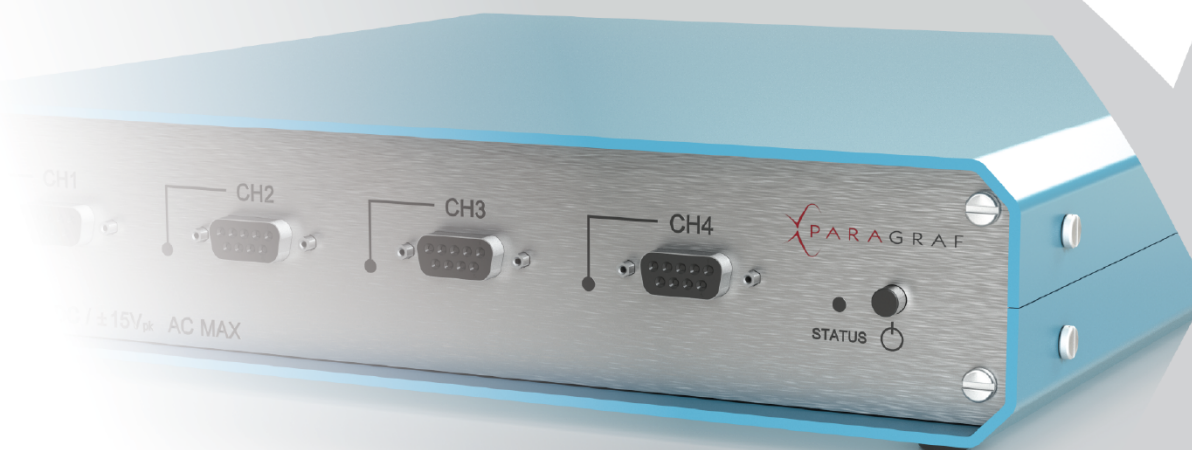




MiST – Multi Sensor Test Unit Reference Manual

Software Version 0.8.4



Contents

1	Copyright and Disclaimer	3
2	Revision History	3
3	This Manual	4
4	Glossary of Terms	5
5	Product Information	5
6	Intended Use	6
	6.1 Reasonably Foreseeable Misuse	6
	6.2 Competent Personnel.....	6
7	Specification	7
8	General Description.....	8
9	What's Included.....	8
	9.1 Accessories and Peripherals.....	9
10	Safety Information.....	10
	10.1 Safety Descriptions.....	10
	10.1.1 Safety Meanings	10
	10.1.2 Prohibition, Mandatory Action, and Warning Symbols	10
	10.2 Safety Symbols	11
	10.2.1 Warning Symbols.....	11
	10.2.2 Mandatory Action Symbols	11
	10.2.3 Prohibition Symbols.....	11
	10.2.4 Electrical Symbols.....	11
	10.3 Safety Information	12
11	MiST Block Diagram.....	13
12	MiST Connections.....	15
	12.1 Front Panel	15
	12.2 Rear	15
	12.3 Grounding of MiST	16
	12.4 Input/Output Port	17
	12.5 Probe Connection Ports	18
	12.6 ESD Protection.....	18
13	Connection Set-up of the MiST	19
	13.1 Initial connection.....	19
	13.2 Disconnection.....	19
	13.3 Probe Connections.....	20
	13.3.1 Rear Connections.....	20
	13.3.2 Complete Set-up.....	21
	13.4 Channel Status Indicator	22
	13.5 MiST Status Indicator	22
14	Ethernet Connection	23
	14.1 IP Network.....	23
	14.1.1 DHCP-Enabled networks	23
	14.1.2 Direct connections.....	23
	14.1.3 MiST Identity.....	23
15	Installing the MiST Software Application.....	24



15.1	Obtaining the MiST Software Application	24
15.2	Installation dependencies	24
15.3	Running the installer	24
16	Using the MiST Software Application	25
16.1	Recommended screen resolution	25
16.2	Starting the software application	25
16.3	Connecting to the MiST.....	26
16.4	MiST Config tab	28
16.5	Spin Control tab.....	28
16.6	Channel Config tab.....	30
16.7	Graph Options tab.....	31
16.8	Logging tab	33
16.9	Status bar	37
16.10	Error notifications	38
16.11	Selecting areas of the graph	40
17	Servicing and Maintenance	41
17.1	Cleaning the MiST	41
17.2	Disposal	41
18	Compliance	42
18.1	CE Declaration of Conformity	42
18.2	UKCA Declaration of Conformity	43
18.3	REACH/UK REACH Regulation	44
19	Contact Us	45

1 Copyright and Disclaimer

Copyright

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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

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 2.0	13/12/2023 00:00:00	Initial version

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 operator 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 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 operator. 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	V2.0

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:

- Use in non-industrial or non-research environments.
- Use outdoors.
- Use in wet conditions.
- Use 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
Mains Power Supply Unit					
Power Supply					
Input	Input Voltage	90	264	100-240VAC +/10%	V AC
	Input Frequency	47	63	50-60	Hz
	Input Current			0.8	A
Output	Output Voltage			12	V DC
	Output Current			2.5	A
	Output Power			30	W
Multi-Sensor Test Unit (MiST)					
Voltage Supply					
Input	Voltage	12	15		V DC
	Current		2.5		A
GHS Inputs					
	Common-mode Voltage	-15	+15		VDC+ACpk
	Full-scale Voltage	-15	+15		VDC+ACpk
Bandwidth	Max ADC Sample Rate		200		kHz
Temperature Inputs					
	Voltage	0	+5		V
Power On					
	Power on			10	s
	Warm up Time	0.5	1	0.45	h
Environmental					
	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
Mechanical					
	Height			50	mm
	Width			250	mm
	Depth			250	mm
	Weight		2		kg

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 and temperature sensor.

A computer running Microsoft Windows 10 or above is required to run the MiST software application. This software allows you to set up and configure your MiST and your GHS probe, 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 Power Supply Unit	1
2m Cat5e Ethernet Cable	1
USB to Ethernet Converter	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 (20 cm)	Sensor only
General Purpose Graphene Hall Sensor 3mm QFN	EGHKM01P01	EGHKM01P02	EGHSM01Q01
High Magnetic Field Graphene Hall Sensor 3mm QFN	EGHKM02P01	EGHKM02P02	EGHSM02Q01
Cryogenic mK High Magnetic Field Graphene Hall Sensor 3mm Ceramic QFN		EGHKX01P02	EGHSX01Q02
Cryogenic 4K Mid Magnetic Field Graphene Hall Sensor 3mm Ceramic QFN		EGHKX02P02	EGHSX02Q02
Cryogenic mK Low Magnetic Field Graphene Hall Sensor 3mm Ceramic QFN		EGHKX03P02	EGHSX03Q02

* specification for the probe is shown below:

EGHKM01P01/ EGHKM02P01				
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.

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
	Signal word used to indicate a potentially hazardous situation which, if not avoided, could result in minor or moderate injury
	Signal word used to indicate a potentially hazardous situation which, if not avoided, could result in death or serious injury
	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
	Generic warning Obey the safety instructions		Electric shock Obey the safety instructions Do not touch
	Hot surface Obey the safety instructions Do not touch		Strong magnetic field May affect pacemakers or ICDs

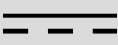


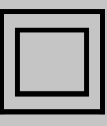
10.2.2 Mandatory Action Symbols

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. 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.

CAUTION



CAUTION: STRONG MAGNETIC FIELDS.

The 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.

