

BlazeMetrics

Gen 1 through Gen 2.5

BlazeBasic, and BlazePlatform Manual

Blaze UI and Office Software 148.03.10

January 2023



Published 18 January 2023 for Blaze software release 148.03.10

Copyright 2023 by Blaze Metrics LLC

Blaze Metrics, LLC
8825 34th Avenue Ne Suite N
Quil Ceda Village, WA 98271
USA
support@BlazeMetrics.com
www.blazemetrics.com

BlazeMetrics systems are covered by U.S. Pat. No 11,169,086.

Table of Contents

Chapter 1: Introduction	13
Searching this manual electronically	13
Notations used in this manual	13
General Policies	13
Software License and Upgrades	14
Computer Warranty and Service	14
Service, Training and Technical Support	14
Disposal	14
Chapter 2 Site Preparation	16
System Components	16
Space and weight	20
General installation environment	21
Utilities	21
Environmental conditions	22
Wetted Components	23
Internal approval for installation	24
Chapter 3 Safety	25
General Safety	25
Blaze Basic (Microscopy Only) System Laser Classification and Safety	25
Blaze Platform (Raman) System Laser Classification and Safety	25
CE, UL and Regulatory Compliance	28
Chapter 4 Product Description	30
System Overview	30
Probe Configurations	30
Main Enclosure	31
Applications and Capabilities	31
Chapter 5 Installation	32
Site Preparation by Customer	32
Unpacking	32
Unpacking Instructions for Units with NEMA Enclosure	35
Installation Instructions for Lab Systems	36
Installation Instructions for Pilot Probe with NEMA Enclosure	38

Enclosure Installation.....	38
Probe Installation.....	39
Probe Gas Connections	39
Using The Cool Gas Connection	40
Using the WINDOW Gas Connection	40
Alternative USB Cables Between Blaze and Computer.....	40
Raman Set Up for First Generation Blaze	40
Remote Interlock.....	41
Fiber Optic Connectors	41
General Instructions.....	42
Blaze Raman Connectors	43
Raman Set Up for Blaze Platform.....	44
Laser Hardware On/Off Keys	44
Set Up of External Raman System.....	44
Input of External 785 Raman Laser into Blaze Platform	44
Blaze Enhanced Safety Feature.....	45
Cleaning the Fiber Connections	45
Software Set Up	45
Customer Supplied Computers and Computer Configuration.....	45
General.....	45
Blaze UI Software and Installation	46
Blaze Office Software and Installation	46
Blaze UI Start Up Sequence.....	46
Chapter 6: System Start Up.....	47
Window Reference	47
Chapter 7: Routine operation	53
Starting The Blaze Unit.....	53
Indicator lights	53
Probe Position.....	53
Probe Installation in a Lab Reactor	54
Probe Installation in a Pipeline	55
Software Overview.....	56
New Data Format and Migration of Old Data.....	58

Quick Steps to Data.....	60
Acquire Window.....	61
Recall 1.....	61
Recall 2.....	61
Sample Compare.....	61
Keys to Collecting the Right Data.....	61
Annotating an Experiment.....	62
Automatic Annotations.....	64
Modifying or Adding Annotations in Review Mode.....	64
General Display control.....	67
Distribution and Trend Autoscaling	67
Zooming in X	67
Zooming in Y.....	68
Panning (Moving) in X or Y.....	68
Trend Display	69
Image Display	70
Live Image Display.....	70
Image Measurement Tool.....	72
Image Information	73
Visual Trend (Image Slices)	74
Selecting Individual Images.....	74
Recalling and Reviewing Data	74
Chapter 8: Advanced Operation	76
Full Menu Bar Descriptions	77
Play.....	78
Record	78
Schedule Experiment Stop	79
Save Measurements Every (seconds or minutes).....	80
Images per Second, Minute, or Hour.....	81
Recommended Measurement and Image Saving Settings	81
Recommended Data Transfer and Backup Frequency	83
Triage	83
Advanced Triage Parameters	84

Image Plane Position.....	85
Laser Indicator	87
Laser Energy	88
Overview of Blaze Platform Raman Controls.....	90
785 nm Raman Modes	90
785 Off	90
Simultaneous Blaze Microscopy & 785 Raman.....	90
Alternating Blaze Microscopy & 785 Raman	91
785 Only	92
Manual 785nm Raman ON, no external control.....	93
Set 785 nm Laser Power	93
532 nm Raman Modes	94
532 Off	94
Manual 532 nm Raman.....	94
532 nm Raman Only.....	95
Window Cleaning	95
785 nm Laser Activity Indicator	96
External Laser Warning	96
Start Up Sequence: Blaze UI & PanoramaWasatch - Same Computer	96
Averaging	97
Method	98
Image Tools.....	99
Minimum Black Level Applied.....	100
Binning	101
Gamma.....	101
White Level Minimum Percent	101
Black Level Minimum Percent.....	102
Maximum White Level Applied.....	102
Auto Gamma	102
Pixel Interpolation.....	102
Color Saturated Pixels	102
System Defaults and Undo Latest Changes	103
Stats Config (Statistical Configuration)	103

Presets.....	103
Advanced Customization	103
Trend #	104
Source	105
Distro.....	105
Statistic.....	105
Weight Type	106
Minimum and Maximum Length	107
Percentile	107
Chi Square	108
High Dynamic Range Turbidity (HDR_Turbidity).....	108
Channel Grouping	109
Applying Changes.....	110
Trend Window	110
Time Axis	110
Y Axis	111
Pins Basic Functions	112
Pins for Image Selection and Image Scrolling	114
Pins for Reference Distribution and Sample Compare	114
Live Pin	115
Quick Selecting Pins from Visual Trend.....	115
Stats Table.....	115
Clean	118
Recall 1	119
Close Recall 1	121
View Experiment Details.....	122
Export Data to Excel Spreadsheet.....	123
Export all RAW Images to PNG format	124
Append, Crop, Extract Section(s) of Experiment Data	124
Open Folder for PNG Captures Video	128
Recall 2	128
Recall 3	129
Experiment Information.....	129

Sample Compare.....	130
Settings.....	134
Change Blaze Experiment Files Location.....	134
User Preferences.....	134
Acquisition Parameters.....	135
Device Info	136
Diagnostics	136
About.....	136
Blaze Metrics Website	137
Contact Us.....	137
Exit Application	137
Legal Info.....	137
Distribution Window.....	137
Legend.....	138
Grid.....	138
Axes.....	138
Weighting.....	139
Recommended Weighting	140
Absolute Number and Percent	141
Image Window	141
Save Image PNG	142
Color Map.....	143
Color Bar	143
Enhancement	143
Sizing	144
Importer for Reading in OPC Data	144
21 CFR Part 11.....	144
Chapter 9 Operational Tips	145
Data Transfer and Backup.....	145
External Drive Type	145
Use of Mobile Cart	145
Probe Angle and Orientation in Reactor	146
Probe in Solution Before Recording Data	146

Measuring in Small Vials	147
Measuring in Flow Cells and Pipelines	147
Raman Spectra	147
Room Light and Sunlight Effect on Blaze and Raman	148
FBRM and PVM Effect on Raman	148
Chapter 10 Data Analysis and Reporting	149
Exporting Displays to Reports	149
Alternative Method for Pasting into Reports	150
Recall 1	151
Pins	152
Pin and Dot Position	152
Selecting An Individual Image	152
Scrolling Through All Selected Images	152
Pins for Reference Distribution and Sample Compare	153
Pins for Sample Compare	153
Quick Select of Pins from the Visual Trend	154
Automatic Pin Placement	154
Automatic Sorting of Pins	154
Y Scale of Trends	155
Recall 2	156
Video Creator	156
Sample Compare	159
Trend Compare	163
Export Data to Excel Spreadsheet	165
Export all RAW Images to PNG format	166
Show Saved PNG Captures	167
Exporting Blaze Trends to iControl™	167
Appendix A Purge Accessories	168
Condensation Prevention Kit for Probe Window	168
Mounting	168
Connections	168
Instructions	169
Probe Head Cooling Kit	171

Purge Connections for Blaze Pilot Probes.....	171
Using the Probe Head Cooling (COOL)	172
Using the Condensation Prevention (WINDOW)	172
Appendix B Probe Mounting Options.....	173
Glass Reactor Adapters	173
Threads for Flexible Mounting of Adapters	173
Dip Pipe Mounting Adapter	175
Y-Flow Fitting	176
Radial Flow Cell	178
Appendix C Window Replacement Procedure	182
Equipment and Parts.....	182
Instructions	182
Appendix D FAQs and Troubleshooting.....	185
Support Contact Information.....	185
Is vibration ok for the probe and optics? What about ultrasonics?	185
Log files for diagnostics.....	185
Image and Measurement Show Different Time Stamps from Each Other	185
Different Images Show the Same Time Stamp	185
Image not changing.....	186
Laser won't turn on.....	186
Image is black or nearly black	186
Clean System Message Appears During Measurement.....	186
Image contains spots that don't move	187
Image contains large dark areas	187
Image contains unexpected particles	188
Probe Window Appearance and Damage.....	188
Can't Find Image Plane Focus	189
Image Plane Not Moving.....	190
Slow updating of live image	190
Not connected to camera	190
Blaze UI not working after uninstalling Pylon RunTime.....	192
Not connected to laser or No focus device detected	192
Unrecoverable camera error message	192

Connected but software not working	192
Communication errors and loss in laser intensity	192
Communication errors and/or slow software response	193
Communication errors after connecting Bluetooth headset.....	193
Software stopped running when unattended	193
Software crashes after pressing play button	194
Exported images look different (darker or lighter) than in Blaze software	194
Image File Name, Epoch Time, and Date Time	194
Reading the SQLite database files used to store Blaze data	194
File transfer and data backup is slow.....	195
Sharing Files Outside the Network	196
IT/Network Questions.....	196
Comparing Blaze Results to Older Technologies Including FBRM®	197
Appendix E Errors and Warnings	200
Laser	200
Under Temperature Warning	200
Over Temperature Warning.....	200
Laser State Warning	201
Probe Head	201
Over Temperature Notice	201
Over Temperature Warning.....	202
Over Temperature Error and Measurement Pause	203
Excess Image Plane Movement Detected.....	203
Appendix F Index, Glossary and Abbreviations.....	204
Appendix G Team Viewer	205
Appendix H First Time Installation Instructions for Blaze UI on Customer Supplied Computer	206
Main Steps	206
Computer Requirements	206
Other Requirements:	206
Step 1 Installing Drivers and Remote Support Software	207
Step 2 Installing Blaze UI Software	212
Step 3 Optimizing Computer Performance.....	216
Appendix I Installation Instructions for Blaze Office on Customer Supplied Computer	238

Computer Requirements	239
Other Requirements:	239
Appendix J Laptop Port Expander Connections	240
Appendix K Blaze Pilot NEMA Enclosure Drawing	241
Appendix L Terms and Conditions	242

Chapter 1: Introduction

This manual covers the site preparation, safety, installation, and routine operation of Blaze Metrics systems. The Blaze Metrics 400 and 900 systems are designed for laboratory and pilot scale reactors used for research, development, and process optimization. Blaze Metrics systems are available in multiple configurations. Differences in the field of view or probe dimensions are noted in the text but are not broken out separately. Additional safety considerations related to systems equipped with a Raman Channel are called out with additional notations. Interfacing to a Raman spectrometer and laser is covered in the installation section.

If you cannot find the necessary hardware related information in this manual or have additional questions, please contact Blaze Metrics directly.

Searching this manual electronically

The PDF version of this manual can be searched in Browsers and PDF readers by pressing 'ctrl + f' and then typing the word or phrase of interest. The first result is often in the table of contents, click on the table of contents entry to jump to that section. The word or phrase may be in multiple portions of the manual, however the primary section listed in the table of contents is typically the best point to start.

Notations used in this manual

The following icons will be used to call out steps of special importance including those related to personal safety or potential equipment damage.



Information icon denotes step or detail of relevance to an inexperienced user



Caution icon denotes step with potential for general hazard or equipment damage if done incorrectly.



Laser Safety icon denotes step where exposure to hazardous radiation may occur if done incorrectly.

General Policies

Site preparation is the responsibility of the end user. This includes facility modifications and compliance with applicable company and local safety requirements.

Blaze Metrics will not provide certifications for mechanical designs that interface the Blaze Metrics probe to the end user's process equipment.

Blaze Metrics warrants its products for 16 months from date of installation or 18 months from date of shipment, whichever comes first. The warranty is limited to defects in materials and workmanship. In the event a factory repair is required, Blaze Metrics will issue a return materials authorization (RMA). It is recommended to keep the original packaging in the event return shipment is required. See Blaze Metrics General Terms and Conditions for details.

Software License and Upgrades

Blaze Metrics software comes with a perpetual license, there is no required annual maintenance fee. Additional new features added to specific software package(s) will be included in free of charge upgrades for at least a year from date of shipment.

Computer Warranty and Service

Blaze Metrics will provide computer technical assistance as it relates to the installation, maintenance, and use of the Blaze Metrics software. Compliance with company specific IT policies is the responsibility of the end user. Warranty and service of the computer included with the Blaze Metrics system will be provided by the computer manufacturer.

Service, Training and Technical Support

Please contact the Blaze Metrics for service, training, and technical support:

Blaze Metrics, LLC
8825 34th Avenue Ne Suite N
Quil Ceda Village, WA 98271
USA

info@BlazeMetrics.com

+1-206-338-5220

Each Blaze Metrics system comes with Team Viewer software pre-installed so that upgrades, training, and troubleshooting can be made over the internet. The end user must enable Team Viewer and provide the pass code to allow Blaze Metrics to access their system. Details are covered in Appendix G on Team Viewer.

Blaze Metrics partners with UPS for shipments within the United States and DHL for international shipments. Please notify us immediately if you are shipping to Blaze Metrics from outside the United States via another carrier because this may result in delays and additional costs in broker/forwarder fees.

Disposal

When this product reaches end-of-life it should be disposed of in accordance with local regulations at the collecting point specified for electrical and electronic equipment.



Customers subject to WEEE (European Directive 2012/19/EU on Waste Electrical and Electronic Equipment) can arrange the return of an end-of-life product as follows:

1. Contact Blaze Metrics Customer Service.
2. Blaze Metrics LLC will provide a WEEE RMA number, a shipping account number, and a ship to address.
3. Package the product and ship to Blaze Metrics LLC. (If possible, use the original shipping box, otherwise provide an adequate container and enough padding to securely protect the unit). The product

will be dealt with per Blaze Metrics' end-of-life recycling program in strict accordance with environmental regulations.

