) to display, known as the **display window**. It also toggles the visibility of the Graph Control panel (see below) and determines the behaviour of the y-axis zoom function (see the description of Y-Axis Voltage/Tesla below).

The Graph Control panel (shown above) allows the graph to be paused, such that the display will not change as new data points are received from the MiST. When paused, the display can be altered to show past measurements (up to 1,000 seconds ago) or to zoom in and out along the x-axis (time), which can be useful at higher data rates (e.g., to see each individual measurement at 5 kHz).

### Scroll

Translate (move) the graph left or right by the width of the display window. The value of *Centre* (which shows the x-coordinate of the central point) is updated accordingly.

Scrolling can be done by either clicking the Scroll buttons (shown above) or (perhaps more conveniently) by holding the SHIFT key down and moving the mouse-wheel.

### *Move*

Translate the graph left or right by one quarter of the width of the display window. (Useful for fine-grained movement.) The value of *Centre* is updated accordingly.

### *Zoom (X-Axis)*

Zoom in or out by halving or doubling the size of the display window (whilst keeping the central point constant). The value of *Span* (which shows the width of the display window) is updated accordingly.

Zooming can be done by either clicking the Zoom In/Out buttons (shown above) or by holding the CTRL and SHIFT keys down and moving the mouse-wheel.

### *Reset*

Reset the Zoom level to one. Useful to undo previous zoom operations quickly. The value of *Span* is updated accordingly.

**Note:** The scroll-bar immediately beneath the graphing area can also be used to translate the graphs.

**Note:** The graph can display a maximum of 1,424 data points at once. At the smallest display window of one second (with no zoom), data rates higher than 1 kHz will mean that some of the data points are not displayed. At the largest display window of 1,000 seconds, some data points will be dropped from the display for all data rates. To see all data points within a particular time interval, it may be necessary to pause the graph and then use the Move, Scroll and Zoom buttons described above.

### **Y-Axis Voltage/Tesla**

These controls set the scale (zoom level), position (centre) and range of values on the y-axis. They are equivalent to the move, scroll and zoom functions in the Graph Control panel for the x-axis (shown above), although they do not require the graph to be paused.

The scale can be set by either selecting the value from the drop-down list or by holding the CTRL key down and moving the mouse-wheel. This determines the number of Volts/Tesla per major division along the y-axis and automatically updates the size of the range, which shows the total height of the y-axis display and is equivalent to the display window for the x-axis.

The position can be set by either clicking the arrow buttons or moving the mouse-wheel (without touching the CTRL key). This determines the y-coordinate at the centre of the display.

The range can be further altered (independently of the scale) by clicking the arrow buttons, which is useful for fine-grained adjustments.

**Note:** When setting the scale (zooming in or out), the default position (centre) will be set to the average y-value over the past two seconds. When more than one channel is enabled (and hence displayed), zooming sets the centres of all graphs in this way, in order to show the central y-regions of all graphs at the same time. To change this default behaviour, choose a different option from the *Auto-centre on zoom* drop-down box.

### **Saturation LEDs**

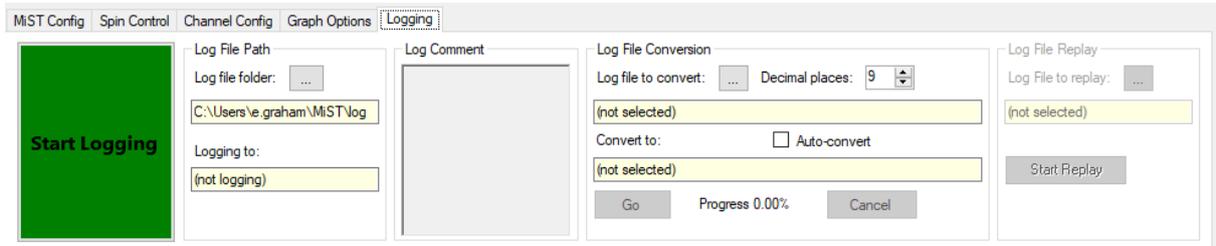
These indicate saturation errors (describe above) for each of the four channels individually. The meaning of the colours is as follows:

- **Red** – A saturation error occurred in the last quarter of a second (0.25 seconds)