The 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

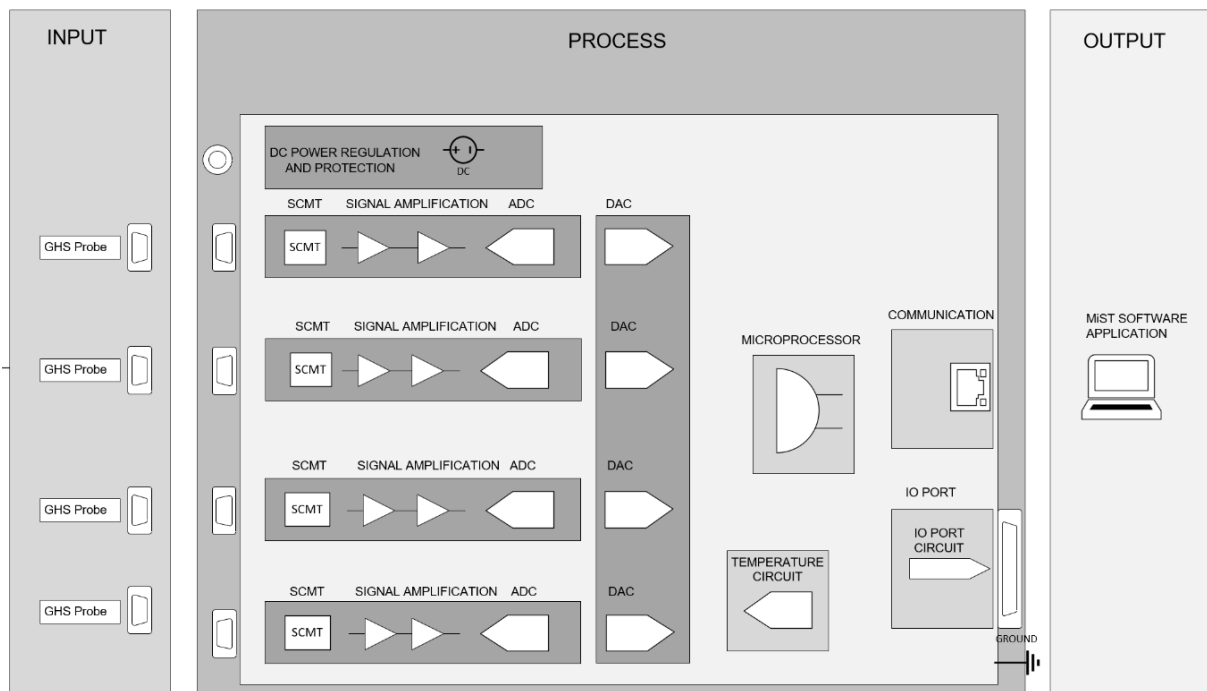


CAUTION: RISK OF DAMAGE TO EQUIPMENT.

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 cable (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 Installing 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

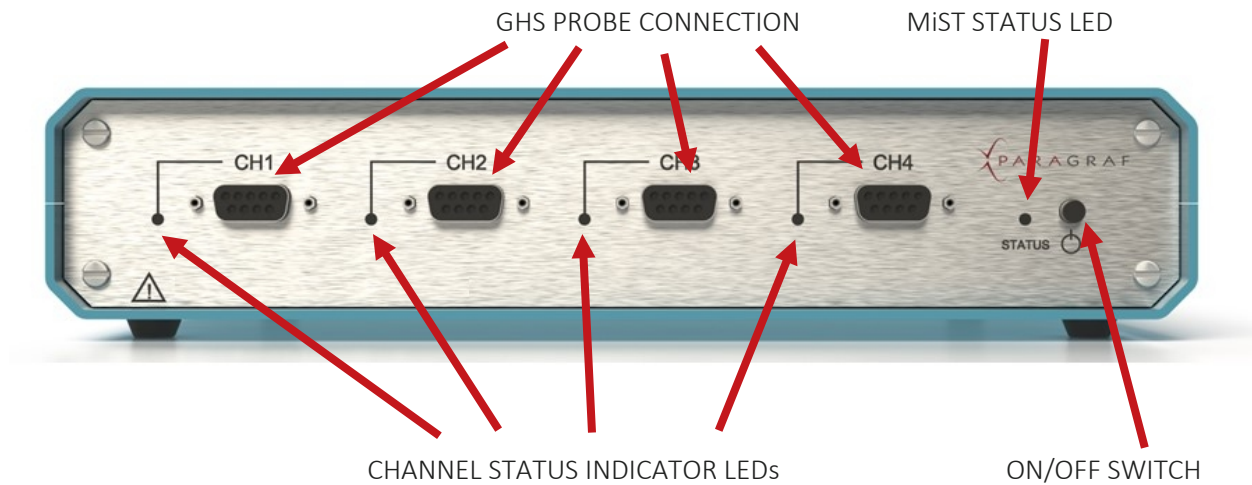


CAUTION: MAGNETIC FIELDS TO USERS.

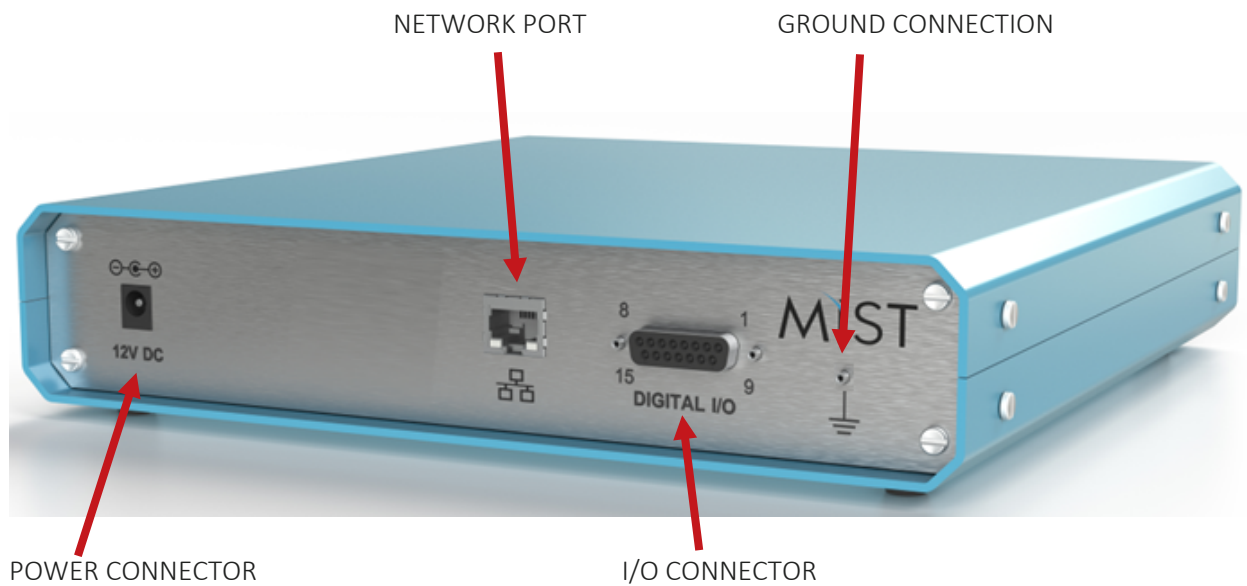
Using the MiST within large magnetic fields could cause permanent damage to the MiST or cause interference to the measurement. Use the approved probe accessories locate the MiST away from the magnetic fields such that only the sensor probe end is exposed to the measured fields.

12 MiST Connections

12.1 Front Panel



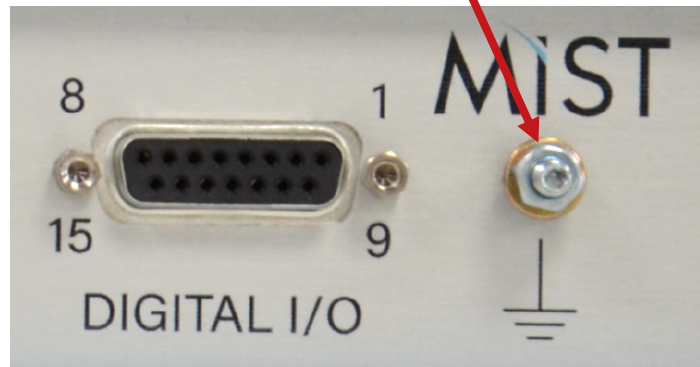
12.2 Rear



12.3 Grounding of MiST

Ensure the MiST grounding point on the rear of the unit is connected to the same Earth point as the Mains Power Supply Unit for correct measurement readings.

GROUND POINT – REAR PANEL



WARNING



WARNING: RISK OF ELECTRIC SHOCK TO USER.

This product does not have a protective safety ground or earth. The ground connections through the ethernet and ground terminal are for measurement purposes only.

12.4 Input/Output Port

The MiST provides three 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.