Chapter 2 Site Preparation

For the purposes of site preparation there are two configurations: microscopy or microscopy + Blaze Raman Channel. Additional requirements for Blaze Raman will be broken out separately.

System Components

The microscopy configuration consists of the sensor probe and connected main enclosure as well as a separate computer. The sensor probe comes in two standard sizes and on standard lab units is connected to the main enclosure by an armored conduit of 8.5 feet (2.6 m) standard length with a bend radius of 10 inches (25.4 cm). There is an option for a longer conduit of 15 feet (4.6 m) with a bend radius of 12 inches (30.5 cm). The Pilot probe has a conduit of 13.8 feet (4.2 m) with a bend radius of 12 inches (30.5 cm). The conduit or its connection to the probe or main enclosure cannot be altered by the User; any attempts at alteration will void the warranty. The computer is connected to the main enclosure by a 6.5 foot (2 m) long USB 3.1 cable. This USB 3.1 cable can be disconnected when needed. This cable is tested for and dedicated to the Blaze system, other USB 3.1 cables are not assured to work with the system and not covered under the warranty. The main enclosure and computer should be installed outside of the fume hood or other protected area.

Drawing showing overall components and arrangement of cables/conduits:

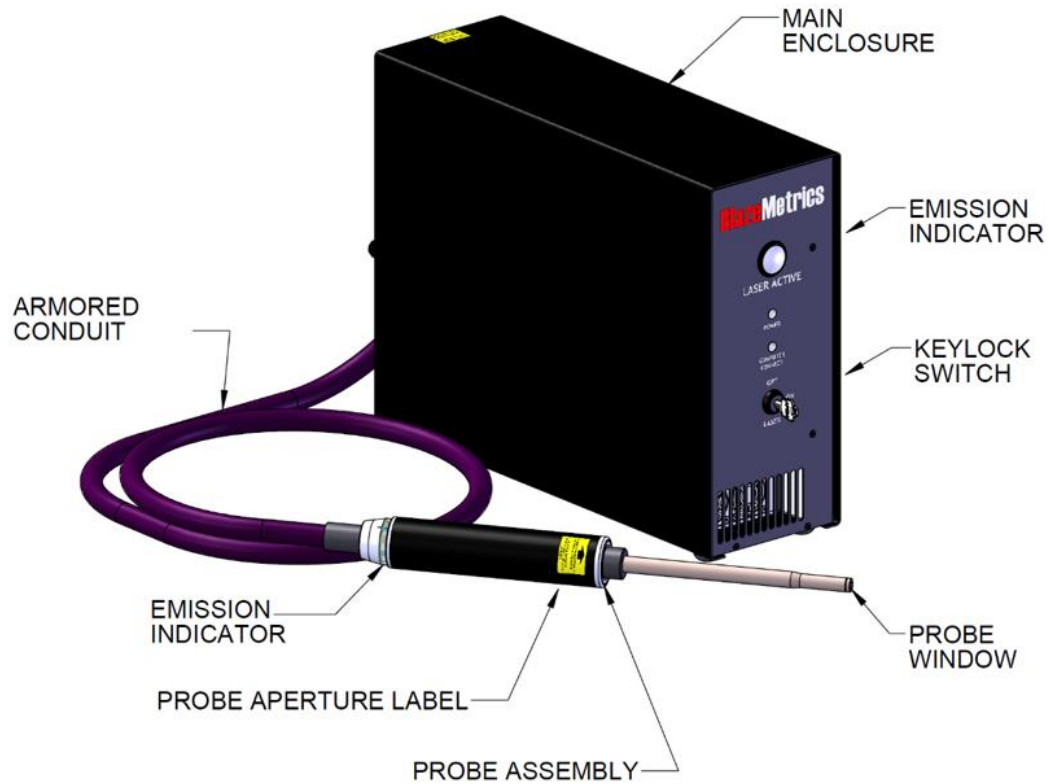
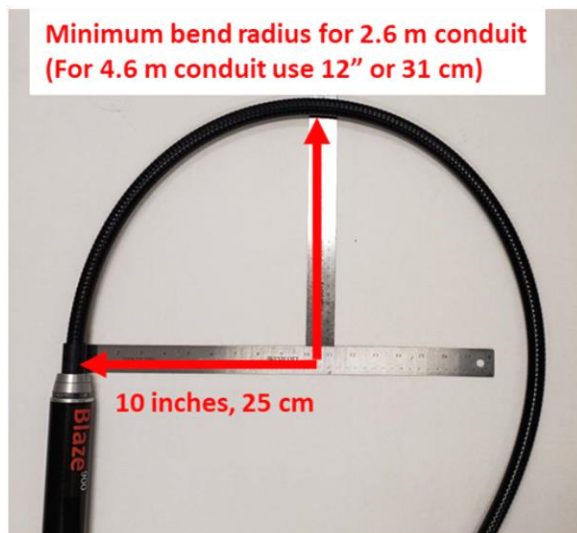
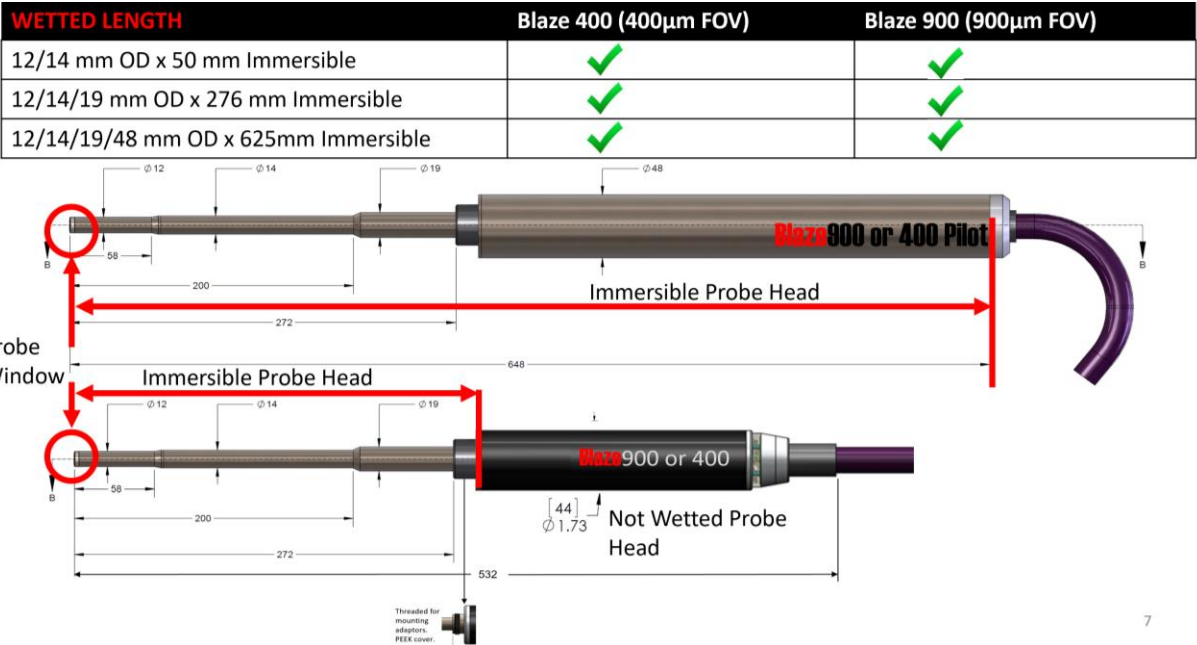


Photo showing standard lab probe allowed 10-inch (25.4 cm) conduit bend radius, do not bend more than this for conduits < 4m. If conduit is > 4m the allowed bend radius is 12 inches (30.5 cm).

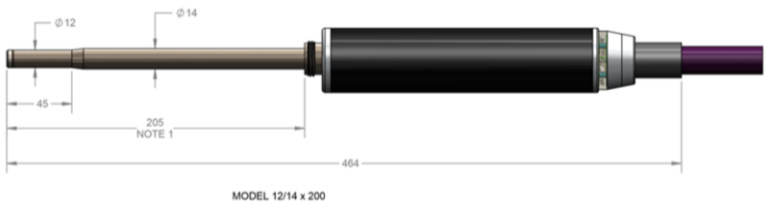


The Blaze 400 and Blaze 900 are available in all standard probe sizes (**Note:** please visit the [BlazeMetrics Website](#) for the most up-to-date probe configurations available):

Standard Probe Size Options



Probes shipped prior to fourth quarter 2019 were 206 mm immersible length (dimensions below). Upgrades to 276 mm wetted length are available.



CLASS 1M Laser Device: Blaze Metrics Microscopy Systems are Class 1 Laser devices unless otherwise specified. Appropriate eye protection precautions matching your corporate safety rules should be taken. **DO NOT** look into the probe tip.

Microscopy + Raman Systems:



CLASS 3B Laser Device: Blaze Metrics Microscopy and Raman Channel Systems, unless otherwise specified, are Class 3B Laser devices. Appropriate eye protection precautions matching your corporate safety rules should be taken. Do NOT look into the probe tip. Make sure to follow all safety precautions associated with the internal or external excitation light source.

The Microscopy + Blaze Raman Channel: For 532 nm excited Raman the internal 532 nm laser source is utilized for excitation, and an external Raman Spectrometer built for acquiring spectra from 532 nm excitation is required. 785 nm Excited Raman requires both an external 785 nm Raman Excitation Laser source and a Raman Spectrometer built for acquiring spectra from that 785 nm source.

For 532 nm excited Raman, a single fiber optic cable connects the Blaze Collection to the Spectrometer. For 785 nm excitation, two fiber optic cable connections are made: one for the excitation light source, and the other for transferring the collected Raman light. [Note: An optional accessory developed by Kaiser in collaboration with Blaze is available to optimize the signal and hence to substantially improve the signal to noise between the Kaiser RXN Raman systems and the Blaze Raman Channel. It requires a Kaiser PhAT probe collection connector and is connected in the same way as the standard method described below. The PhAT probe connector can be supplied for the RXN1. For the RXN2 the system requires an upgrade. Please contact Blaze Metrics if you would like this accessory.]

Standard Blaze Raman Channel to 532 nm Raman Spectrometer:

- 400µm diameter NA 0.37 (or lower NA depending on the spectrometer used) fiber optic cable connects the Blaze Collected Raman Spectroscopy Output, to the 785 nm or 532 nm Spectrometer.

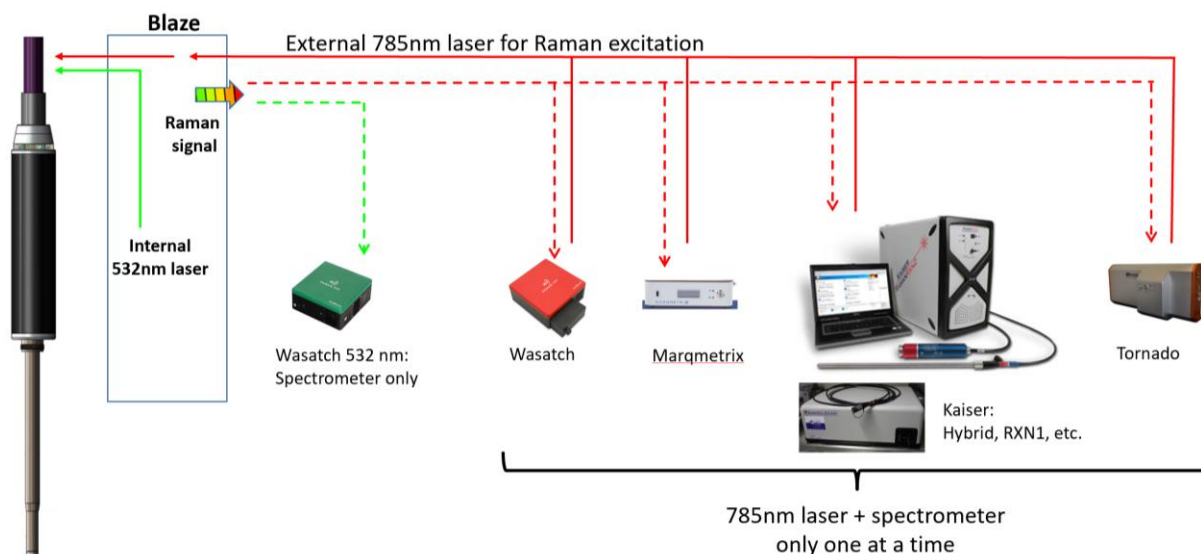
Standard Blaze Raman Channel to external 785 nm Raman Excitation source and Spectrometer:

- 100 or 105 µm diameter 0.22 NA fiber optic cable connects the external 785 nm laser source to the Blaze Main Enclosure
- 400µm diameter NA 0.37 (or lower NA depending on the spectrometer used) fiber optic cable connects the Blaze Collected Raman Spectroscopy Output, to the 785 nm Spectrometer.

Note: There is a Blaze accessory to allow *collection of both 785 nm and 532 nm* excited Raman. Two spectrometers are required. Please contact Blaze Metrics if you require this accessory.

Fiber Optic length and minimum bend radius vary depending on fiber type.

Raman Integration Notes



Space and weight

Main Enclosure footprint: 35cm height x14.4cm wide x 45cm deep; approximate weight 20.6lbs [9.3kg]

Sensor probe dimensions see drawing above, approximate 1.6lbs [0.72kg]

Overall weight of lab model sensor probe, conduit, and main enclosure is 23.4lbs [10.6kg]

Computer footprint varies depending on the system.

Raman Spectrometer size and weight depends on the model used. See Raman Spectrometer Manual for details.



General installation environment

The Blaze Metrics 400 and 900 lab systems are designed for indoor installation. The wetted portion of the sensor probe is designed for direct immersion in a chemical reactor or process stream, the non-wetted portion and supporting enclosure are not designed or rated for process conditions. Environmental conditions for each system component are given separately.

Utilities

A DC power source (output 24VDC 5A) is connected to the main enclosure and supplies both the main enclosure and sensor probe. A 90-240 volt alternating current (VAC) to 24 VDC power adapter or Country appropriate 24 VDC power adapter is included with the system, it requires a single standard line voltage outlet. See Regulatory Compliance section for further details on the power adapter.