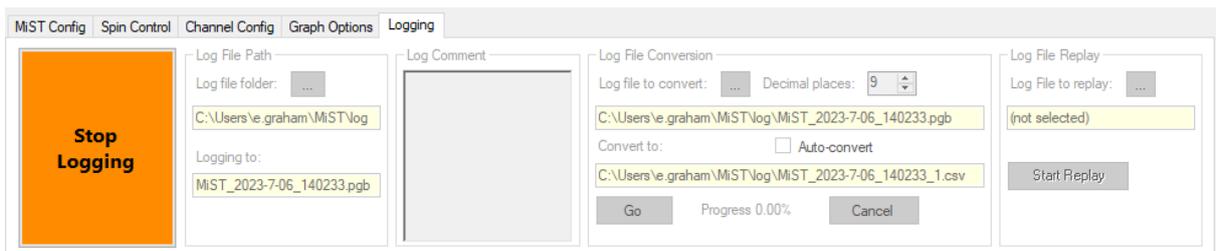
- **Yellow** – A saturation error occurred previously (since Clear was last clicked) but not in the last 0.25 seconds
- **Green** – No saturation errors have occurred since Clear was last clicked

Clicking Clear will immediately reset the LED to Green.

## 16.8 Logging tab



Press the green button to start logging. This will log all data points in raw byte form as received from the MiST for all enabled channels. The log files are binary (not text) and are named **MiST\_YYYY-M[M]-DD\_HHMMSS** (to show the current date and time) with file extension **.pgb** (for **Paragraf** binary file). Once logging, the button turns orange; press it again to stop and save the log file to your computer.



**Note:** The **maximum size** any log (.pgb) file is allowed to reach is **2 GB**. The application will not be able to convert a larger file to CSV or to replay it (see below), thus rendering it useless. The application will enforce this limit and curtail logging ten seconds before the file is predicted to grow beyond 2 GB. A warning is displayed before logging starts that estimates the amount of time data may be logged at the current data rate and number of enabled channels.

### Log File Path

This displays the current folder in which log files will be saved and the current log file being written, if any. By default, the log-file folder is **C:\Users\[username]\MiST\log**; this can be changed by clicking on the “...” button (with the three dots).

### Log Comment

Any text entered here will be saved to the log file and visible when converting to CSV (see below).

### Log File Conversion

Clicking the “...” button selects a log (.pgb) file to be converted to human-readable CSV format (that can be opened with Excel); clicking Go then converts it. The name of the resulting CSV file is shown, which is the name of the .pgb file with “\_1” at the end. For large log files, several CSV files may be produced during the conversion, numbered \_1, \_2, \_3 etc., in order to keep each one no larger than 50 MB (for ease of use in Excel).