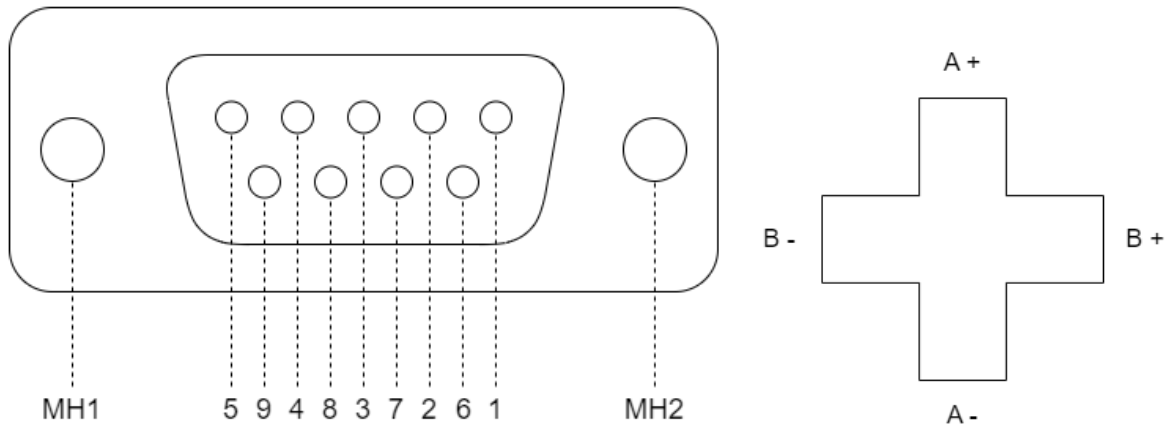
OUTPUT SUPPLY	MIN	MAX	UNITS
+/-15V Maximum Current		100	mA
+5V Maximum Current		200	mA

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 four 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	GND	Ground connection
4	RTD T+	Temperature sensor signal positive (4-wire)
5	RTD I-	Temperature sensor current return (4-wire)
6	GHS A-	Hall Sensor Channel A-
7	GHS B-	Hall Sensor Channel B-
8	RTD I+	Temperature sensor current source (4-wire)
9	RTD T-	Temperature sensor signal negative (4-wire)
MH1, MH2	GND	Ground connection for connector

12.6 ESD Protection

The MiST GHS probe inputs and Digital IO port 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 Set-up of the MiST



WARNING

WARNING: RISK OF ELECTRIC SHOCK TO USER.

Only use the supplied Mains Power Supply Unit 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

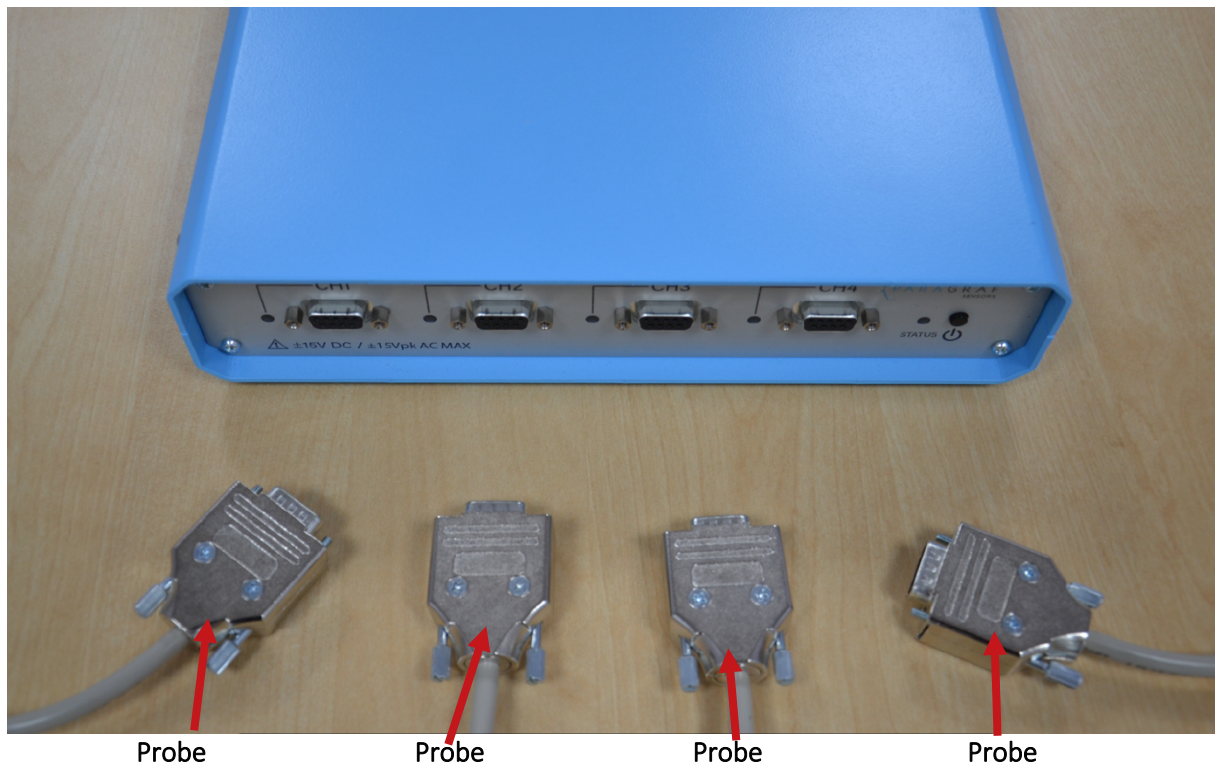
1. Ensure that the MiST is located on a stable surface and not covered.
2. Connect a GHS Probe to the input connector and ensure that the connector screws are tightened to stop the connector falling out of the socket.
3. Connect one end of the ethernet cable to the rear panel socket on the MiST, and the other to your computer.
4. Connect the mains power supply cord 2.1mm barrel connector to the MiST rear panel socket.
5. Connect one end of the grounding cable to the grounding stud (rear), and the other end to the same ground source as the power supply.
6. Connect the power supply adaptor to the mains power supply and switch on.
7. Press the power switch on the front panel of the MiST.
8. Locate the GHS Probe tip in the measurement area.
9. Open the MiST software application on the computer and follow section 15 MiST Software Application instructions for using the software and setting gains and measurement.

13.2 Disconnection

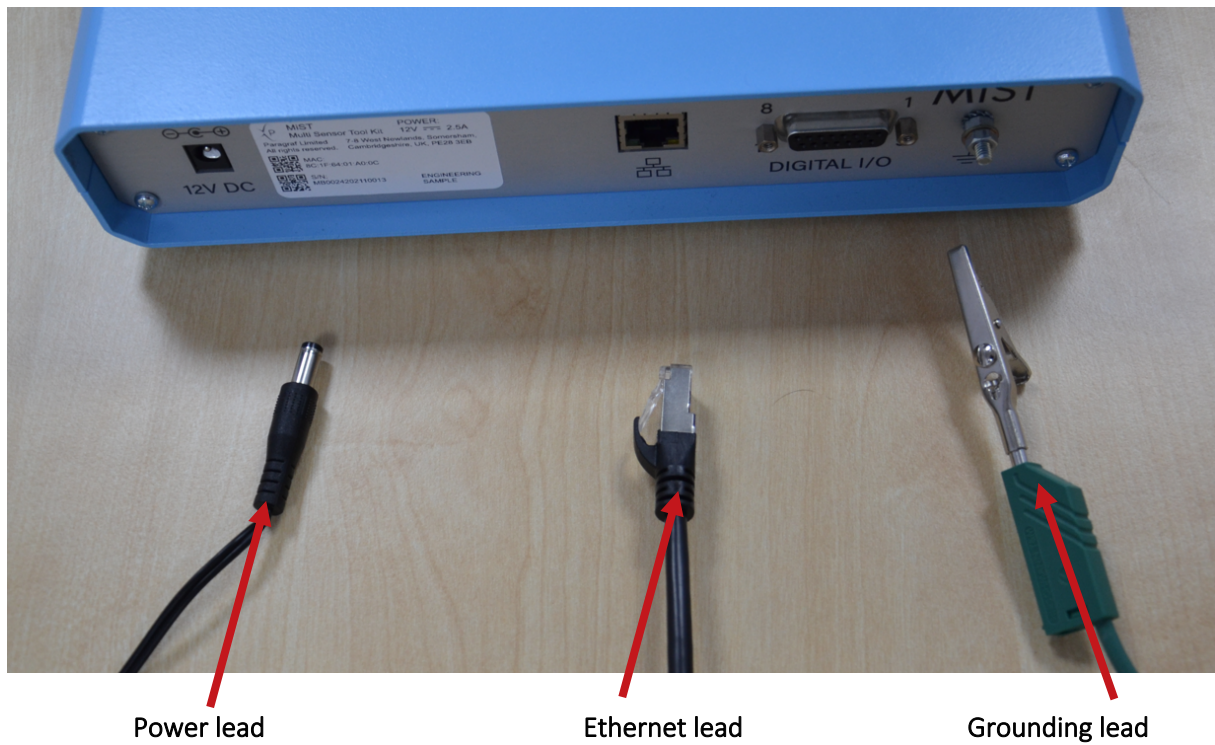
1. To turn off the MiST, push the power switch to release it.
2. To disconnect the power supply during normal operation, use the power switch on the front panel of the MiST, switch off the mains supply and disconnect the power supply adaptor. Then remove the power supply cord from the MiST.