There are two separate purge systems available:

- 1) Condensation Prevention Kit with N₂ purge to prevent internal condensation at the probe window. Recommended for operation below 5°C. Note: the Wetted Tip Standard Operation Range is -5°C to 100°C.

Clean, dry nitrogen supply required (not to exceed 45 psi or 3 bar gauge)

Purge Connection is barbed fitting for 4 mm ID tubing

Flow is typically 0.2 l/m max at 2 bar or 29 psi

Blaze strongly recommends using high purity N₂ from a cylinder as the condensation

prevention gas. The internal optics are exposed to the purge gas, damage due to contaminants from the gas are not covered under warranty. If instrument quality air (ANSI/ISA S7.0.01-1996 standard) is used, special attention should be paid to maintenance of the filter system to prevent the introduction of oil and dust.

- 2) Probe Head Cooling Kit using instrument air purge of non-wetted back section of the probe for cooling of the sensor and other components when installed in a Dip Pipe or other unusually hot environment. This enables operation of the non-wetted backend of the probe up to 62°C [Note: future production versions will enable higher operational temperatures], 131°C non-operational (cleaning) utilizing the Blaze Dip Pipe installation method. Note: not ATEX.

This cooling purge option requires clean dry air or nitrogen meeting ANSI/ISA S7.0.01-1996 Quality Standard for Instrument Air which requires:

- pressure dew point as measured at the dryer outlet shall be at least 10°C (18°F) below the minimum temperature to which any part of the instrument air system is exposed. The dew point shall not exceed 4°C (39°F) at line pressure.
- maximum 40 micrometer particle size in the instrument air system is acceptable for the majority of pneumatic devices. **Pneumatic devices that require instrument air with less than 40 micrometer particle sizes shall have additional filtration to meet the particulate size limit for the device.**
- Subsequent to any maintenance or modification of the air system, maximum particle size in the instrument air system should be verified to be less than 40 micrometers or the particulate size limit.

- lubricant content should be as close to zero as possible, and under no circumstances shall it exceed one (1) ppm w/w or v/v. Any lubricant in the compressed air system shall be evaluated for compatibility with end-use pneumatic devices. For example, the use of automatic oilers is strongly discouraged.

The NEMA (IP66) enclosure has an air inlet to cool internal heat generating components. The air used for cooling must meet instrument air standards.

The computer includes its own power adapter, system dependent. Note: for Dell XPS laptops the power must be plugged directly into the computer, not the port expanders which is not rated for the required wattage.

Raman equipment requirements vary by manufacturer. Typically, they require a single standard line voltage outlet. See Raman Spectrometer Manual for details.

Environmental conditions

Wetted Probe Tip

Condition

Allowed Range

Temperature

Operation from -5°C to $+100^{\circ}\text{C}$ with the condensation prevention kit; can be steam cleaned to 131°C when non-operational and turned off when equipped with probe head cooling purge.

Relative Humidity

Non-condensing, use of condensation prevention kit required when below $+5^{\circ}\text{C}$

Pressure

Vacuum to 147 psi (10 bar) for probes made in 2019 or later, vacuum to 87 psi (6 bar) for probes made prior to 2019. Higher pressure option to 22 bar available.



The window is designed for operation over a wide temperature range as experienced in chemical reactors. It is not designed to withstand thermal shocks from sudden temperature changes by switching instantly from hot to cold solution (or vice versa) or sudden contact with dry ice or similar situation where the temperature change is several degrees per second.

Non-wetted back end of probe & conduit

Condition	Allowed Range
Temperature	30 °C
Relative Humidity	N/A

Main Enclosure and Computer

Condition	Allowed Range
Temperature	30 °C
Relative Humidity	Non-condensing

For Raman Laser Excitation Source & Spectrometer and Computer environmental requirements, please see their respective manuals.

Wetted Components

Only the probe tip is designed to be a wetted part for immersion in a process vessel, pipeline, or flow cell. The four wetted components are constructed of the following:

- 1) Probe tip body and window assembly body- Alloy C276 (or C22) standard, 316 Stainless steel and custom materials available.
- 2) O-ring between tip and window body- Kalrez 7075 standard, ETP available.
Welded tips without O-rings are also available.
- 3) Window- synthetic sapphire standard, synthetic diamond available.
- 4) Standard window braze is electroplated with high purity nickel for chemical resistance with a layer of gold on top, custom materials available. For some applications a protective inert metal oxide layer is used. Please contact Blaze to verify the exact materials used in your configuration.



NOTE: the standard window configuration is not designed for dry powder use. This includes but is not limited to dryers, blenders, or fluid bed reactors. For these environments, please request a suitable window configuration from Blaze Metrics. Use of a Blaze probe without a suitable window will void the instrument warranty.

Internal approval for installation

Please ensure all necessary internal approvals are completed prior to installation.

For Blaze first generation systems equipped with a Blaze Raman Channel and all Blaze Platform systems, please ensure the necessary safety precautions for a Class 3B laser system are in place at the time of installation. Note: all 785 nm excited Raman systems are Class 3B.

Chapter 3 Safety

The different models have distinct laser classifications and distinct laser safety requirements. Read carefully and act appropriately for your configuration.

General Safety

The Blaze system has no user accessible moving parts and operates using 24 Volt DC power to minimize mechanical and electrical hazards. However, proper safety precautions including personal protective equipment (e.g., safety glasses, gloves) should be used whenever interacting with the hardware system to avoid exposure to the chemical or biological process being measured by the Blaze system.

Blaze Basic (Microscopy Only) System Laser Classification and Safety

Blaze Basic systems and first generation Blaze systems with microscopy only are compliant with Class I laser product as defined by DHHS 21 CFR 1040.10 and 1040.11 except for deviations pursuant to LASER NOTICE 50 dated June 24, 2007.

Blaze Basic systems and first generation Blaze systems with microscopy only are also compliant with Class 1M laser product as defined by IEC 60825-1.



LASER SAFETY WARNING: There are no user serviceable items inside the main enclosure. Opening the enclosure and adjusting the internal components may result in hazardous radiation exposure.



Looking directly into the aperture of any laser-emitting device is never advised. Do not bring the probe window close to your eye.

Blaze Platform (Raman) System Laser Classification and Safety

Blaze Platform systems and first generation Blaze systems with Raman are configured with two lasers, a 532 nm laser for microscopy and Raman spectroscopy, and a 785 nm laser for Raman spectroscopy.

The Blaze system is a Class IIIb laser product and complies with 21 CFR 1040.10 and 1040.11 except for conformance with IEC 60825-1 Ed. 3, as described in Laser Notice No. 56, dated May 8, 2019.

The Blaze systems is a Class 3B laser product in accordance with IEC 60825-1.



LASER SAFETY WARNING: There are no user serviceable items inside the main enclosure. Opening the enclosure adjusting the internal components may result in hazardous radiation exposure. Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.



DANGER: Visible and Invisible Laser Radiation is emitted from the window. Avoid direct exposure to the beam. Shielding of the vessel or use of laser protective eyewear required for operators in proximity of the probe.

Laser Classification: Blaze systems contain one or two lasers.

Laser 1:	Wavelength:	532 nm
	Max. Pulse Energy:	12 uJ
	Pulse Duration:	15 ns
	Max. Repetition Rate:	5000 Hz
	Beam Divergence:	>95 mrad
Laser 2:	Wavelength:	785 nm CW
	Max. Power Output:	480 mW
	Beam Divergence:	>84 mrad

Laser Controls, Adjustments, and Safety Devices

Power Switch: The power rocker switch is located at the back of the Main Enclosure. When the power switch is ON, the cooling fans will be running and temperature controls for the lasers will be active.

Laser Key Switches: The Laser Key Switches are located on the front panel of the Main Enclosure. When a switch is ON, the laser is enabled, and when the switch is OFF the laser is disabled. The key can only be removed in the OFF position.

Emission Indicators: There are three indicators that illuminate if the laser is enabled.

- At the top of the operator's computer screen
- The "Laser Active" light on the front panel of the Main Enclosure
- An LED ring on the end of the probe where the conduit is attached

Remote Interlock: The 2-pin remote interlock connector is located on the back panel of the Main Enclosure above the power switch. If the pins are shorted together the laser can be operated. The connector can be used to disable the laser remotely if a switch is opened to indicate an unsafe condition.

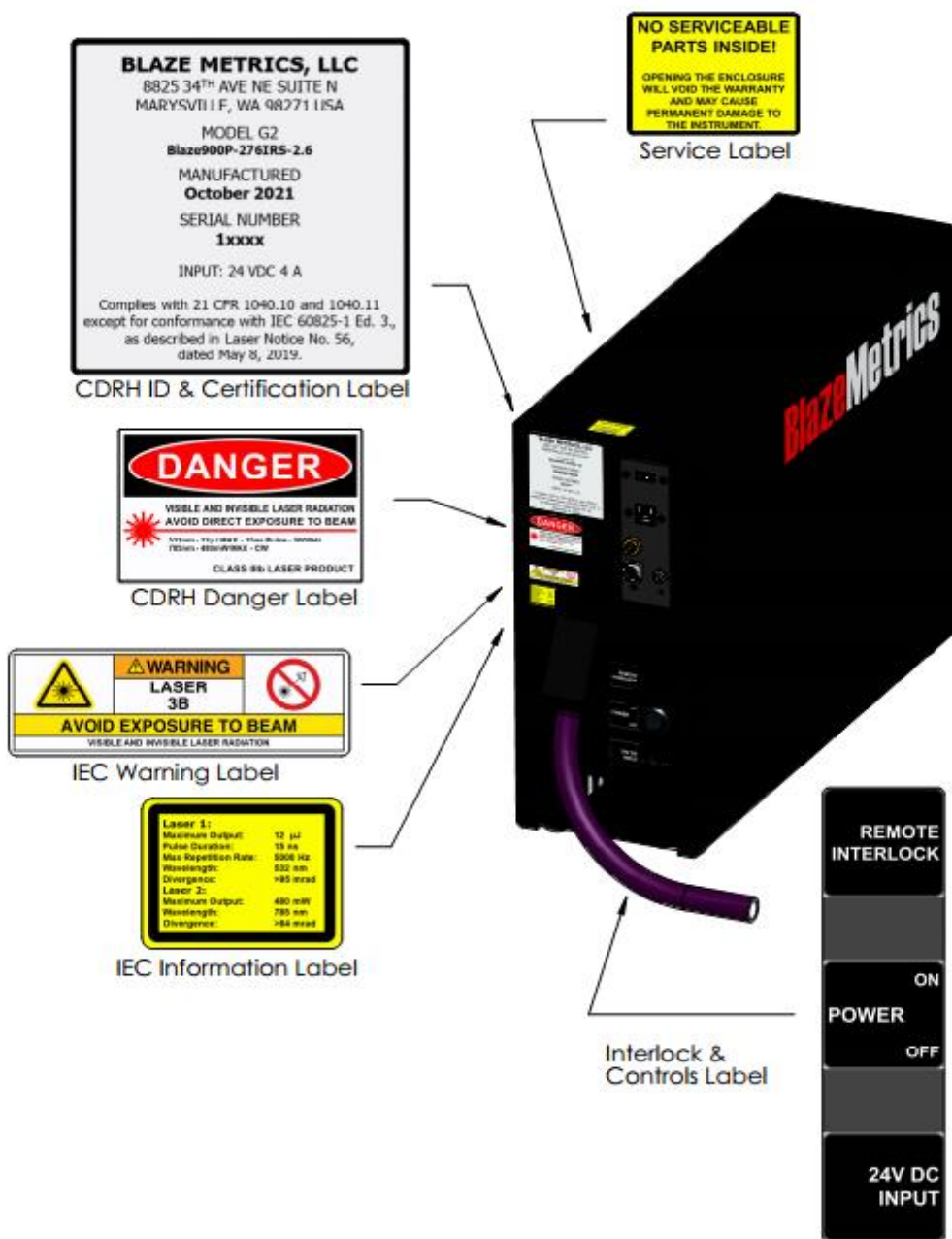
Laser Adjustments: During operation, the lasers are controlled from the computer screen. The operator may turn the lasers ON or OFF and set the output power of each one. The software may also be set up to automatically adjust the output of the lasers in response to measured inputs.

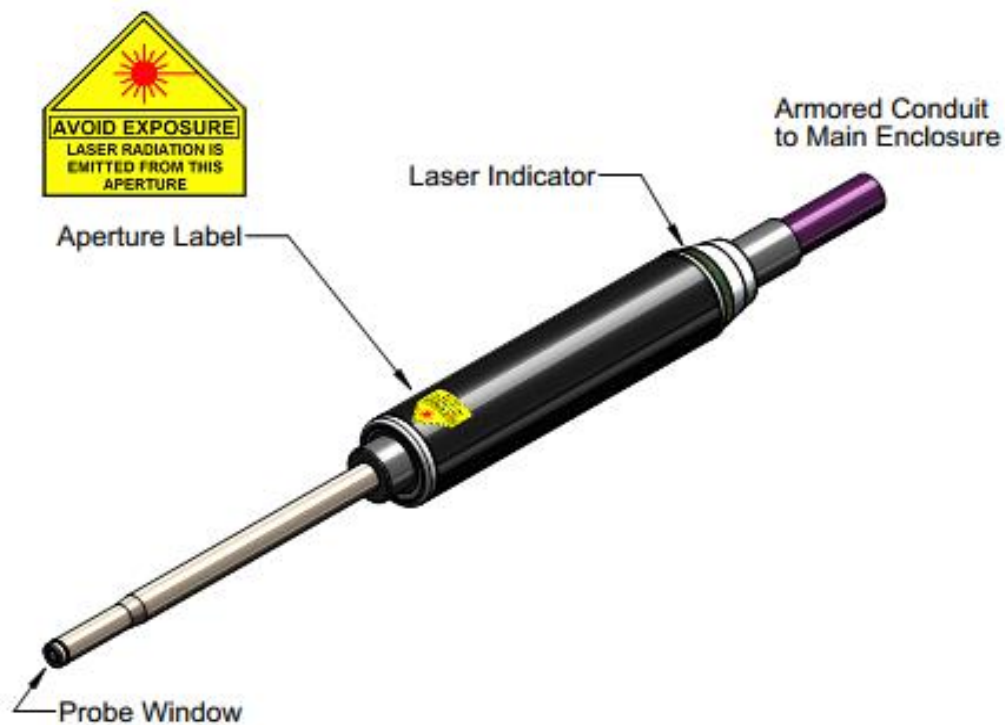
Caution - Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Nominal Ocular Hazard Distance - The NOHD is the distance from the probe window at which the irradiance is equal to the MPE (Maximum Permissible Exposure). For Blaze systems under worst case conditions, the NOHD is 2.4 meters.