## 2. Software export file format when non-spinning

Timestamp	Row Type	Board	Ten Channel	Channel 1	Channel 2	Channel 3	Channel 4	Channel 1	Channel 1	Channel 1	Channel 1	Channel 2	Channel 2	Channel 2	Channel 2	Channel 3	Channel 4										
1	Header	2023-02-1	MIST0127.0.D.2	ADC1 (V)	ADC2 (V)	ADC3 (V)	ADC4 (V)	ADC5 (V)	ADC1 (V)	ADC2 (V)	ADC3 (V)	ADC4 (V)	ADC5 (V)	ADC1 (V)	ADC2 (V)	ADC3 (V)	ADC4 (V)	ADC5 (V)	ADC1 (V)	ADC2 (V)	ADC3 (V)	ADC4 (V)	ADC5 (V)	ADC1 (V)	ADC5 (V)		
4	Settings	["\$schema": "https://son-schema.org/draft/2020-12/schema", "title": "MIST Saved Settings", "description": "This document records MIST Control App settings", "type": "object", "formatVer": "1", "settings": {"appGlobalItems": {"logFolder": "C:\\Users\\o.masseglia\\MIST\\log"}, "mstks":																									
5	0 Sample	6.25E-07	-9.7E-07	8.13E-07	2.19E-07	0	-7.8E-07	9.06E-07	-1.6E-07	-6.9E-07	-5.6E-07	-1.3E-07	-5.6E-07	-1.3E-07	-5.6E-07	-4.1E-07	7.81E-07	4.69E-07	0	6.25E-07	0	0	0	0	0	0	
6	4.00E-05 Sample	-9.7E-07	7.19E-07	-3.1E-07	-9.4E-07	7.3E-07	3.13E-07	6.3E-08	6.25E-07	-1.3E-07	-2.5E-07	-3.1E-07	2.81E-07	6.3E-08	6.88E-07	5.63E-07	-6.9E-07	8.75E-07	-8.4E-07	2.5E-07	-6.6E-07	-6.6E-07	-6.6E-07	-6.6E-07	-6.6E-07	-6.6E-07	-6.6E-07
7	8.00E-05 Sample	5.94E-07	-9.7E-07	8.13E-07	2.19E-07	0	-7.8E-07	9.06E-07	-1.6E-07	-6.9E-07	-5.6E-07	-1.3E-07	-5.6E-07	-1.3E-07	-5.6E-07	-4.1E-07	7.81E-07	4.69E-07	0	6.25E-07	0	0	0	0	0	0	
8	0.00012 Sample																										
9	0.00016 Sample																										
10	0.0002 Sample																										
11	0.00024 Sample																										
12	0.00028 Sample																										
13	0.00032 Sample																										
14	0.00036 Sample																										
15	0.0004 Sample																										
16	0.00044 Sample																										
17	0.00048 Sample																										
18	0.00052 Sample																										
19	0.00056 Sample																										
20	0.0006 Sample																										
21	0.00064 Sample																										
22	0.00068 Sample																										
23	0.00072 Sample																										
24	0.00076 Sample																										
25	0.0008 Sample																										
26	0.00084 Sample																										
27	0.00088 Sample																										
28	0.00092 Sample																										
29	0.00096 Sample																										

**Column definitions**

- columns of timestamps in seconds
- 5 columns per channel. There are 4 channels (tagged a, b, c and d in this slide); 5 data points acquired at regular interval between each timestamp. In the example above there are 5 sample every 40µs so 1 sample every 8µs.  
 1<sup>st</sup> line: ADC1 at 0µs, ADC2 at 8µs, ADC3 at 16µs, ADC4 at 24µs, ADC5 at 32µs  
 2<sup>nd</sup> line: ADC1 at 40µs, ADC2 at 48µs, ADC3 at 56µs, ADC4 at 64µs, ADC5 at 72µs  
 3<sup>rd</sup> line: ADC1 at 80µs....  
 ....

### Log File Replay

This allows a previously recorded log file to be replayed through the software. Clicking the “...” button selects the log (.pgb) file to be replayed and then Start Replay starts the replay. This sets the relevant settings in each tab to the values they held when the log file was recorded and then displays graphs of each enabled channel (from the log file).

**Note:** In order not to conflict with incoming data, replaying log files is only possible when the application is **not** connected to a MiST.

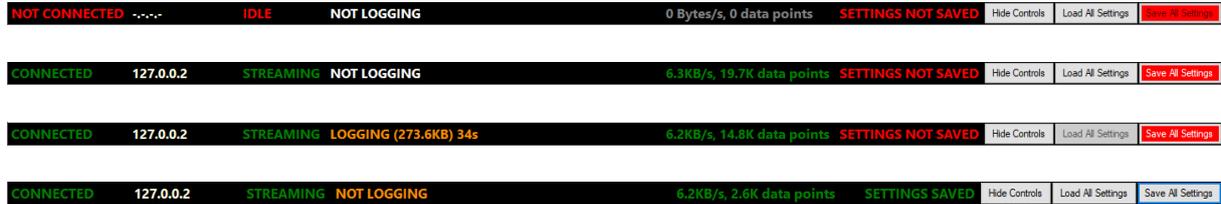
When replaying a log file, the graphs are permanently in “Pause” mode (because there is no new data coming from the MiST); therefore all settings on the Graph Options tab (see above) are available.





## 16.9 Status bar

At the bottom of the screen is the status bar. Some example statuses are shown below:



From left to right, the information displayed is as follows:

- Connection status (whether connected to a MiST)
- MiST IP address (when connected)
- Data streaming status (whether streaming in spinning/non-spinning mode or idle)
- Logging status (whether logging is taking place)
- Incoming data rate (bytes/second) and total number of data points received
- Settings status (whether the most recent values have been saved)

The Hide Controls button toggles whether the settings tabs are displayed; hiding them will provide a bigger display area for the graphs, which can be useful when several channels are enabled.