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 to the power supply adaptor first.

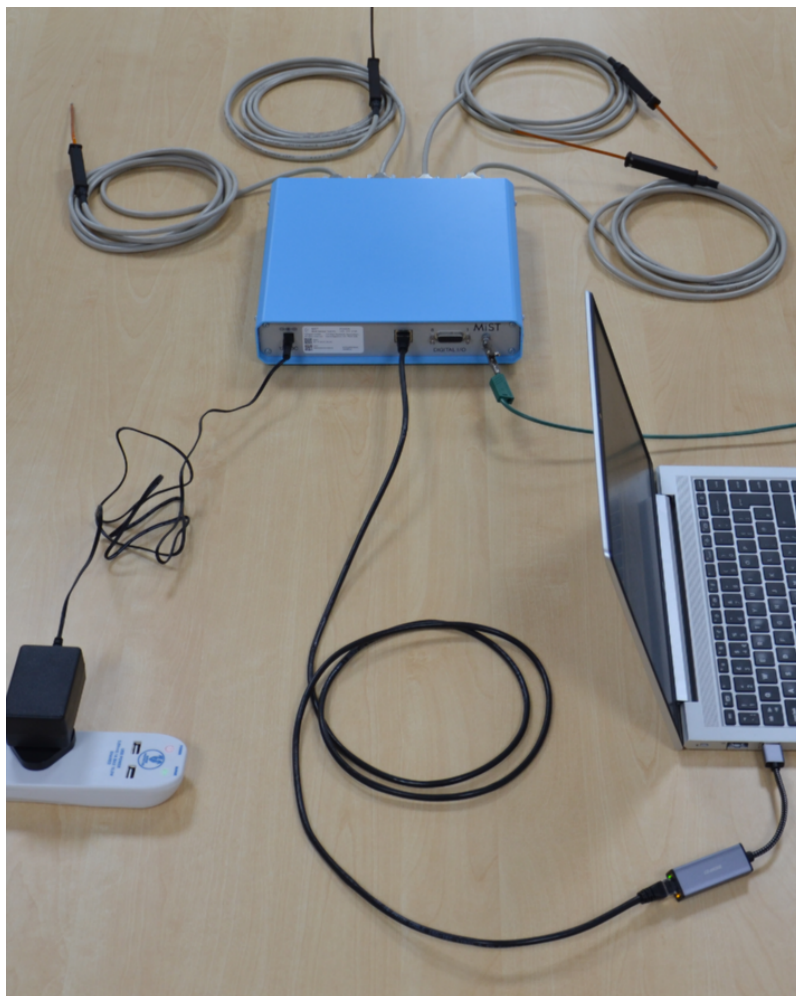
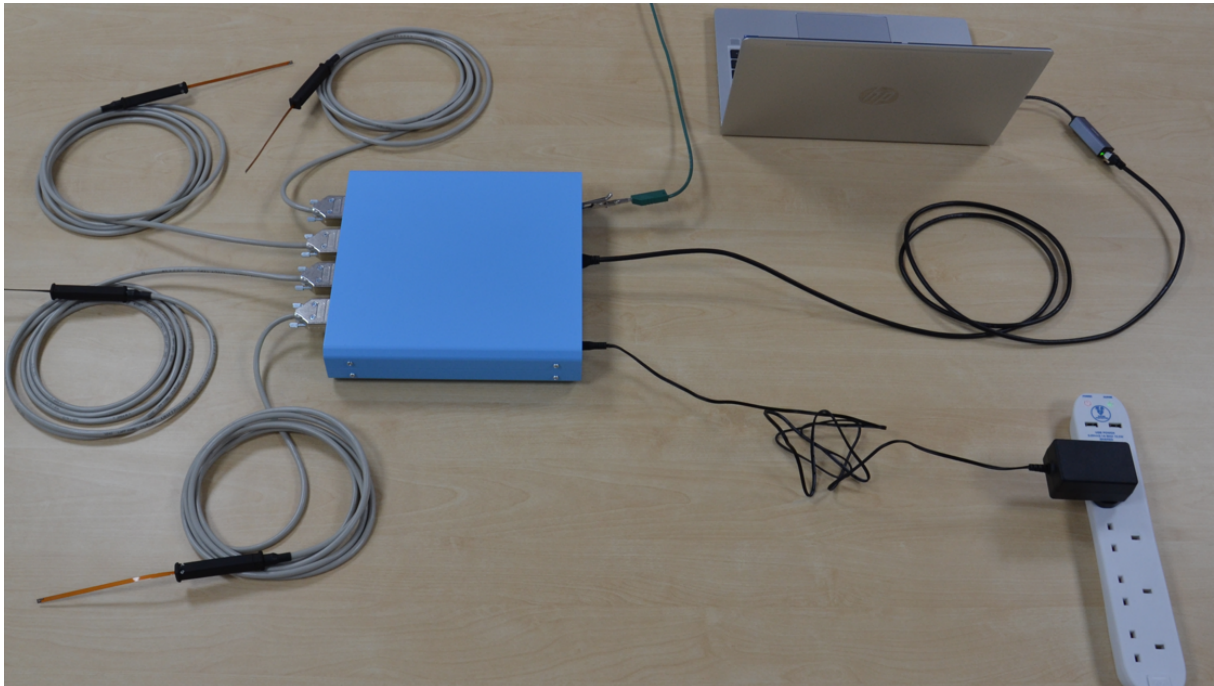
13.3 Probe Connections







13.3.1 Rear Connections







13.3.2 Complete Set-up



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 cable (provided), or a USB to Ethernet adaptor (provided).

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 Installing the 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 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.

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.

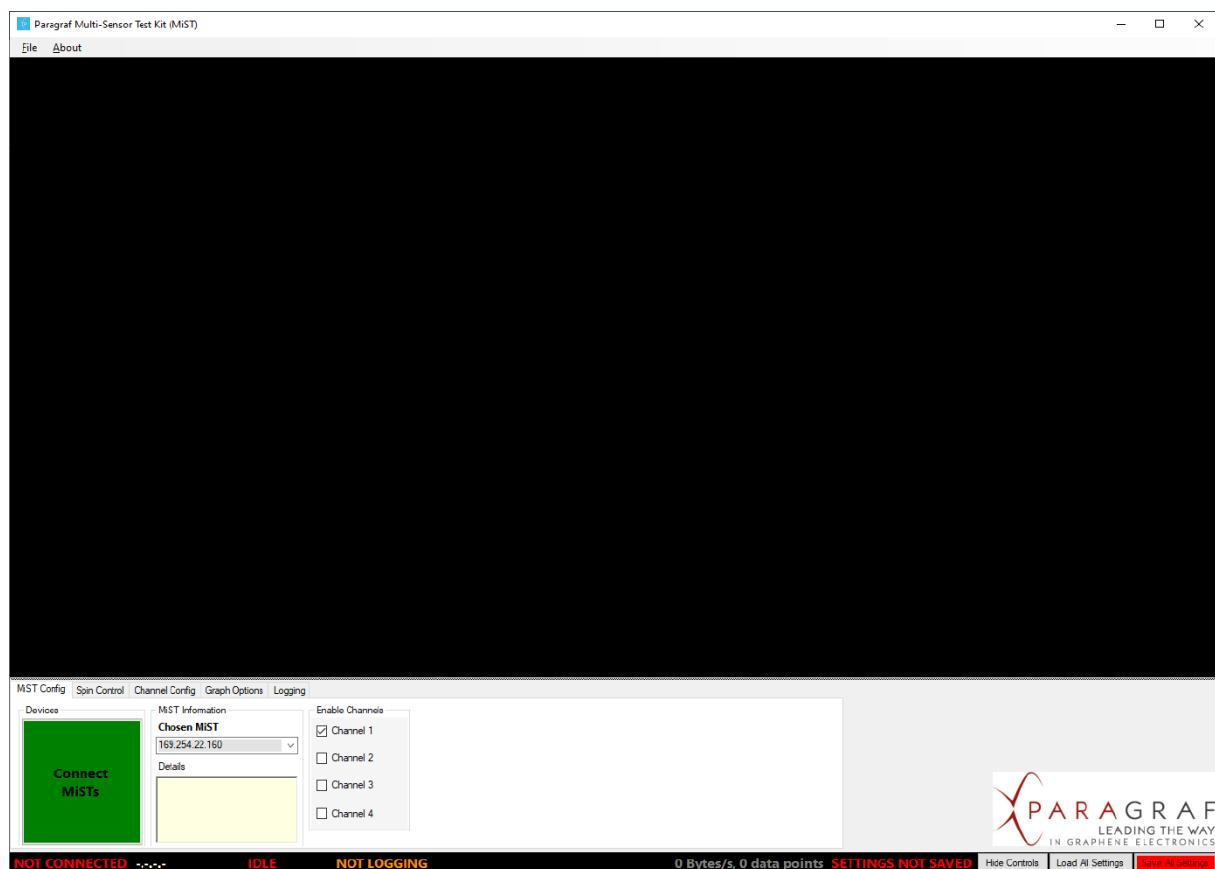
16.1 Recommended screen resolution

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**.