Labels - Blaze systems are labelled as required by CDRH regulations. These labels for identification, warning, and information are applied to the product where they can be seen without being exposed to laser radiation. See below for the locations of safety information labels.

The CDRH requires labels for identification, warning, and information to be applied to the product where they can be seen without being exposed to laser radiation. The following figures show the purpose and location of each label.





CE, UL and Regulatory Compliance

All Blaze systems conform to the following CE standards:

Emission Standard EN-61000-6-4

Immunity Standard EN-61000-6-2

Low Voltage Directive

RoHS Directive 2015/863

Directive 2011/65/EU

A declaration of CE conformity is available.

Blaze systems are compliant with Underwriters Laboratories Inc. (UL) a Nationally Recognized Testing Laboratory (NRTL) approved body.

There is no AC power to the Blaze Unit. Blaze systems use a 24-volt power supply which is UL Listed. Since the highest voltage in the unit is 24 VDC, the Blaze falls under the rules for SELV (Safety Extra Low Voltage) circuits.

UL requirements state the certification requirements pass to the power supply if there are no operator accessible parts, including the output of the AC adapter, that have a voltage higher than 42.4 VAC peak (30VAC RMS), or 60 VDC. Accordingly, the certification requirements are fulfilled by the included 24 VDC power supply manufactured by CUI Inc. which is UL listed under File Number E210311. Further information can be found by searching the file number on the UL website ul.com/apps/product-iq, (free) registration is required.

Chapter 4 Product Description

System Overview

The microscopy configuration consists of the sensor probe and connected main enclosure as well as a separate computer. The sensor probe comes in two standard sizes and on standard lab units it is connected to the main enclosure by an armored conduit of 8.5 feet (2.6 m) standard length with a bend radius of 10 inches (25.4 cm). Conduits over 4 m have a bend radius of 12 inches (30.5 cm). The conduit cannot be altered or removed by the User, any attempts at alteration will void the warranty. The computer is connected to the main enclosure by a 6.5 foot (2 m) long USB 3.1 cable. This USB 3.1 cable can be disconnected when needed. This cable is dedicated to the Blaze system, other USB 3.1 cables are not assured to work with the system and not covered under the warranty. The main enclosure and computer should be installed outside of the fume hood or other protected area.

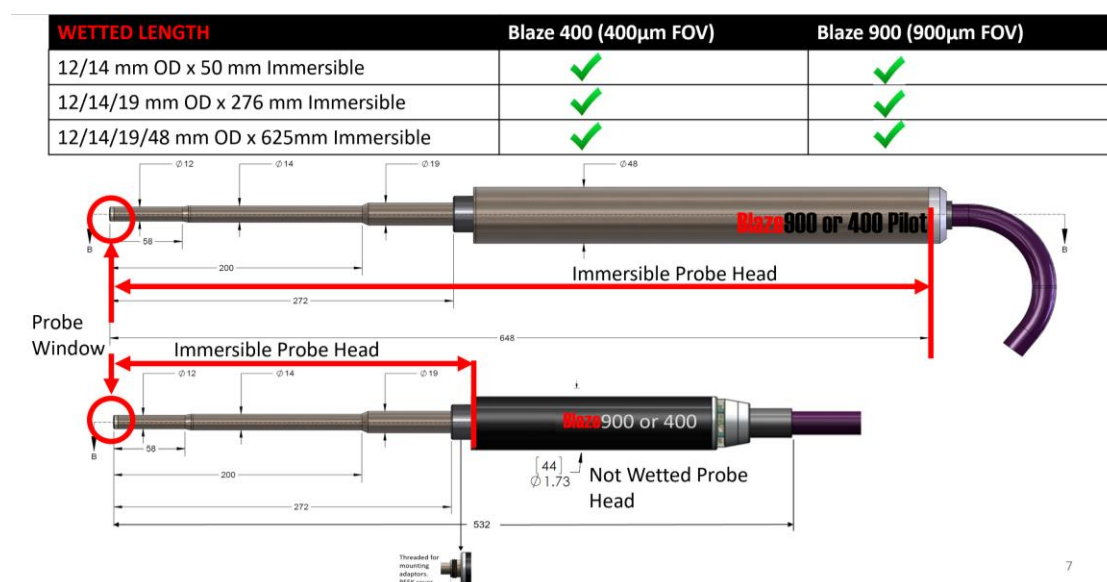
Probe Configurations

The probe comes in four standard form factors. For typical lab use the 12/14/19 x 276 mm probe is appropriate for 3 ml to 5 L vessels. In scintillation vials a 3-5 ml fill volume is enough to immerse the probe window when using a four point magnetic stir bar. In automated lab reactors of 50-100 ml the 14 mm diameter section will be passing through and fixtured to the probe head fitting. In larger vessels the 19 mm diameter section will be passing through and fixtured to the probe head fitting. The 276 mm length is enough to ensure a consistent tip position for standard lab reactors to 2 L. Reactors at the 5 L typically need a low-profile lid to ensure the same tip position at 5 L as at 2 L.

The Blaze Pilot model has the same 276 mm tip as well as an immersible probe head for an overall maximum wetted length of 625 mm. It can also be dip pipe mounted.

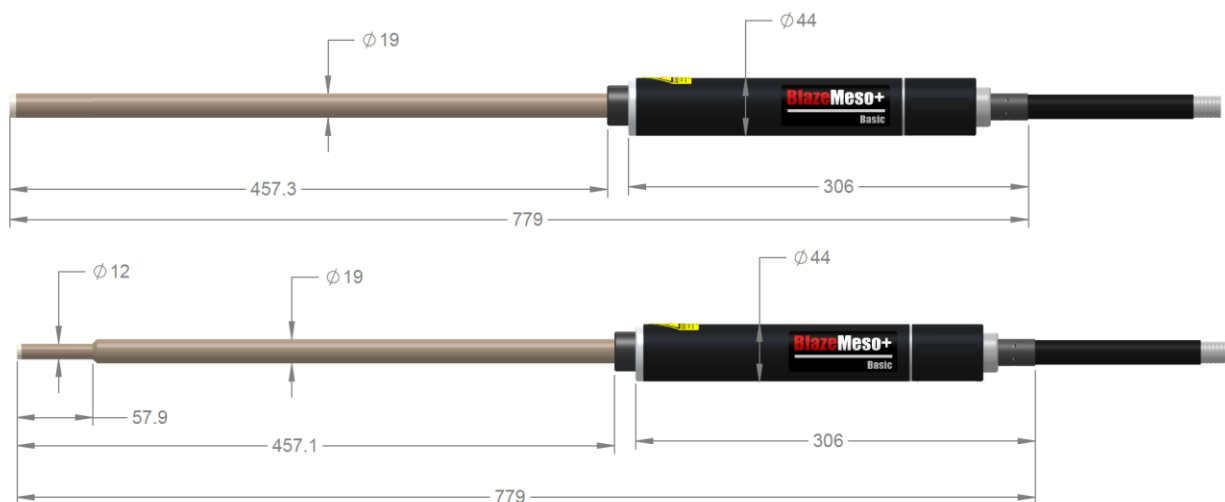
Both the Blaze400 and Blaze900 are available in all form factors. Drawings of the lab and pilot form factors are presented below, dimensions are in mm:

Standard Probe Size Options



All probes shipped in 2019 and earlier have a wetted length of 206 mm with a 12/14 mm OD. As of 2020 both 206 and 276 mm wetted lengths became available. The general specifications and operation of the 206 mm probes is otherwise identical.

As of 2022 a new probe with 461 mm of wetted length became available with either a 12/19 mm OD or straight 19 mm OD. The drawings below are for detachable style probes which became available in late 2022.



Main Enclosure

Inside the main enclosure are optical components and the Blaze Illumination/excitation 532 nm laser source.

Applications and Capabilities

The Blaze400 and Blaze900 are designed to provide high resolution microscope quality images and quantify sub-visible and visible particles in real time under process conditions. Common applications include crystallization, encapsulation, protein agglomeration and precipitation, particle count, liquid in liquid dispersions/emulsions, milling, etc. Typical users apply varying temperature, mixing, reagent(s), additive(s), addition rate, or other process variables and use the Blaze to track or determine the change to physical and chemical properties of particles and particle structures as they exist in their process environments. Properties tracked include particle dimensions, shape, amount of agglomeration, dispersion rate, chemical transition and/or composition, as well as many other physical and chemical properties. Systems equipped with the Blaze Raman Channel can obtain additional information about the liquid chemistry and solid form such as polymorphs. The Blaze Raman Channel is designed to be particle focused and collects proportionally more signal from particles than typical Raman probes which collect a higher portion of their signal from the carrying solution.

The Blaze Metrics team has measured thousands of particulate processes. Please contact us with any questions and for suggestions on what factors to consider when measuring your process.

Chapter 5 Installation

Site Preparation by Customer

A minimum of 2 electrical outlets and a minimum bench space of 40cm height x 20cm wide x 50cm deep, or cart of equivalent size, is required within 3' [0.9m] feet of the final probe installation location.

For systems with a Raman Channel, an additional 2 electrical outlets as well as adequate bench or cart space is required for the Raman. The Raman should be set up within 3' [0.9m] of the Blaze Main Enclosure.

Unpacking

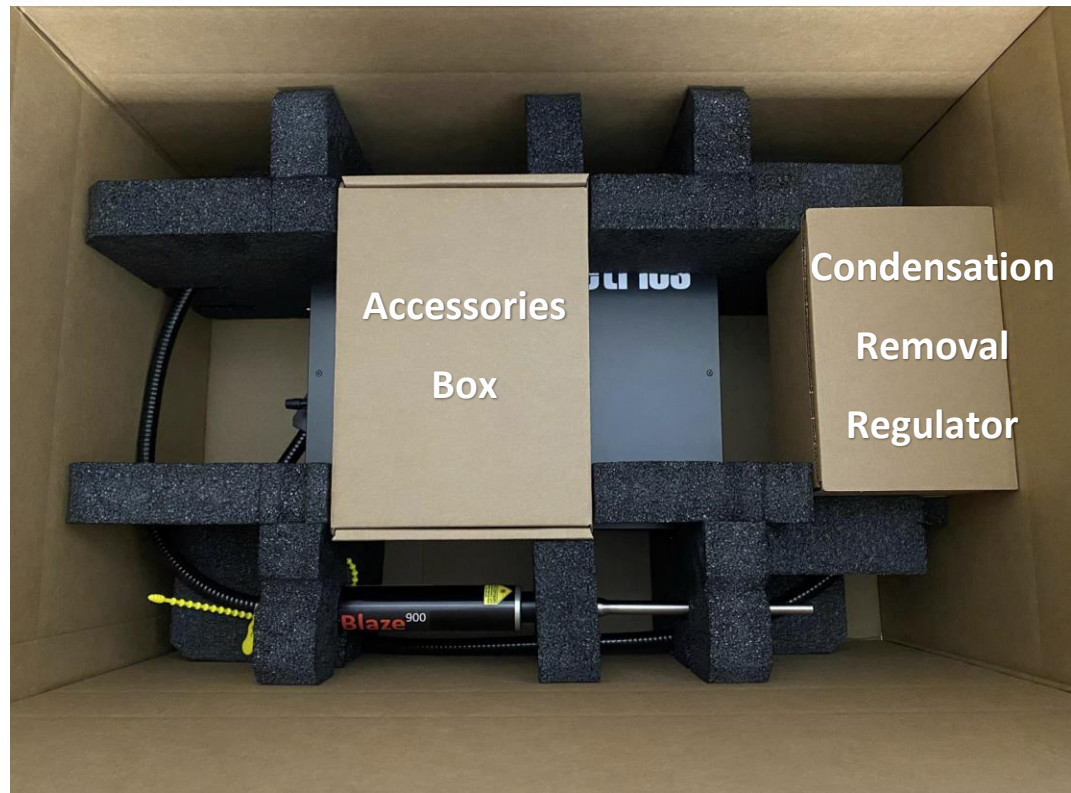
The Blaze system is packaged in a single box containing the sensor probe attached to the main enclosure by a conduit, necessary peripherals (in two smaller boxes), laptop computer (if ordered) and Wasatch Raman spectrometer (if ordered). **Unpacking is a two-person job.**

1. Place the box near the installation location and open the box. Lift the center foam cut-out and remove the laptop computer. Remove the Wasatch Raman spectrometer box next to the laptop.



a.

2. Remove the top foam layer. Remove the two boxes containing needed accessories and the condensation removal regulator:



a.

3. With two people lift the Blaze system with the foam and place on flat surface which is accessible from all sides.



a.

4. Undo the yellow cable tie to remove the probe. **First person ‘unwraps’ the probe from the foam** by holding the probe and walking around the foam, being careful not to twist the conduit. Once the probe is ‘unwrapped’ the **second person removes the main enclosure** (black box) from the foam to the installation location, placing it with the lettering upright.



5. Keep the original packaging in case the system needs to be transported to another site or sent to Blaze for an upgrade or repair.

If the packaging cannot be stored Blaze will keep it and return it (if needed) at no charge beyond shipping.

If the packaging is thrown out and needed in the future Blaze will charge for new packaging as well as shipping.

Never disconnect the sensor probe from the main enclosure.