The Load All Settings and Save All Settings buttons enable loading previously saved settings from a file or saving the current configuration to a file. The Save All Settings button will be shown in red if there have been any changes made to the settings since the last time a settings file was loaded.

**Note:** Settings will be saved in JSON format to a file called **MiST settings.json** in the directory **C:\Users\[username]\MiST\settings**. To avoid a build-up of past settings files in this directory, this file will be *overwritten* each time the settings are saved; therefore it is advisable to take a copy of any reference settings files needed for future use. The format of the settings in this file is identical to those in the CSV file when a log file has been converted to CSV.

## 16.10 Error notifications

Occasionally, the MiST encounters measurement errors during normal operation and reports these to the user via the controller application.

### Types of error

The MiST identifies two different types of error:

- **Saturation errors**, where the voltage read is outside the range of acceptable values (namely  $\pm 4.096V$ , including any magnification from the gain setting); hence the signal is said to be saturated. When this happens, the specific channel where the saturation is detected will be indicated by the Saturation LEDs box in the Graph Options tab of the dashboard.



- **Processing errors**, where the physical ADC components of the MiST encounter errors whilst reading a signal, or the MiST firmware is unable to process the measurements in time with the specified data-rate. When this happens, the graph for the channel in question will show the curve (trace) in red rather than the usual yellow colour.



## Rectifying errors

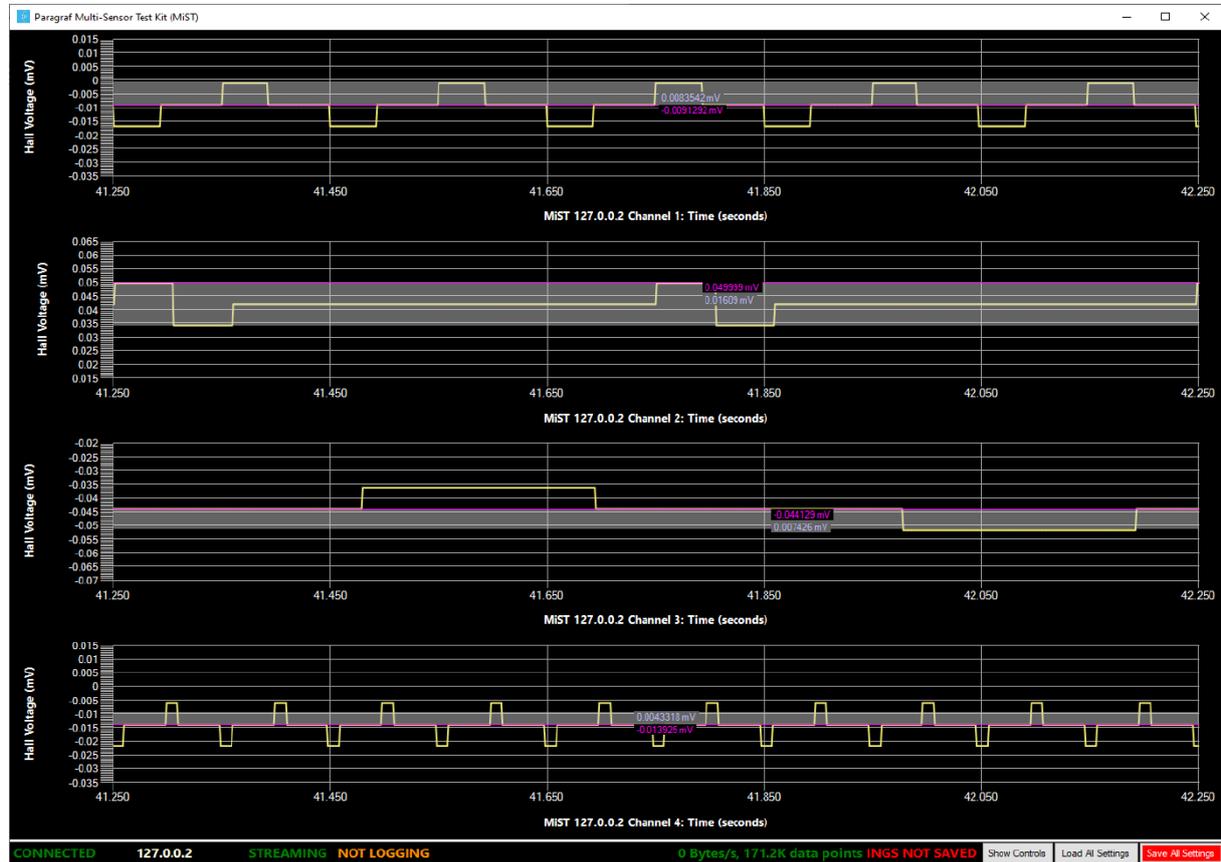
For saturation errors, the signal must be brought back into the acceptable range. This may involve reducing the gain; or (when no gain has been specified) the source of the voltage will need to be adjusted.