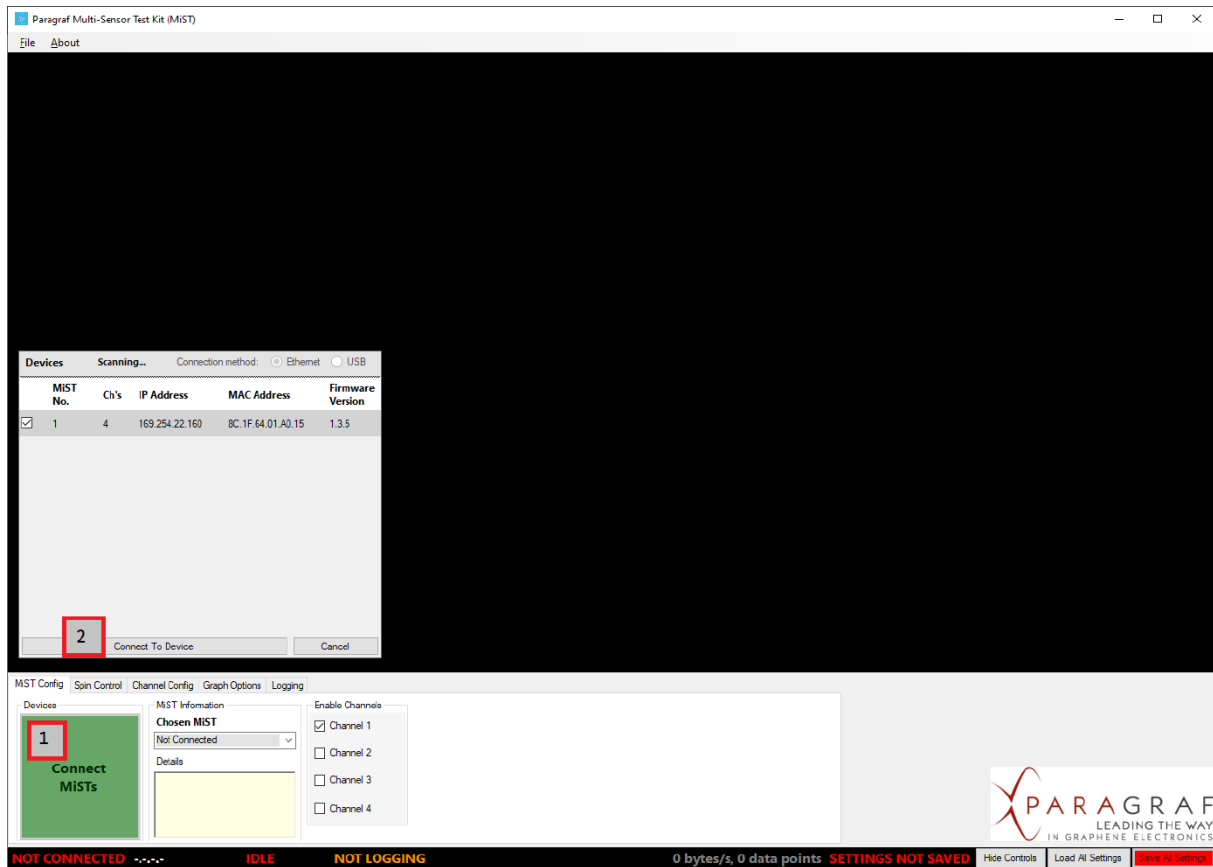
The screen below appears, along with a console window giving a detailed log of all actions the application carries out).



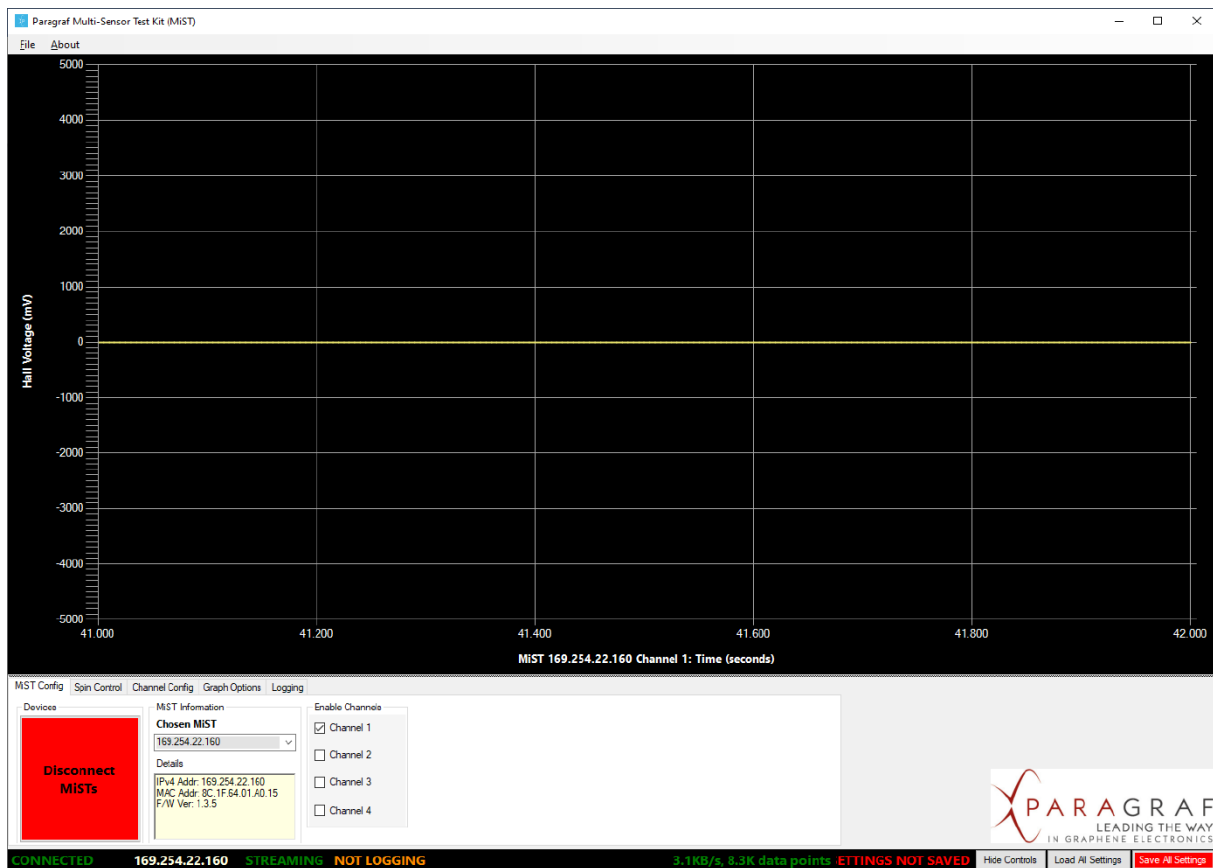
16.3 Connecting to the MiST

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”.



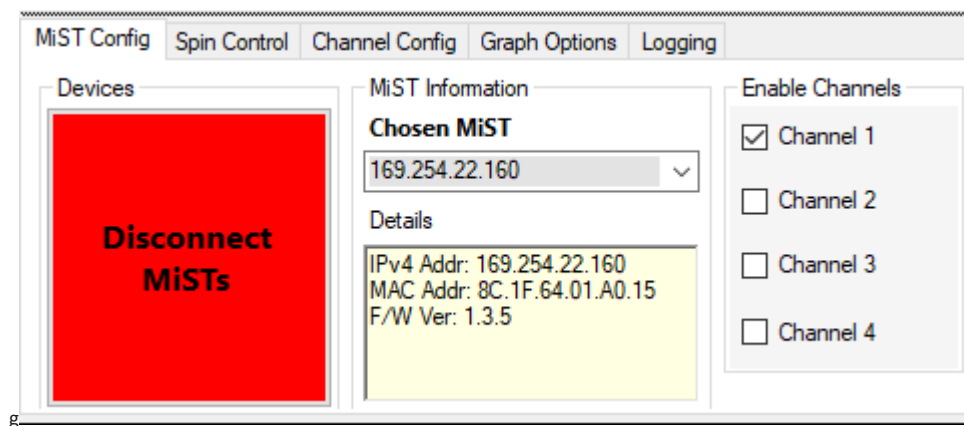
Once connected to the MiST, the application will look like this (notice the connection information now present):



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","fielddoffs":"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.