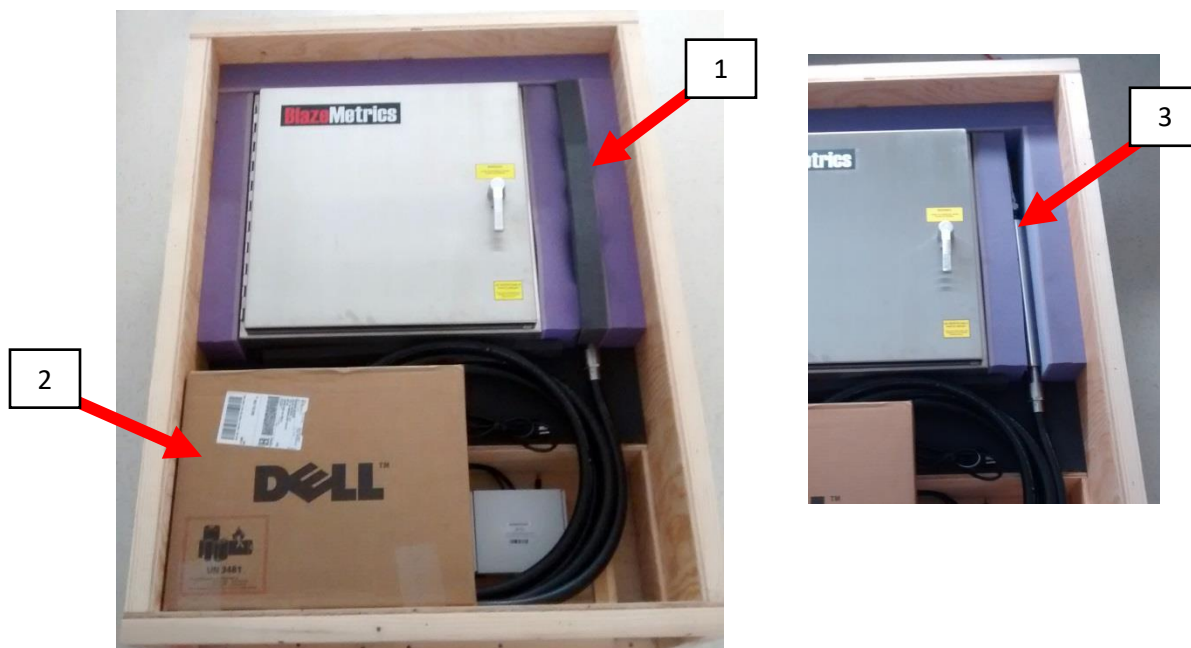
Shipping or transportation of the unit without proper packaging may cause damage to the unit and is not covered by warranty.



Disconnecting the sensor probe from the main enclosure will cause damage to the unit and is not covered by warranty.

Unpacking Instructions for Units with NEMA Enclosure

This process **requires 2 people**. After removing the crate lid and the top layer of foam:



1. Remove the gray foam strip (1) to reveal the probe (3).

2. Remove the computer (2).

3. Cut the ties (4) holding the conduit.

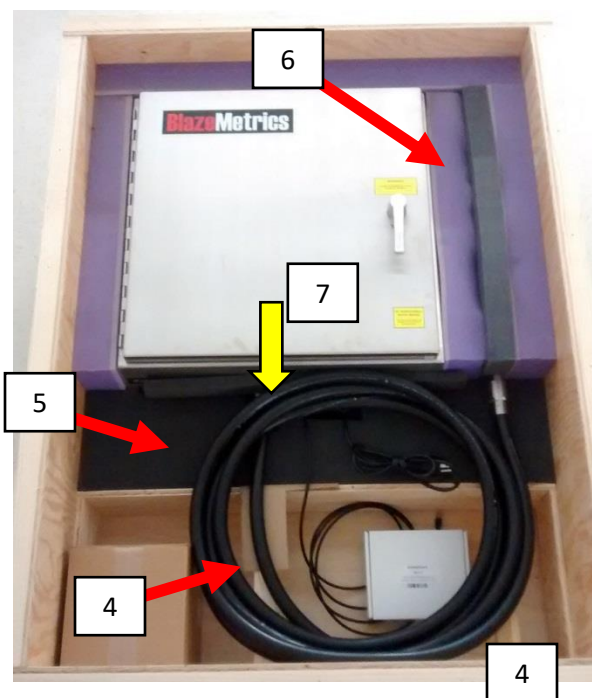
4. Lift the probe (3) out of the cushion. **HANDLE THE PROBE CAREFULLY.** Take care not to bend the conduit too tightly.

5. Lift the conduit coils out of the crate while the second person holds the probe. Uncoil the conduit as needed to allow access to the SS enclosure.

6. Remove the dark gray cushions (5).

7. Remove the purple cushion (6) on the right side of the SS enclosure.

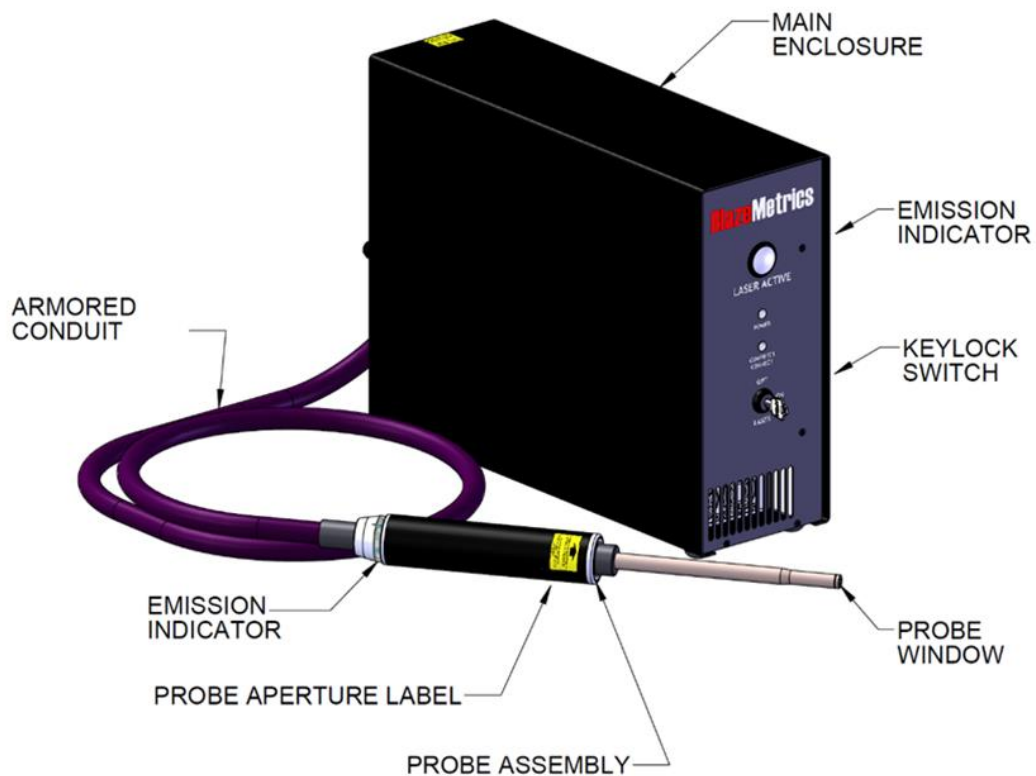
8. Slide the SS enclosure in the direction of the yellow arrow (7) and then lift out. Have a cart or benchtop available to set down the SS enclosure.



Installation Instructions for Lab Systems



Note: earlier units may not have the accessory USB port. The accessory USB port is meant for connection of the Raman spectrometer. When the Blaze enclosure is powered on, the USB cable between the computer and Blaze enclosure carries both the Blaze and Raman communications.



Place the main enclosure within 3 feet (0.9 meter) of the final probe installation location.

Verify the laser key is in the OFF position and the power button is in the OFF position.

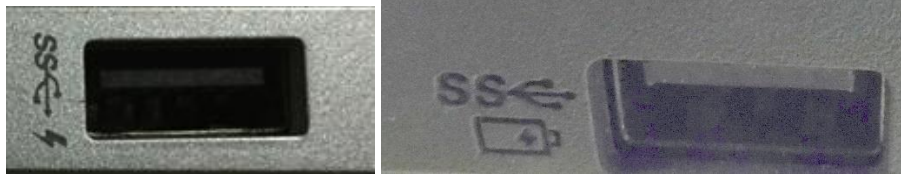
Connect power adapter to the 24 V supply input and then plug into the wall outlet. Be sure to push the power adapter fully into the 24 V supply input.

Connect the Blaze supplied USB 3.1 cable to the Main Enclosure.

Connect the other end of the Blaze supplied USB 3.1 cable to a USB 3.1 port or USB C port directly on the computer. Do not use a USB Hub. USB 3.1 ports are marked as follows:



If available, use the USB 3.1 port with lightning bolt or battery symbol shown below:



Do not use a USB Hub.

If using an external HDR monitor such as the Dell UP2718Q monitor, the video connection should be plugged into NVIDIA video port on the computer. The monitor settings should be brightness set to 100%; contrast set to 100%; sharpness 80%.

Turn the laser key to the ON position. Note: the key only controls the laser, not the overall electrical power.

Turn the power button ON.

NOTE: For the laser to come to a fully stable mode, warming up for 20 minutes may be required. For example, this step is required when the Enclosure is stored in a cold location and brought into a warmer location.

Installation Instructions for Pilot Probe with NEMA Enclosure

Enclosure Installation

The enclosure is 24" x 24" x 9" (61 x 61 x 23 cm) and must be mounted to a flat surface or a structure designed to support it. There are four mounting brackets on the enclosure, the appendix includes a drawing of the enclosure with mounting dimensions.

The Blaze probe and conduit are permanently attached to the enclosure. Have one person hold the probe while two people move the enclosure into position.



Disconnecting the sensor probe from the main enclosure will cause damage to the unit and is not covered by warranty.

There are three cable fittings at the bottom of the enclosure:

1. Probe Conduit Fitting (do not remove or detach)
2. USB Cord Grip
3. Power Cord Grip

The cord grips (2 and 3) may be replaced with other fittings if required. The USB and Power cables that are provided are adequate for commissioning.

Enclosure cooling is required if installed in a high temperature environment or direct sun. Instrument air can be used to cool the electronics in the enclosure. There are two push-in tube fittings at the bottom of the enclosure, one for air inlet and one for exhaust. They accept ¼-inch (6mm) OD tubing such as nylon or polypropylene.



The **maximum pressure** at the inlet **cannot exceed 0.2 psi** (6"wc, 0.01 bar, 1379 Pascal).

Do not restrict the exhaust.

Probe Installation

Install the probe in the process vessel. The weight of the probe and conduit should not be concentrated on thinner section of the probe tube. Blaze has clamps and other means to attach supporting devices to the probe housing, contact Blaze Metrics for more information. If the probe is unsupported, damage to the probe or the tube fitting may result.

If two clamps are used, both clamps must be aligned along the same axis to prevent stress on the probe tube. The constant stress from misaligned clamps will damage the probe. Damage will occur more quickly if installed in a high vibration environment.

The probe conduit should not be allowed to hang unsupported. The minimum bend radius is 12 inches (31 cm). Support the conduit near the probe, and in other locations as needed to maintain a bend radius greater than 12 inches (31 cm). Often the conduit can be hung over the lab clamp scaffold in a fume hood.

Probe Gas Connections

The fittings at the back of the probe housing serve two purposes. They are labeled:

EXHAUST ◀

WINDOW ▶

COOL ▶



The WINDOW connection is a 2mm tube fitting, connected to the Purge Regulator. This feature is used if the process temperature causes condensation inside of the window.

The COOL fitting accepts a 6mm tube. The air flowing through this port removes heat from the sensor in the probe body (the end opposite the window). If the probe body is in ambient air below 40 C, then

cooling is not necessary. If the probe body is enclosed in a dip pipe immersed in a high temperature process (over 40 C) then cooling is needed.

The EXHAUST fitting is left open if either the WINDOW or COOL features are used. It is recommended that the exhaust be protected against water ingress if needed. This can be accomplished with a length of tubing, an exhaust filter, or both.

Note: each port is to remain plugged when not in use.

Using The Cool Gas Connection

Connect a 6mm tube to the COOL fitting. Maximum pressure at this port is 14psi (1 bar). Only clean instrument air or dry nitrogen gas is allowed (see Blaze Operation Manual for instrument air specifications).

Remove the plug from the EXHAUST fitting. Protect the port as noted above.

Leave the WINDOW port plugged.

Using the WINDOW Gas Connection

Included with the Purge Regulator is a flexible tube, with a section reduced to 2mm diameter. Connect the 2mm tube into the WINDOW fitting and the large end to the OUTLET of the Purge Regulator. Adjust the pressure to 14 psi (1 bar) and adjust the flow for at least 0.1 l/m. If required, increase the pressure to achieve 0.1 l/m flow. Further instructions for the purge regulator are included in the Appendix.

Alternative USB Cables Between Blaze and Computer

USB-C ports are better if the cable is connected/disconnected often. Example suitable cable:

<https://www.amazon.com/gp/product/B011BZ2QSG?th=1>

USB-B connector for Blaze side, USB-C connector for computer side, meets USB 3.1 Gen 1 standard.

To locate the computer further away an active extension cable can be used. The following cable has been tested with Blaze systems:

https://www.amazon.com/dp/B0115E292G/ref=twister_B07C8HDZPK?_encoding=UTF8&th=1

additional lengths are available through the manufacturer

<https://newnex.com/usb-3-active-cable-a-to-b.php>

Note: this cable has a USB A male connector on the computer side, a USB A to C adapter may be needed.

Raman Set Up for First Generation Blaze

This section applies to systems with optional Raman and covers connection of the Raman laser and spectrometer to the Blaze. Refer to 3rd party Raman system manual for complete set up of the Raman system.



LASER SAFETY WARNING: Turn off the Raman laser before connecting or disconnecting fibers to avoid exposure to laser radiation. Once the Raman laser is turned on the Blaze is a Class 3B product.

Remote Interlock

A remote interlock is provided on the Blaze. This interlock is shipped with a loop installed and does not require modification for the Blaze to operate.

If local laser safety requirements require the remote interlock to be connected to a physical switch connected to a door, warning light, etc. first remove the factory installed interlock loop. It is located on the back of Blaze main enclosure just above the main power switch. Connect the remote interlock to the switch(es) using a Switchcraft Micro-Con-X connector (part number 16282-2PG-315). Further information under <http://www.switchcraft.com/productsummary.aspx?Parent=857>.

Fiber Optic Connectors

The excitation laser and collected Raman signal are transmitted over fiber optics cables. The fiber optic cables are secured by different style connectors. For any single installation, one or more of the connector styles listed below may be used.

An FC connector uses a 2.5 mm ferrule. Check the key for alignment and finger tighten to secure. Do not use tools to tighten.



An SMA connector uses a 1/8" ferrule. There is no alignment key. Finger tighten and do not use tools.



An MTP connector is rectangular in shape.



General Instructions

Note: a Blaze Start Up Guide may exist for your spectrometer, currently guides are available for Tornado and Wasatch. Please contact Blaze Metrics for further information.