Processing errors indicate that the MiST is working too hard and cannot read or process all the measurements at the prescribed data-rate and number of channels. The solution is to reduce the data-rate or the number of devices (channels) being measured at the same time.

## 16.11 Selecting areas of the graph

Left-clicking inside the axes in any of the graphs shows a (magenta) coloured horizontal line with a label displaying the x-coordinate of the line. Furthermore, dragging the line up or down (whilst holding the left mouse button down) draws a shaded area with a label showing the height of this area.

These lines can be set for each channel independently as shown below:



Right-clicking inside a particular graph removes any lines and labels that may be visible.

## 17 Servicing and Maintenance

This product contains no user-serviceable parts. Any repair, servicing or calibration of the product must only be performed by Paragraf Limited or an approved service provider.

### WARNING



#### WARNING: RISK OF ELECTRIC SHOCK TO USER.

Do not tamper with or disassemble the product or accessories in any way as any internal damage will degrade performance or likely cause permanent damage to internal parts and void the warranty.

### 17.1 Cleaning the MiST

The outer case of the MiST must be kept clean and free of dust. Use a soft cloth to clean the surfaces periodically.

### WARNING



#### WARNING: RISK OF ELECTRIC SHOCK TO USER.

When cleaning the product, do not use any fluid to clean the equipment. To prevent electric shock, switch off and remove Power supply unit from the mains supply. Do not allow water or any other liquid to enter the product case. Water ingress will likely cause permanent damage to the internal parts.

### 17.2 Disposal

#### WEEE Regulation Requirement

Symbol	Description
	Do not dispose of this product as general waste.



Disposal of the MiST or GHS Probes requires that a separate collection for waste electric and electronic equipment (WEEE) is required. Check local regulations regarding WEEE and if needed contact a WEEE waste removal firm or return to Manufacturer for disposal.

# 18 Compliance

## 18.1 EU Declaration of Conformity



### EU DECLARATION OF CONFORMITY

**Product:** Multi-Sensor Test Unit  
**Model number:** MiST  
**Serial number:** MC0024203-1100XX  
Where MC002420X = 3 or 4 and 11XXXX = 110000 – 119999  
**Variant:** V3 / V4

**Name and Address of manufacturer:**

Paragraf Ltd 7-8 West Newlands Somersham Huntingdon Cambridgeshire PE28 3EB UK  
[www.paragraf.com](http://www.paragraf.com) Telephone +44 1223 739782 Company number: 09889431

*This declaration of conformity is issued under the sole responsibility of the manufacturer.*

**Object of the declaration:** Multi-Sensor Test Unit (MiST)

**The object of the declaration described above is in conformity with the relevant Union harmonisation legislation:**

Low Voltage Directive 2014/35/EU	Directive 2014/35/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits.
Electromagnetic Compatibility Directive 2014/30/EU	Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility (recast) and all related amendments
Restrictions on Hazardous Substances Directive 2011/65/EU	Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment and all related amendments

**Reference to the relevant harmonised standards used or reference to the other technical specifications in relation to which conformity is declared:**

EN IEC 61010-1: 2010+A1:2019	Safety requirements for electrical equipment for measurement, control, and laboratory use – General requirements
EN IEC 61326-1:2021	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements
EN IEC 63000: 2018	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