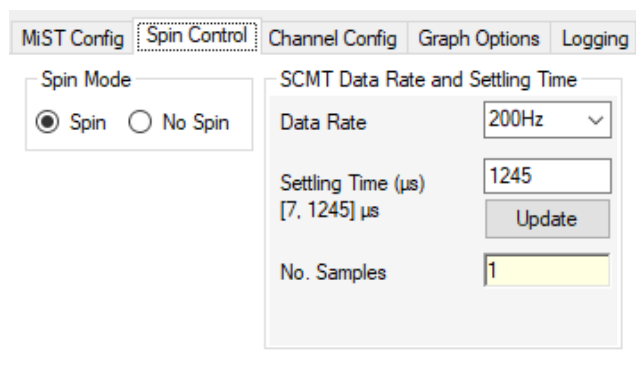
Enable Channels

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 or the Enter key 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] μ s. Attempting to set a settling time outside this range will be rejected by the software, which will instead use the nearest valid value.

The screenshot shows the 'MiST Config' software interface with the 'Spin Control' tab selected. The 'Spin Mode' section has two radio buttons: 'Spin' and 'No Spin', with 'No Spin' being selected. The 'Non-Spinning Config' section contains a 'Data Rate' dropdown menu set to '25KHz'. The 'Non-Spinning Hall Offsets' section displays four channels, each with a 'Hall Offset mV' value of 0.000 and a corresponding up/down arrow control.

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.

The screenshot shows the 'Channel Config' tab selected among 'MiST Config', 'Spin Control', 'Graph Options', and 'Logging'. Below the tab are four sub-tabs: 'Channel 1', 'Channel 2', 'Channel 3', and 'Channel 4'. The 'Channel 1' sub-tab is active, displaying three main configuration sections: 'Drive Current and Gain', 'Calibration', and 'Post Processing'. The 'Drive Current and Gain' section has 'Drive Current' set to '200uA' and 'Gain' set to '1'. The 'Calibration' section has 'Sensitivity (V/AT)' set to '100' and a 'Probe Device ID' field with a 'Submit' button. The 'Post Processing' section has checkboxes for 'LPF', 'HPF', and 'Rolling Average', each with a 'Configure' button. The 'Rolling Average' section also shows '30 seconds' and '6000 samples'.

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 ± 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 screenshot shows a 'Low-Pass Filter Configuration' dialog box. It has a 'Filter Order' dropdown menu set to '2' and a 'Cut-off Freq (Hz)' input field set to '100.00'. There are 'OK' and 'Cancel' buttons at the bottom.

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 seconds).

The screenshot shows the 'Graph Options' tab in the MiST software. It contains several sections: 'Show Hall Type' with radio buttons for 'Voltage' (selected) and 'Tesla'; 'Show Graphs' with a radio button for 'Hall Measurement' (selected); 'Graph Control' with a 'Latest data to display' dropdown set to '1 seconds', a checked 'Hide graph controls' box, and an 'Auto-centre on zoom' dropdown set to 'All channels'; 'Y-Axis Voltage/Tesla' with a 'Scale (Volts per division)' dropdown set to '1V' and 'Position (Centre)' and 'Zoom (Range)' controls showing '0V' and '10V'; and 'Saturation LEDs' with four channels, each with a status indicator and a 'Clear' button. Channel 1 is active (green), while Channels 2, 3, and 4 are inactive (grey).

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 screenshot shows the Graph Control panel in two states. The top state is 'Paused', with the 'Pause' button highlighted. The bottom state is 'Resumed', with the 'Resume' button highlighted. Both states show the same set of buttons: '<<- Scroll', '<- Move', 'Zoom In', 'Pause/Resume', 'Reset', 'Zoom Out', 'Move ->', and 'Scroll ->>'. The 'X-Axis: Span: 1.000s Centre: 25.000s' is shown for the paused state, and 'X-Axis: Span: 1.000s Centre: 42.000s' is shown for the resumed state.

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

The screenshot shows the 'Logging' tab in the MiST Config application. On the left is a large green button labeled 'Start Logging'. To its right are four configuration panels: 'Log File Path' (with a folder selection button and a text field showing 'C:\Users\ie.graham\MiST\log'), 'Log Comment' (a large text area), 'Log File Conversion' (with 'Log file to convert' and 'Convert to' dropdowns, an 'Auto-convert' checkbox, and 'Go', 'Progress 0.00%', and 'Cancel' buttons), and 'Log File Replay' (with a 'Log File to replay' dropdown and a 'Start Replay' button).

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.

This screenshot shows the 'Logging' tab after logging has started. The 'Start Logging' button has turned orange and is now labeled 'Stop Logging'. The 'Log File Path' panel now shows a specific log file name 'MiST_2023-7-06_140233.pgb' in the 'Logging to:' field. The 'Log File Conversion' panel now has a file selected in the 'Log file to convert' dropdown, and the 'Convert to' dropdown shows 'MiST_2023-7-06_140233_1.csv'. The 'Log File Replay' panel remains unchanged.

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).



Note: Large log files may take a while to convert. The application estimates the conversion time based on the size of the log file and any previous conversions since the application was first started. If the estimate is greater than 30 seconds, a warning is displayed to the user asking them if they wish to continue. The progress of the conversion will be displayed in terms of how much of the log file has been converted.

The CSV file contains actual voltage and magnetic field (Tesla) values rather than the raw byte data contained in the log file. The number of decimal places in these voltage and Tesla values may be specified; the default is nine but this may be reduced to save space. It also contains a copy of the settings in JSON format and any comments that were made at the time of logging.

The format of the values in the CSV file is dependent on whether spinning or non-spinning mode has been selected. Details are given below:

1. Software export file format when spinning

[illegible]

1. Time in seconds columns
2. 6 columns per channel. There are 4 channels (tagged a, b, c and d in this slide)
3. Data from each of the 4 phases of the modulated signal in Volts
4. Demodulated value of the field in Volts
5. Demodulated value of the field in Tesla calculated using the sensitivity values entered in the previous slide

2. Software export file format when non-spinning

Timestamp	Row Type	Board Ten	Channel 1	Channel 2	Channel 3	Channel 4	Channel 1	Channel 2	Channel 3	Channel 4	Channel 1	Channel 2	Channel 3	Channel 4	Channel 1	Channel 2	Channel 3	Channel 4	Channel 1	Channel 2	Channel 3	Channel 4	Channel 1	Channel 2	Channel 3	Channel 4	Channel 1	Channel 2	Channel 3	Channel 4	AA	AB	AC
1.	Header	2023-02-15-MIST0127.0.0.2																															
	Settings	{"Schema": "https://json-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\\io-masseglia\\MIST\\log"}, "mstks":																															
	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 -4.1E-07 7.81E-07 4.69E-07 0 6.25E-07 -3.8E-07 0 0																															
	4.00E-05 Sample	-9.7E-07 7.15E-07 -3.1E-07 -9.4E-07 7.5E-07 3.11E-07 6.3E-08 6.25E-07 -1.3E-07 -2.5E-07 -1.1E-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																															
	8.00E-05 Sample	5.63E-07 3.11E-07 6.13E-07 -6.4E-08 -3.4E-07 -3.4E-07 -1.5E-07 3.1E-08 1.88E-07 -5E-07 3.4E-08 -7.5E-07 6.35E-07 -3.1E-08 -6.4E-07 -5.6E-07 -8.9E-07 -3.4E-07 6.56E-07 -3.4E-07																															
	0.00012 Sample	2a 2b 2c 2d																															
	0.00016 Sample																																
	0.0002 Sample																																
	0.00024 Sample																																
	0.00028 Sample																																
	0.00032 Sample																																
	0.00036 Sample																																
	0.0004 Sample																																
	0.00044 Sample																																
	0.00048 Sample																																
	0.00052 Sample																																
	0.00056 Sample																																
	0.0006 Sample																																
	0.00064 Sample																																
	0.00068 Sample																																
	0.00072 Sample																																
	0.00076 Sample																																
	0.0008 Sample																																
	0.00084 Sample																																
	0.00088 Sample																																
	0.00092 Sample																																
	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.
1st line: ADC1 at 0μs, ADC2 at 8μs, ADC3 at 16μs, ADC4 at 24μs, ADC5 at 32μs
2nd line: ADC1 at 40μs, ADC2 at 48μs, ADC3 at 56μs, ADC4 at 64μs, ADC5 at 72μs
3rd line: ADC1 at 80μs....
.....