All 785nm Raman - Blaze integrations are connected by two different fiber optics:

- 100 or 105 micron fiber optic connects the laser output from the Raman system to the Blaze port labelled “ExcLaser”. The Blaze side uses an SMA or FC connector. The connector on the Raman system side is typically FC though it varies by supplier. Read the fiber and port labels and look at the connection types before connecting. The laser output from the Raman system will be marked with laser safety warnings and labelled laser output, laser excitation, excitation, or similar wording.
- 400 micron fiber optic connects the collected light output from the Blaze (port labelled “Spectroscopy Collection”) to the Raman system port for spectrometer input. The Blaze side uses an FC connector. The connector on the Raman system side varies by supplier. Read the fiber and port labels and look at the connection types before connecting. The spectrometer input to the Raman system will be labelled as spectroscopy collection, spectrometer input, collection, or similar wording.

Function	Fiber Type	Raman System Port Name	Blaze Port, Connector
Laser excitation	100 or 105 μm NA 0.22, 2m	Laser Output	“ExcLaser”, SMA or FC
Spectrometer Collection	400 μm NA 0.37, 2m	Spectrometer Input	“Spectroscopy Collection”, FC

For 532 nm Raman the Blaze provides the 532 nm excitation, no connection to the “ExcLaser” on the Blaze is required. The spectrometer collection connection is the same fiber optic as for 785 nm Raman.

The Raman system software is used to control excitation and collection conditions for 785 nm Raman.

The Raman system software is used to control collection conditions for 532 nm Raman, excitation is controlled within the Blaze software. Please contact your local Blaze Application Engineer for additional details on 532 nm Raman.

Refer to the appropriate Raman system manual for software operating instructions.

Blaze Raman Connectors

The connection port for an external Raman excitation laser uses a 100 or 105 μm fiber with NA 0.22 and an SMA or FC connector. The connection port to send light to an external spectrometer uses a 400 μm fiber with NA 0.37 and an FC connector. Finger tighten the dust caps when not in use. Do not use tools to tighten.



Raman Set Up for Blaze Platform

This section covers how the Raman excitation laser works and extra safety features of the Blaze Platform. Connection of the collected signal to the external Raman spectrometer is the same for both first generation Blaze and Blaze Platform.

Laser Hardware On/Off Keys

The 532 and 785 nm lasers both have a separate control key. If the key is in the OFF position the specified laser cannot turn on. If the key is in the ON position, the laser is turned on by the software when the necessary conditions have been met.

Note: the key for the 785 nm internal laser has no effect on the external 785 nm laser. The external 785 nm laser is controlled by the engineering control measures designed into that system; refer to the Wasatch, Tornado, or Kaiser system documentation for further details.

The Blaze UI software detects the state of the 532 and 785 keys. Certain operational steps require the operator to physically turn the keys on or off. The software will not allow the next step to take place until the operator has turned the key (by hand) to the specified position.

Note: the 532 key must be turned ON to use the internal 785 nm laser, even if operating the software in Raman only mode.



Set Up of External Raman System

Please refer to the startup guide of the external Raman system (Wasatch, Tornado, Kaiser) for details and safety precautions.

Input of External 785 Raman Laser into Blaze Platform

The 785 nm laser of the external Raman system is used to trigger the internal 785 nm laser in the Blaze system. Note: the power output of the internal 785 nm laser is independent of the power setting of the external Raman system.



LASER SAFETY WARNING: The external Raman system is a Class 3B product. It is not controlled by the Blaze software or hardware. The Blaze Platform design requires the laser output of the external Raman system to always be connected to the Blaze by fiber optic. If the fiber is disconnected, hazardous radiation may be emitted and can only be shut off by the external Raman system.

Blaze Enhanced Safety Feature

The Blaze Platform will always have pulsed green light (532 nm) whenever the internal 785 nm is on. This serves as an additional indication that the 785 nm laser is active (unlike 532 nm, 785 nm light is not visible to everyone). When ON the 785 nm laser is continuous and not pulsed.

The frequency and intensity of the 532 pulses is determined by the operating mode selected in the software. Pulses will be at maximum frequency when 532 nm Raman is on. Pulses will be at high frequency when Microscopy is on. Pulse will be at low frequency and low intensity when Microscopy is off and the 785 nm laser is on.

Cleaning the Fiber Connections

Small particles of dust or fingerprints on the fiber connection tip significantly reduce the signal. The male FC connectors can be cleaned using a fiber optic cleaning pen made by FiberShack ([Amazon Link](#)). This pen has been tested and found effective by Blaze (there are similar pens made by other manufactures as well but be sure it is rated for the fiber connector style that needs to be cleaned).

Software Set Up

Computers purchased with the Blaze will have the Blaze Metrics UI pre-installed.

Blaze software can be installed on customer supplied computers meeting the minimum required specifications.

Installation of Blaze UI software for instrument control requires administrative privileges. Installation of Blaze Office software for data review does not require administrative privileges.

Customer Supplied Computers and Computer Configuration

General

Both Blaze UI and Office software utilize a Windows 10 based control system. If purchased from Blaze, the computer will be pre-configured for the Blaze software.

Note: The Blaze UI and Blaze Office software are not supported on 32-bit versions of Windows.

For Blaze UI software the minimum computer requirement is 32GB or more RAM; a 1TB SSD (or a second separate 512GB SSD for Blaze application and data only); an Intel i9-8950HK processor; a GTX 1070Ti GPU, and a 4K monitor (or best Dell available in your region). A laptop or desktop can be used depending on the customers need. If a laptop is used, it is suggested that an external 4K monitor be used to extend the Blaze capability. Computer requirements are subject to change in the future to enable additional software capabilities.

For Blaze Office software the minimum computer requirement is a i5 processor (i7 preferred), 16 GB of RAM, and a 4K monitor or highest available resolution monitor.

Blaze UI Software and Installation

Blaze UI software is for real time data acquisition with the Blaze system as well as data analysis. See Appendix H for Blaze UI installation and computer configuration instructions.

Blaze Office Software and Installation

Blaze Office software is for data analysis only and cannot be used to acquire data. See Appendix I for Blaze Office installation instructions.

Blaze UI Start Up Sequence

NOTE: You must power on the Main Enclosure prior to starting the software.

After assuring that the laser key is in the on position and powering on the Main Enclosure, double click on the Blaze icon  to start the software.

NOTE: The power to the Main Enclosure must be on prior to starting the software. A warmup period of 20 minutes is recommended for quantitative measurements.

1. The unit will perform self-diagnostics.
2. The Laser Icon will turn yellow showing that the Laser is ready for use.
3. If an error message is displayed, please refer to the trouble shooting appendix for guidance.

Chapter 6: System Start Up

Window Reference

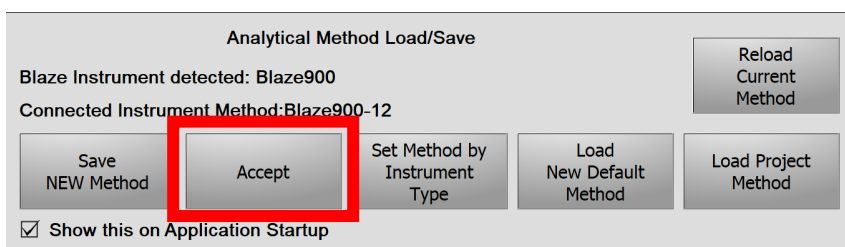
The window reference position is where the Image Plane is focused at the surface of the window. The window reference is set at time of manufacture but may shift during shipment due to movement from one lab to another, dropping the probe or banging it into a metal beam (of course not recommended), wrapping the probe conduit beyond the recommended bend radius, etc.

Under those cases, and on a regular interval, it is recommended that the Window Reference 'Zero' position be calibrated.

Step 1: Apply a piece of blue painter's tape (3M Blue Painters Tape 2090) to the window. Use a fresh piece of tape. If the tape has been allowed to dry out, unwrap and discard one full wrap of tape, and then take a fresh piece. Press it firmly against the window. Do not use other types of tape, they lack the necessary features, and the adhesive can be more difficult to remove.

Step 2: Position the probe at roughly the angle it will be used during operation (e.g., pointed downward when installed in the reactor or pipeline OR, for static sample use, on the window with the window pointed upward above eye level, e.g., whichever angle will be used during measurement)

Step 3: The software will start and recommend the Method based on the model. Click 'Accept'.

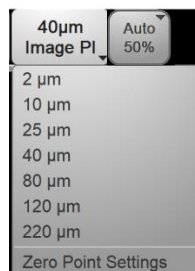


NOTE: Blaze Users Interface Menu Bar (BLZ Menu Bar):



On the BLZ Menu Bar, press the play button  to start imaging. The button will change while active: 

Press the 'Image PI' button on the tool bar (a drop-down menu will emerge). Select 2 µm:

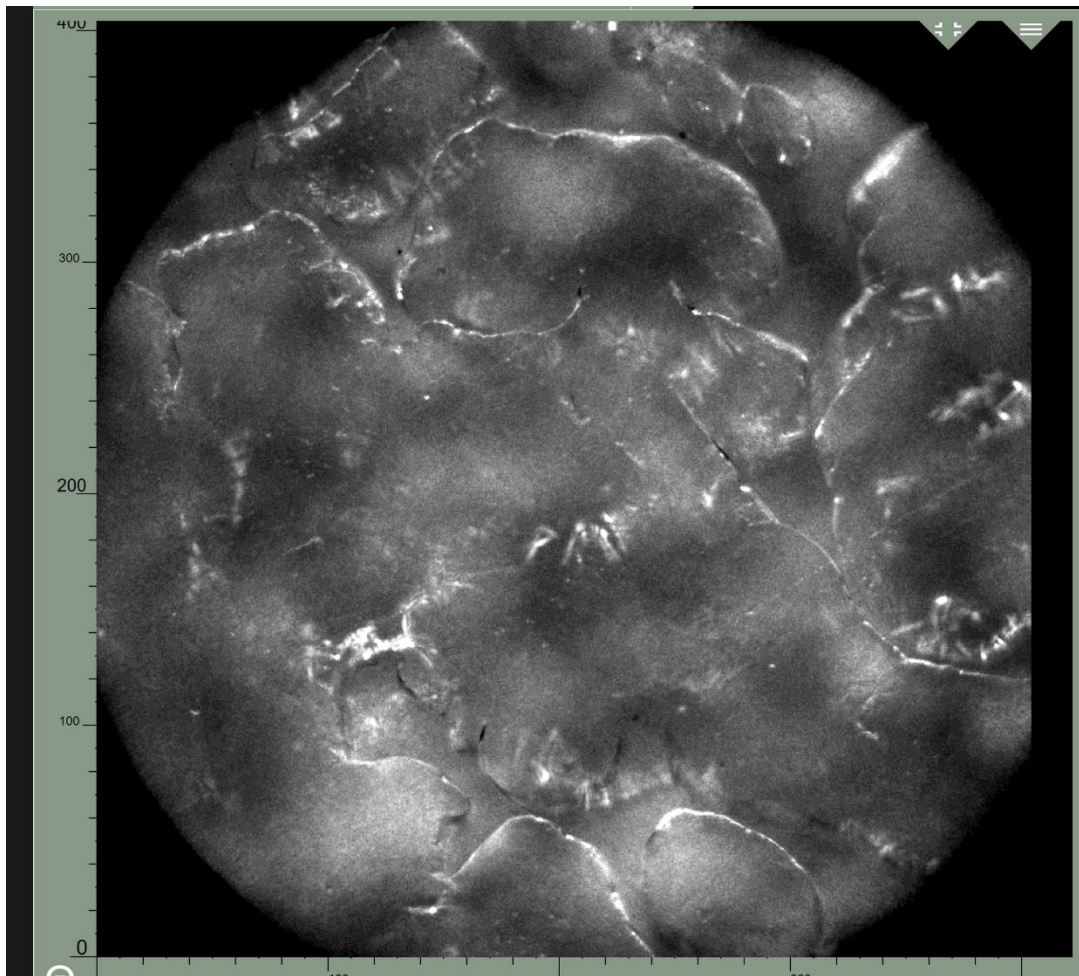


A live image will appear and should be similar to one of the examples shown below.

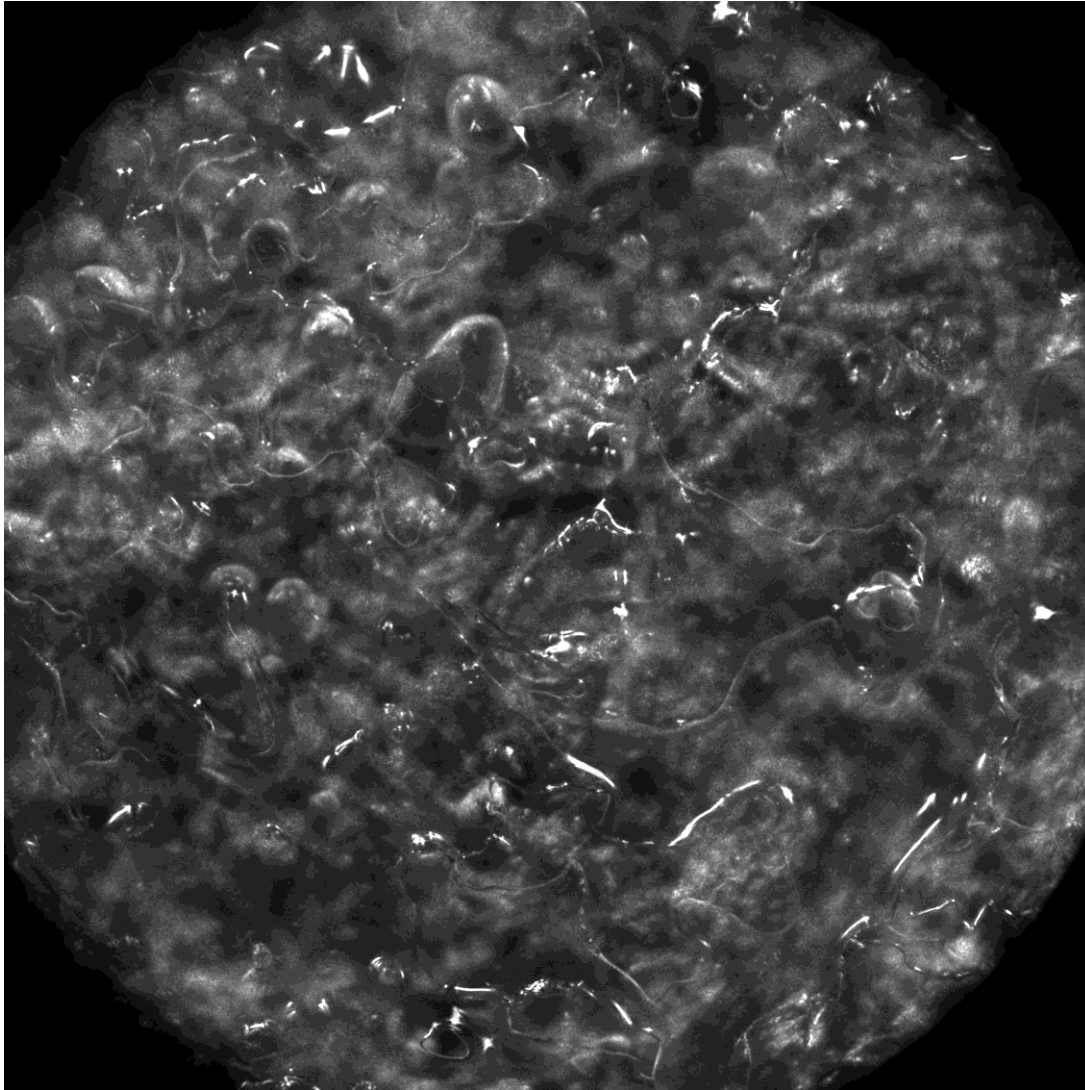
The ideal window reference position is below for Blaze 400 and 900 respectively.