**Additional information:** The MiST shall only be used with the provided power supply (AC/DC adaptor) - Meanwell GSM40A12-P1J - Output 12Vdc at 3.34A; AC 3 pole IEC inlet 110/230V AC. MEAN WELL EUROPE B.V. Langs de Werf 8, 1185XT Amstelveen, The Netherlands

**Signed for and on behalf of the above named manufacturer:**

Sign:  Position: CTO Date of Issue: 2024-05-14

**Address:** 7-8 West Newlands, Somersham, Cambridgeshire PE283EB, UK.

**Authorised Representative in Europe:**

**Address:** Globalnorm GmbH, Kurfuerstenstraße 112, 10787 Berlin, Germany, CRN: HRB 105204 B.



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## 18.2 UK Declaration of Conformity



### UKCA DECLARATION OF CONFORMITY

In accordance with UK Government guidance

**Product:** Multi-Sensor Test Unit  
**Model number:** MiST  
**Serial number:** MC0024203-1100XX  
Where MC002420X = 3 or 4 and 11XXXX = 110000 – 119999  
**Variant:** V3 / V4

**Name and Address of manufacturer:**

Paragraf Ltd 7-8 West Newlands Somersham Huntingdon Cambridgeshire PE28 3EB UK  
[www.paragraf.com](http://www.paragraf.com) Telephone +44 1223 739782 Company number: 09889431

*This declaration of conformity is issued under the sole responsibility of the manufacturer.*

**Object of the declaration:** Multi-Sensor Test Unit (MiST)

**The object of the declaration described above is in conformity with the relevant UK statutory requirements:**

The Electrical Equipment (Safety) Regulations	2016	No 1101
The Electromagnetic Compatibility Regulations	2016	No 1091
The Restrictions of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations	2012	No 3032

**Reference to the relevant designated standard used or reference to the other technical specifications in relation to which conformity is declared:**

BS EN IEC 61010-1: 2010+A1:2019	Safety requirements for electrical equipment for measurement, control, and laboratory use – General requirements
BS EN IEC 61326-1:2013	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements
BS EN IEC 63000: 2018	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

**Additional information:** The MiST shall only be used with the provided power supply (AC/DC adaptor) - Meanwell GSM40A12-P1J - Output 12Vdc at 3.34A; AC 3 pole IEC inlet 110/230V AC. MEAN WELL EUROPE B.V. Langs de Werf 8, 1185XT Amstelveen, The Netherlands

**Signed for and on behalf of the above named manufacturer:**

Sign:  Position: CTO Date of Issue: 2024-05-14

Address: 7-8 West Newlands, Somersham, Cambridgeshire PE283EB, UK.



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## 18.3 REACH/UK REACH Regulation

EU REACH (Registration, Evaluation, Authorisation and restriction of Chemicals) is a European Union regulation that affects the supply and use of substances, and came into operation on 1st June 2007.

UK REACH Regulation is a UK Statutory Instruments that applies to the majority of chemical substances that are manufactured in or imported into Great Britain (GB) (England, Scotland, Wales), and came into operation on 1 January 2021.

Both regulations are concerned with:

- A substance on its own
- A substance in a mixture, for example ink or paint
- A substance that makes up an 'article' - an object that is produced with a special shape, surface or design, for example car, furniture or clothes, electronic components.

As such Paragraf has carried out an audit of the MiST to the latest list of Substance of Very High Concern (SVHC) and found that 2 components used in the circuitry are not REACH compliant. This is due to an increase in lead used in the high temperature solder pads of the components. The lead content is greater than 0.1% w/w of the component. In Paragraf's Risk Assessment for use, it has been determined that the risk to the user is very low as these devices are soldered in state of the art facilities and are sealed within the enclosure of the MiST.

The customer should not repair nor dispose of the MiST and should return it to Paragraf Ltd for correct disposal or contact a WEEE waste removal firm for disposal.

## 19 Contact Us

### Paragraf Ltd

7-8 West Newlands  
Somersham, Huntingdon  
Cambridgeshire PE28 3EB  
UK

Company number: 09889431



+44 1223 739782



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[www.paragraf.com](http://www.paragraf.com)