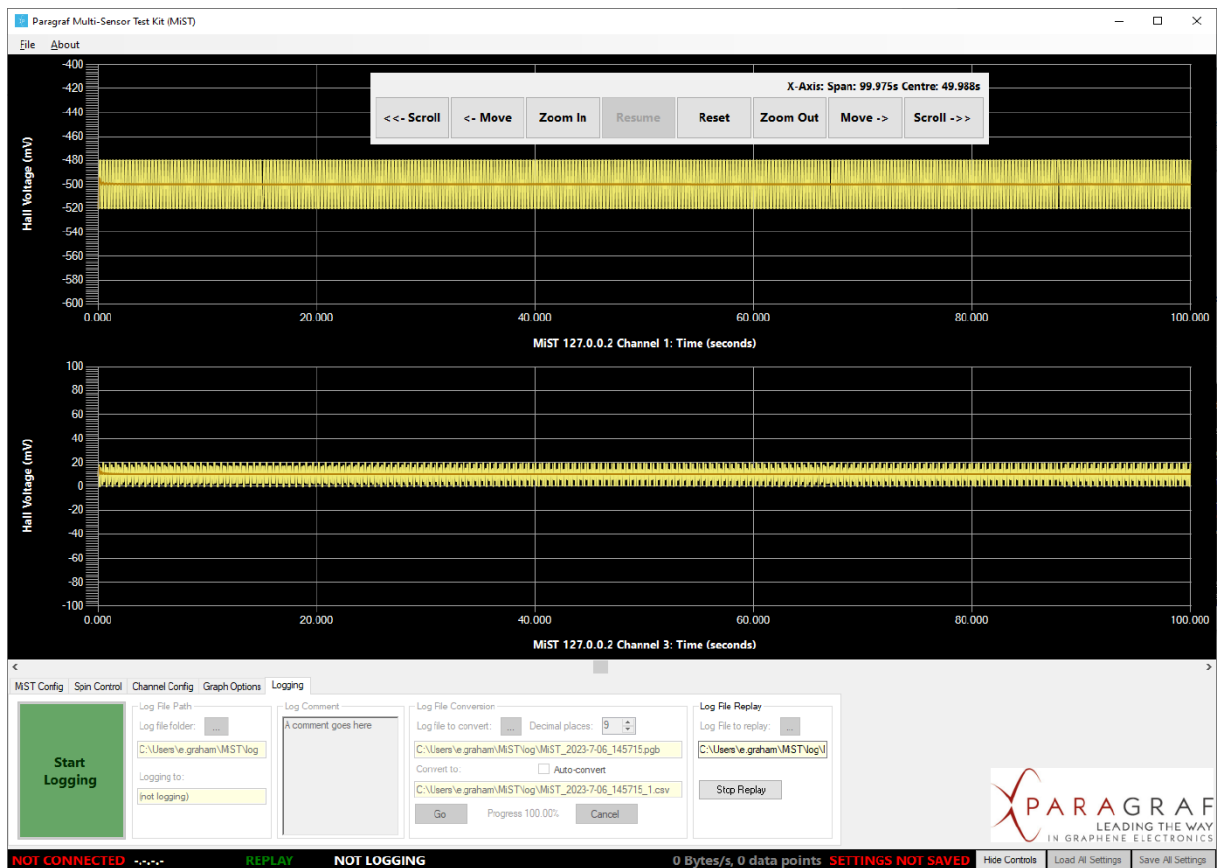
Log File Replay

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.

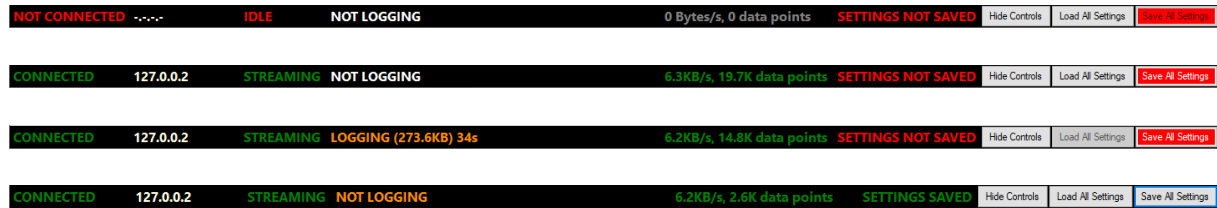
When replaying a log file, the graphs are permanently in “Pause” mode (because there is no new data coming from the MiST); therefore all settings on the Graph Options tab (see above) are available.





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.

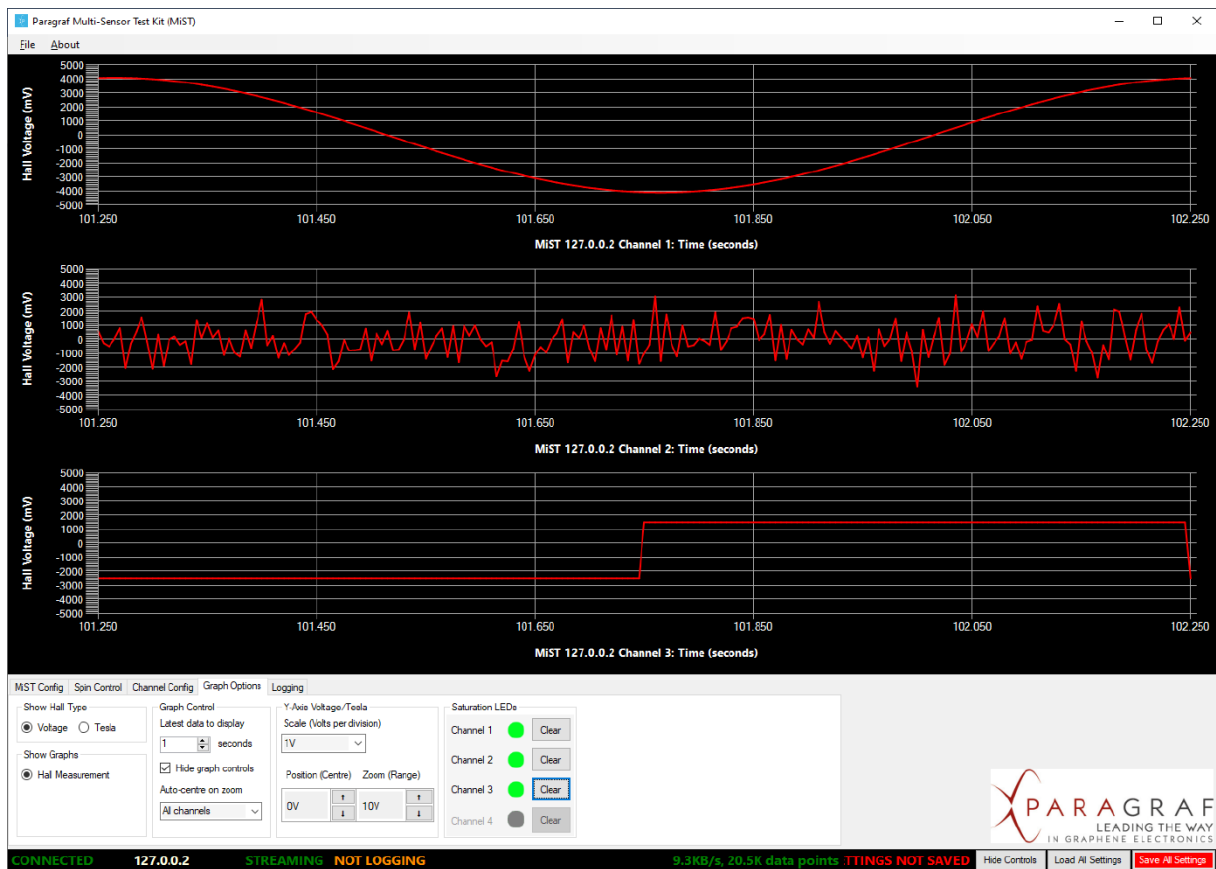
Types of error

The MiST identifies two different types of error:

- **Saturation errors**, where the voltage read is outside the range of acceptable values (namely $\pm 4.096\text{V}$, 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