Note: If you are working with particle systems predominantly less than 10 μ m locating this window reference position and operating no more than 10 μ m into the slurry is important.

Compare the live image to the following to determine the current position:

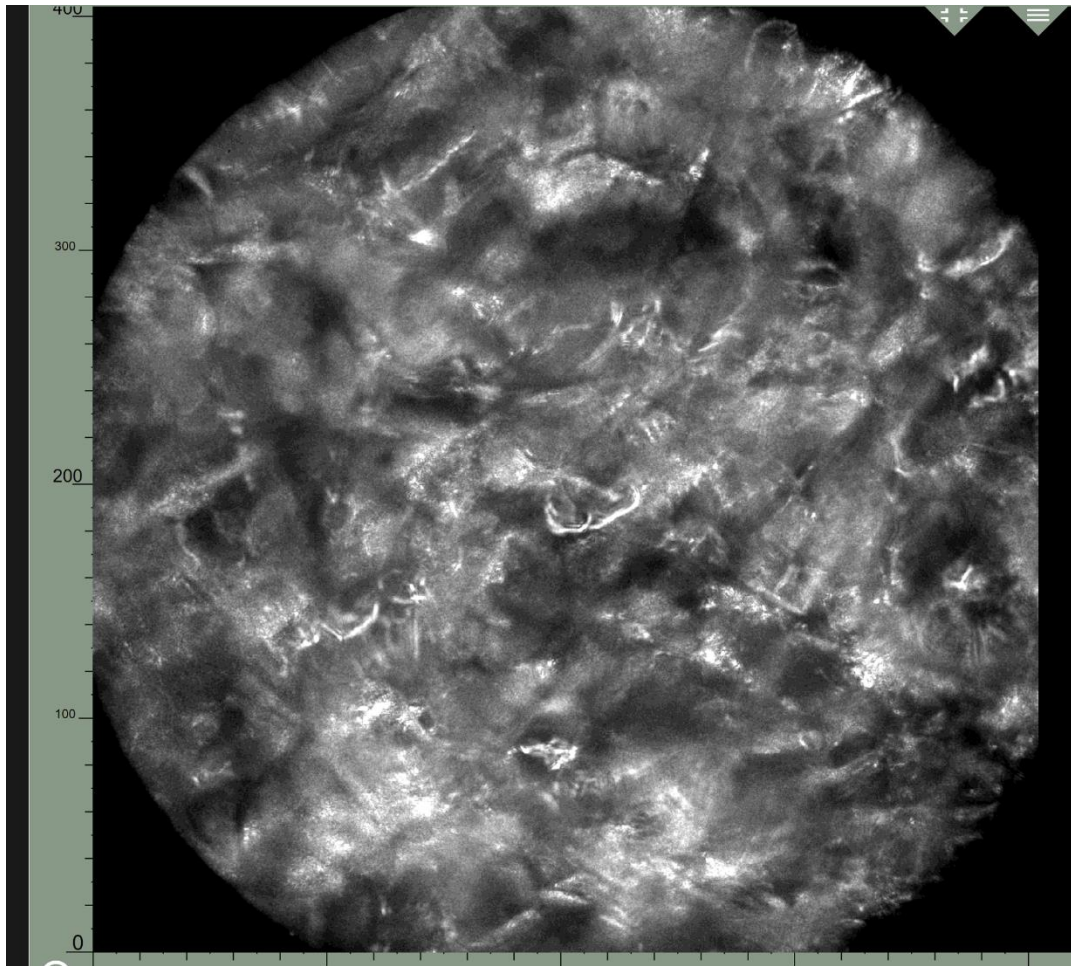


Blaze 400 Image

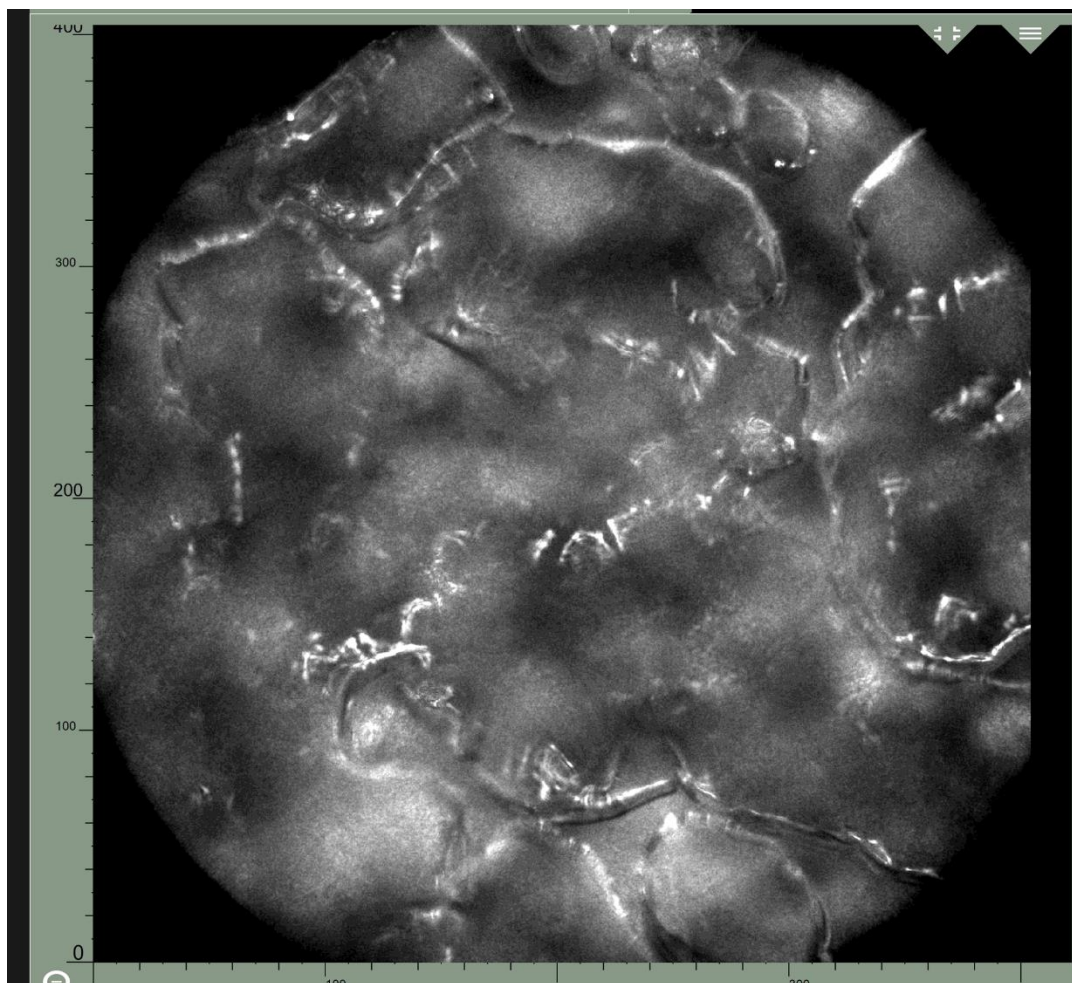


Blaze 900 Image

The best image plane position at the ideal window reference position is above: outlines of 'smashed' adhesive droplets are very sharp (further into the direction of the slurry, away from the window, often roughly spherical adhesive drops can be observed, these can be located some distance from the window.) The droplets pressed right at the window will be 'smashed' and hence have an irregular shape. The edges of this smashed adhesive are right at the window surface and hence the Blaze 'zero' position.

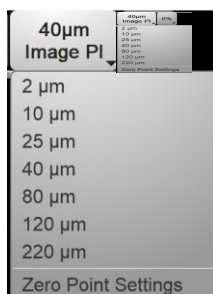


The above Image Plane Position is marginally out from the window, into the slurry (from Blaze 400). This is OK for most applications where the majority of particles are $> 5\mu\text{m}$



The above Image Plane Position is marginally inside the window (Blaze 400 Image).

If the image does not match one of the images above, an adjustment to the zero needs to be made (If the image is completely different from these examples see the FAQ Appendix section 'Can't Find Image Plane Focus' for guidance). To adjust the image plane, select 'Zero Point Settings' from the Image Plane Position button.



Note: selecting Zero Point Settings will automatically turn off Triage. Triage should be turned off when finding the window reference position. If required, Triage can be manually turned on. Triage will automatically turn on again once a preset image plane position is selected.

The following window will appear:

Select 'direction into slurry'. The button will show

Direction into Slurry	Implemented
-----------------------	-------------

Click once on large step. The image will update in real time as motion occurs, motion should be stopped by clicking 'Stop Current Move' if the image is becoming further out of focus, or you have reached a reasonably in focus image. If you have a reasonably in focus image, use the Medium steps to fine tune the focus. When an image like the above is achieved, set the zero by clicking 'zero position'

If the large move resulted in a more out of focus image, reverse direction, 'direction toward the window' and hit on large move and repeat the above. Note you can press 'Stop Current Move' if you see the Image Plane is close to your desired location. A Medium and Small Step can be used to fine tune the position. The depth of field is 1/3 smaller for Blaze400 than the Blaze900 model. The example images are labelled as either Blaze400 or Blaze900.

Step 4: Once the proper Image Plane position is found, and a 'zero' is determined and set, remove the tape and clean the window with a low lint tissue (such as Kimwipe) and solvent. Stop acquiring images, press the  button and it will change to .

Chapter 7: Routine operation

Starting The Blaze Unit

Verify the laser power key is in the ON position, the Main Enclosure is plugged in and powered on, and the Blaze supplied USB 3 cable is connected to the main enclosure and computer. Click on the Blaze icon  to start the Blaze UI.

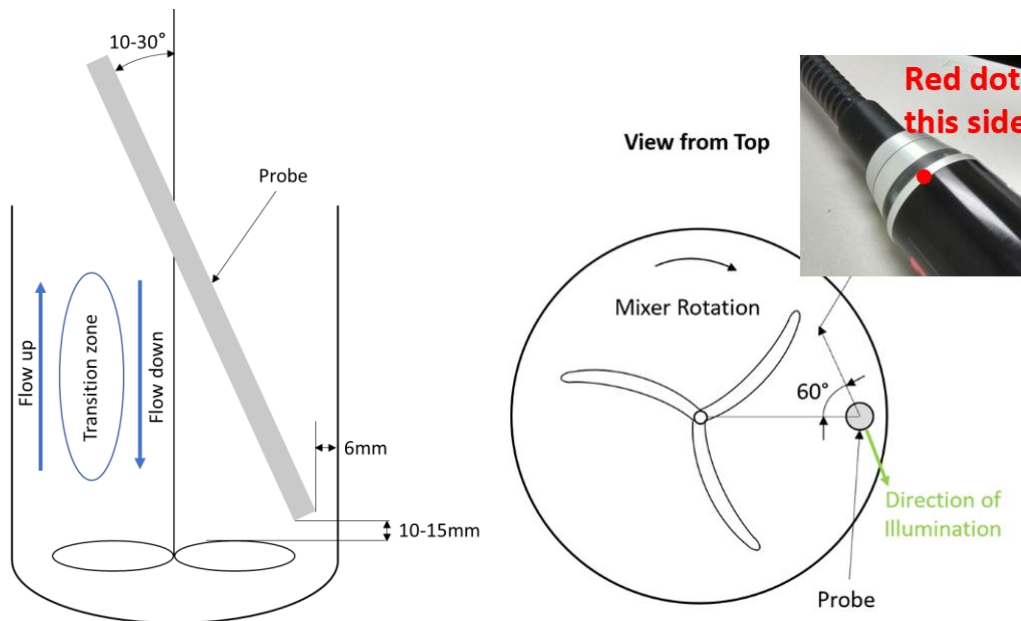
Indicator lights

All three lights on the front of the electronics unit will illuminate at this point.

Probe Position

The probe installation location is critical to a good measurement, the probe will only measure material that is presented to the window. The smaller the particle size, the narrower the distribution, the higher the solids concentration, the less probe orientation impacts the 'sample' presented to the measurement zone. The larger the particle size, the wider the distribution, the lower the solids loading, the more probe orientation to the flow impacts the 'sample' presented to the measurement zone.

For stirred reactors the window should be in a well-mixed zone with particulate flow striking the window. These diagrams show the correct position for reactors with clockwise (from the top) stirring.

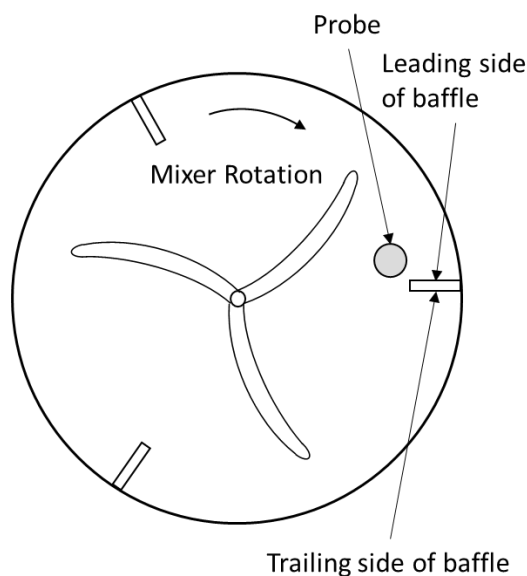


Near the impeller shaft particles typically flow down and away from the window causing a non-representative presentation at the measurement zone.