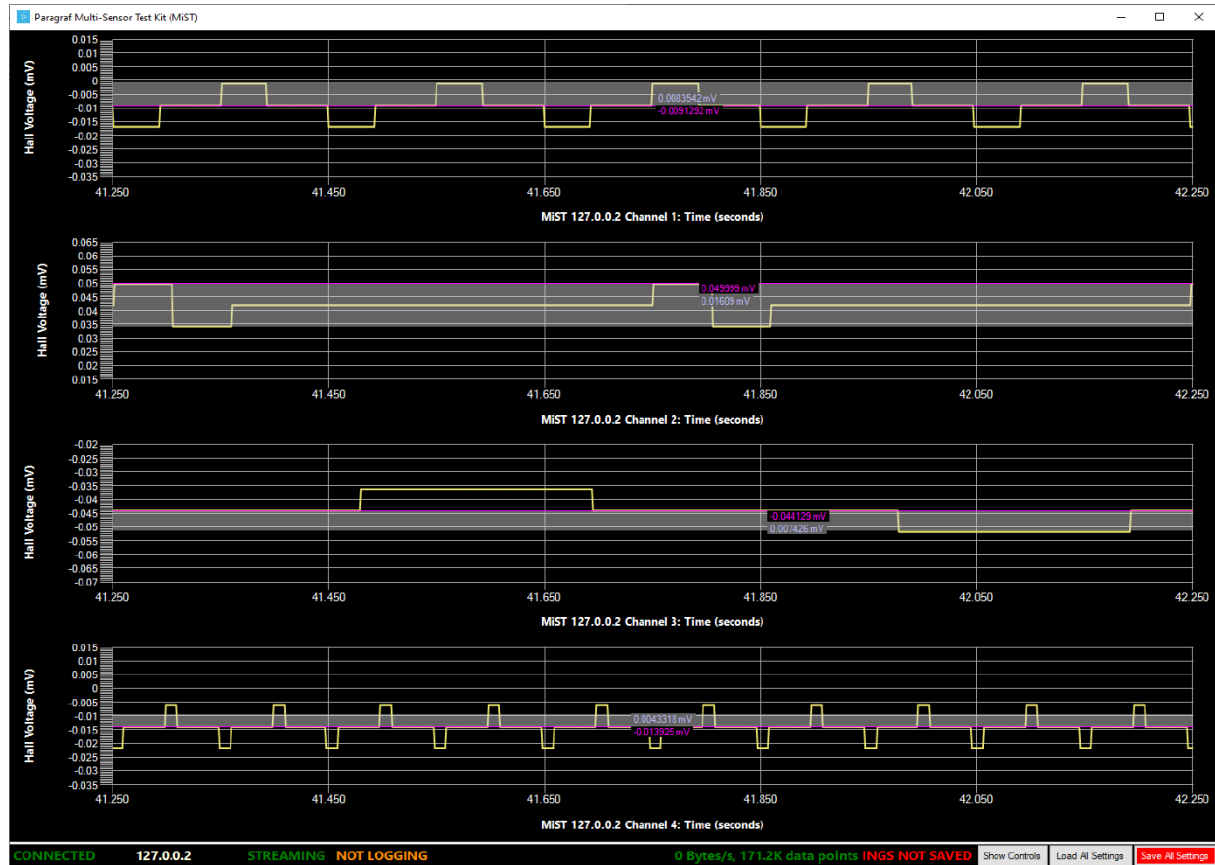
For saturation errors, the signal must be brought back into the acceptable range. This may involve reducing the gain; or (when no gain has been specified) the source of the voltage will need to be adjusted.

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 CE Declaration of Conformity



EU DECLARATION OF CONFORMITY

Product: Multi-Sensor Test Unit
Model number: MiST
Serial number: MB002420X-11XXXX
Where MB002420X = 1 or 2 and 11XXXX = 110000 – 119999
Variant: V1 and V2

Name and Address of manufacturer:

Paragraf Ltd 7-8 West Newlands Somersham Huntingdon Cambridgeshire PE28 3EB UK
www.paragraf.com Telephone +44 1223 739782

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	LVD	2014/35/EU
Electromagnetic Compatibility Directive	EMC	2014/30/EU
Restrictions on Hazardous Substances Directive	RoHS	2011/65/EU
Waste Electrical and Electronic Equipment Directive	WEEE	2012/19/EU

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 55011:2016+A11:2020, Industrial, scientific and medical equipment. Radio-frequency disturbance characteristics. Limits and methods of measurement

EN IEC 61000-4-3:2020, Electromagnetic compatibility (EMC) - Testing and measurement techniques. Radiated, radio-frequency, electromagnetic field immunity test

EN IEC 63000: 2018, Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

Additional information:

Signed for and on behalf of the above named manufacturer:

Sign:  Position: Chris Technocore Date of Issue: 23rd August 2023
OFFICER

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



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18.2 UKCA Declaration of Conformity



UKCA DECLARATION OF CONFORMITY

In accordance with UK Government guidance

Product: Multi-Sensor Test Unit
Model number: MiST
Serial number: MB002420X-11XXXX
Where MB002420X = 1 or 2 and 11XXXX = 110000 - 119999
Variant: V2

Name and Address of manufacturer:

Paragraf Ltd 7-8 West Newlands Somersham Huntingdon Cambridgeshire PE28 3EB UK
www.paragraf.com Telephone +44 1223 739782

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
The Waste Electrical and Electronic Equipment Regulations	2013	No 3133

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 55011:2016+A11:2020, Industrial, scientific and medical equipment. Radio-frequency disturbance characteristics. Limits and methods of measurement

BS EN IEC 61000-4-3:2020, Electromagnetic compatibility (EMC) - Testing and measurement techniques. Radiated, radio-frequency, electromagnetic field immunity test

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:

Signed for and on behalf of the above named manufacturer:

Sign:  Position: **CHIEF TECHNOLOGY OFFICER** Date of Issue: **23rd August 2023**
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. It 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.

AFFECTED UNITS:


Units with serial numbers from MB0024202-110011 to MB0024202-110030 have the following components unless modified by Paragraf Ltd.

Component Data:

Manufacturer: Bourns - TVS Diode

Part Number: SMAJ15A

Part Number: SMAJ24CA

MATERIAL DECLARATION SHEET						BOURNS®		
Material Number		SMAJ5.0A ~ 350A, SMAJ5.0CA ~ 130CA						
Product Line		Semiconductors						
Compliance Date		2011/01/01						
RoHS Compliant		YES	MSL	1				
No.	Construction Element(subpart)	Homogeneous Material	Material weight [mg]	Homogeneous Material Substances	CASRN if applicable	Materials Mass %	Material Mass % of total unit wt.	Subpart mass of total wt. (%)
1	Dice	Silicon	1.330	Silicon	7440-21-3	60.18	1.2800	2.127
				Phosphorus	7723-14-0	0.01	0.0002	
				Boron	7440-42-8	0.01	0.0002	
				Nickel	7440-02-0	14.8	0.3148	
				Lead-containing glass	7439-92-1	12.5	0.2659	
				Silicon dioxide	7631-86-9	10.0	0.2127	
				Aluminum oxide	1344-29-1	2.5	0.0532	
2	High-melting point Solder paste	Solder paste	2.003	Tin	7440-31-5	5	0.16	3.203
				Lead	7439-92-1	92.5	2.963	
				Silver	7440-22-4	2.5	0.08	
3	Lead frame	Copper	27.5	Copper (Cu)	7440-50-8	99.8	43.89	43.978
				Iron	7439-89-6	0.15	0.066	
				Phosphorus	7723-14-0	0.05	0.022	
4	Molding compound	Epoxy material	31.035	Silica	14808-60-7	76	37.72	49.632
				Epoxy resin	25028-94-3	9	4.467	
				Phenolic resin-A,B	9003-35-4	8	3.971	
				Aluminum hydroxide	21645-51-2	6	2.978	
				Carbon black	1333-86-4	1	0.496	
5	Plating	Matte-100% tin	0.663	Tin	7440-31-5	100	1.06	1.06
			Total weight	62.531				
<p>This Document was updated on: 2015/02/09 (EU) RoHS Directive 2011/65/EU Application of lead which are exempted from the requirements: 7(a) Lead in high melting temperature type solders (i.e. lead-based alloys containing 85 % by weight or more lead) 7(c)(i) Electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors, e.g. piezoelectric devices, or in a glass or ceramic matrix compound.</p>								
Headquarters Riverside CA				www.bourns.com				page 1 of 1

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

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