At the wall, the flow is typically consistently upward providing a good 'sample' to the measurement zone.

Between the impeller shaft and the wall, there is a transition zone from flow down to flow up. This zone changes based on solids loading, particle size, etc. Measurement in this zone would include convoluting flow artifacts.

In a baffled reactor, the leading edge of an outside baffle is ideal:



Repeatable probe location and mixing dynamics allow for the best experiment to experiment comparisons. The best probe location is near the impeller tip and near the wall as shown in the diagrams.

If this relative location is kept from scale to scale e.g., from 25ml to 2L, the data from scale to scale will be comparable.

If the probe location is changed at scale, i.e., moved higher up in the reactor, or further into the transition zone, measured data scale to scale will be less relative.

Probe Installation in a Lab Reactor

Stop the overhead stirrer before installing the probe.

Insert the probe through the fitting and visually inspect installation location.



Stirrer contact with the probe window may causes window damage or streaking. Damage is not covered under warranty. Streaks caused by traces of metal on the surface of the window may be removed by polishing. Deep scratches into the window will generally require window replacement which is not covered under warranty.

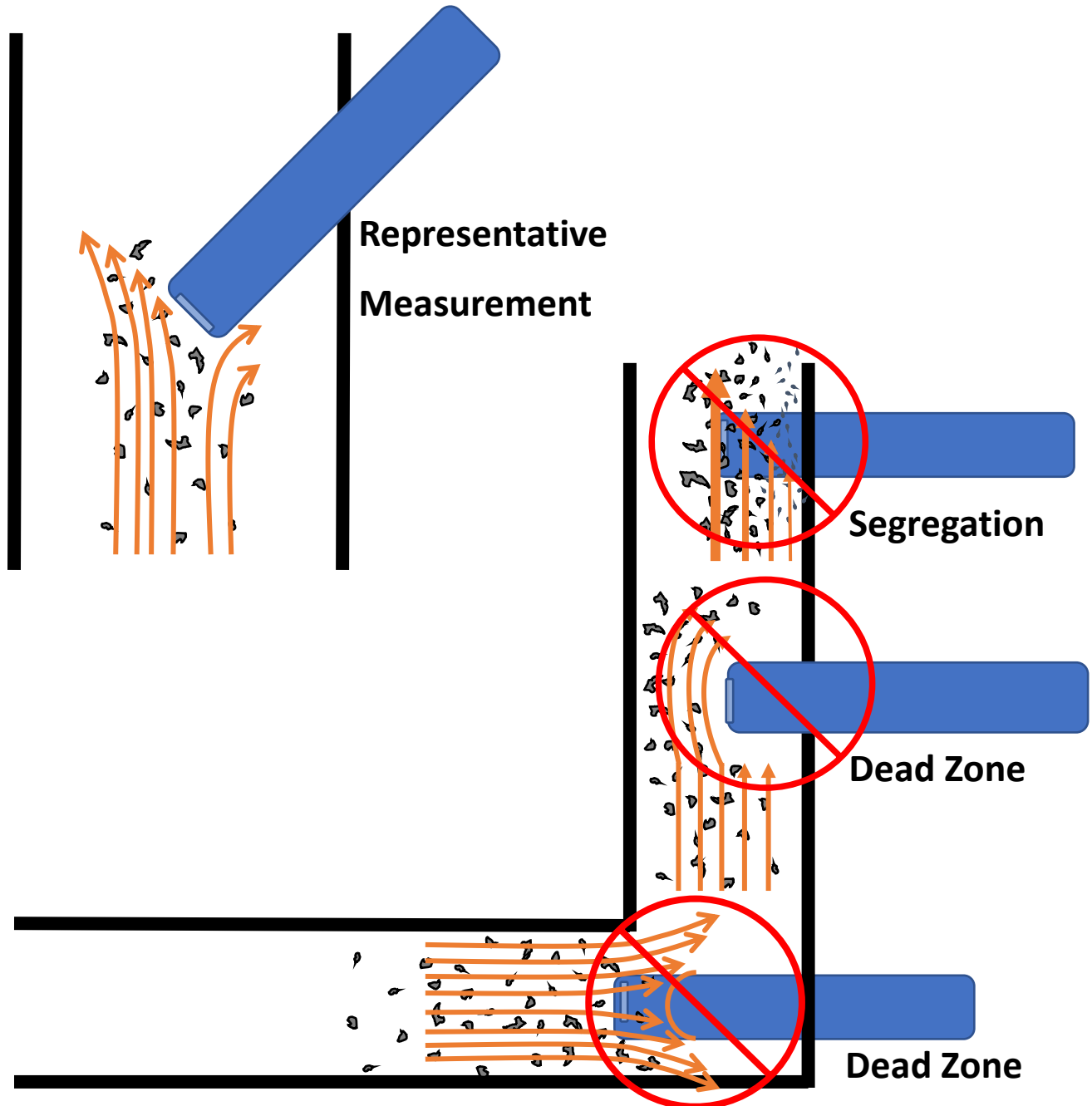
Adjust probe location to bring the window between $\frac{3}{8}$ and $\frac{5}{8}$ inch (10 to 15 mm) above the impeller. The probe should be $\frac{1}{4}$ inch (6 mm) from the reactor wall. Rotate so the red dot on the probe head is aligned as shown in the above diagram.

Tighten compression fitting to lock position. NOTE: It is best to mark the probe right above the compression fitting, outside the reactor, so the probe can be installed in exactly the same position each time. It is common to use a Sharpie permanent marker for this mark.

Manually rotate the stirrer and check for any indication the stirrer is touching the probe window. If the stirrer is striking the probe stop immediately and adjust as needed.

Probe Installation in a Pipeline

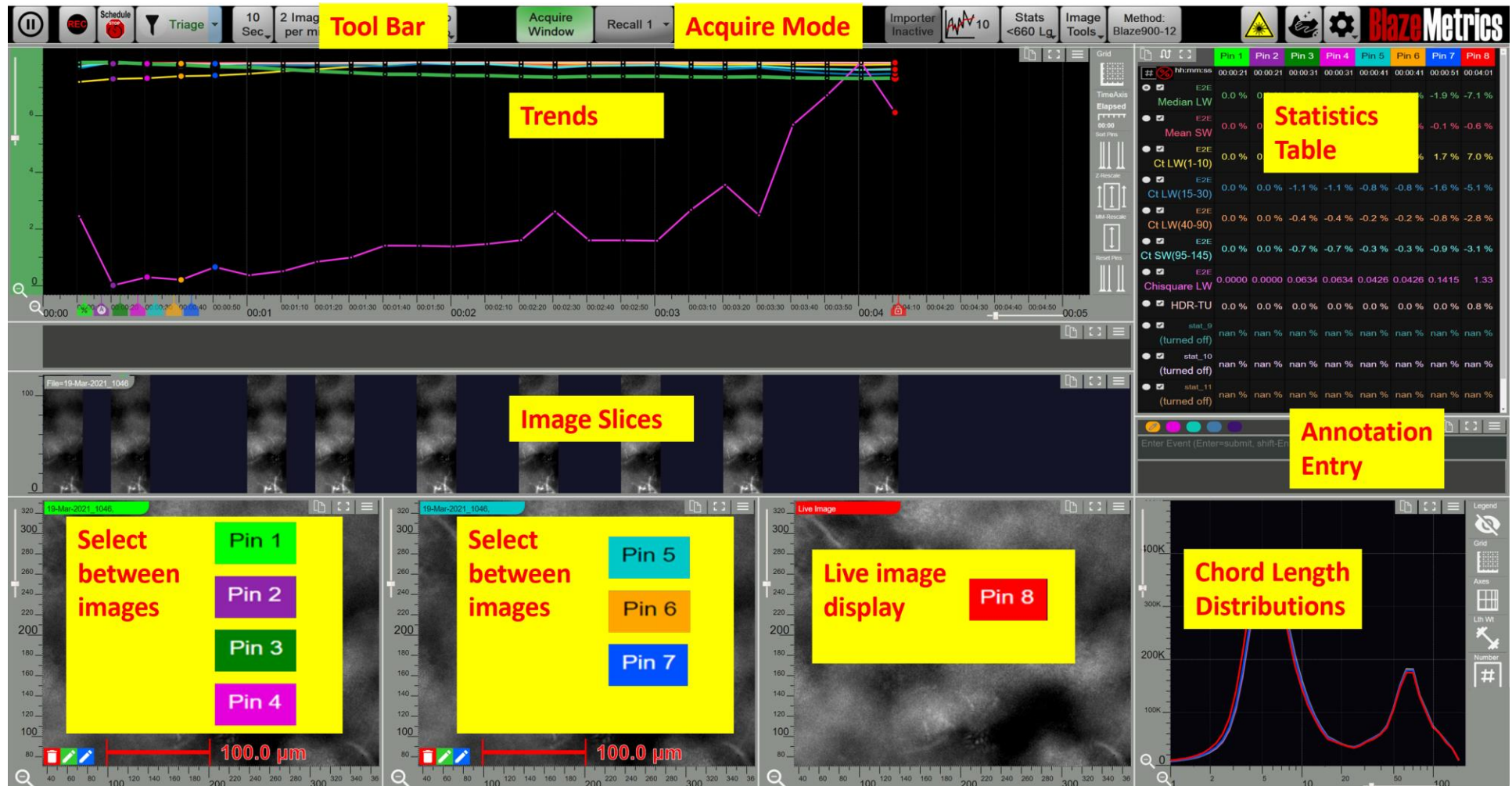
The ideal pipeline installation location is in a vertical up flow section of the pipe. The probe should be facing into the flow and 6 pipe diameters from the nearest elbow. The probe window should be at a 20 to 45 degree angle relative to the flow. These diagrams show ideal and bad pipeline installations.



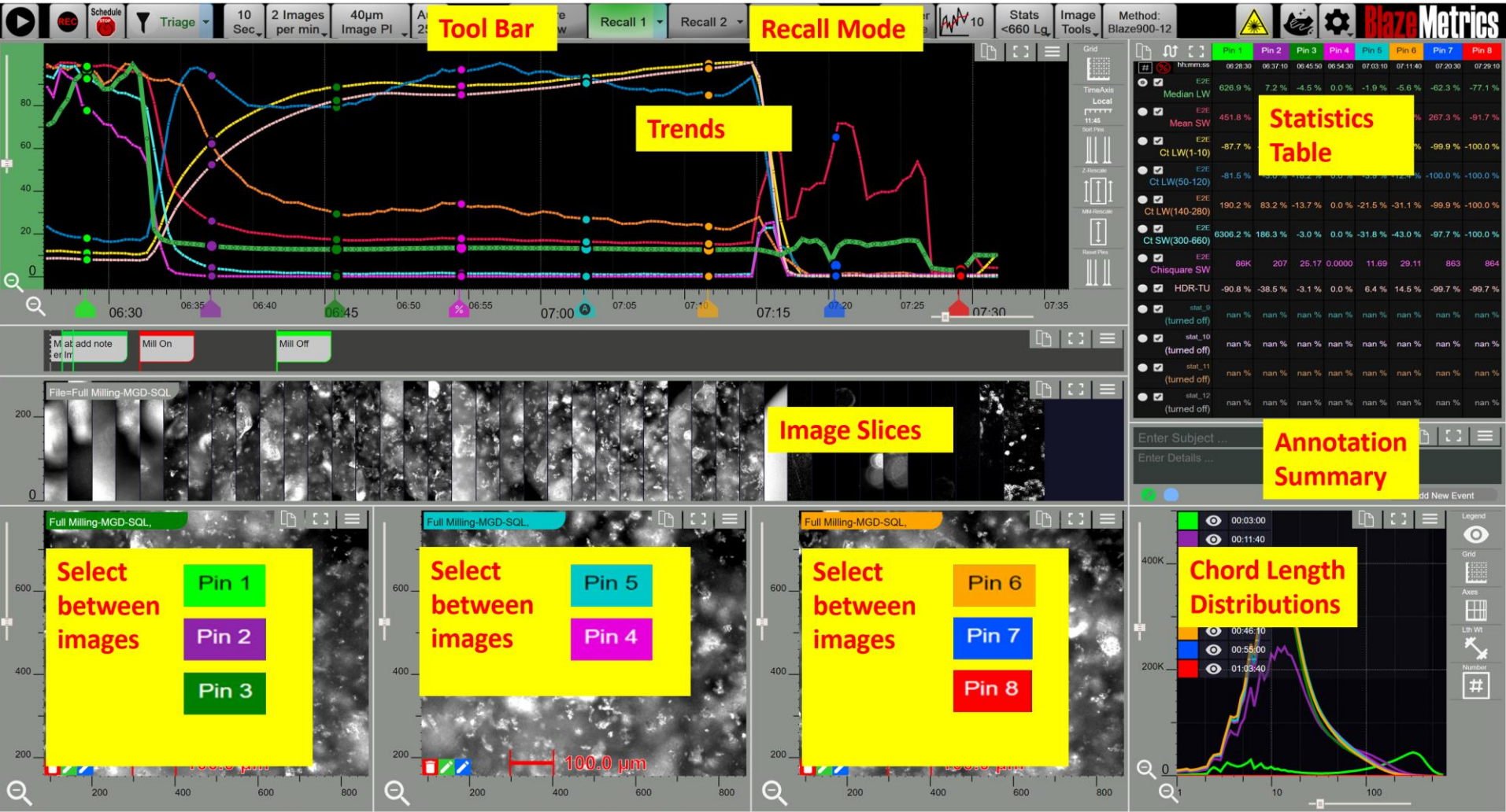
Software Overview

The overview mode of the interface has all displays and annotation entries viewable and accessible simultaneously. Individual displays can be enlarged as needed using the  button. The tool bar contains buttons with functions appearing on click. Note: the live acquire mode display is slightly different than the recall mode display, the tool bar has the most common functions ready for use.

Acquire mode:



Recall mode:

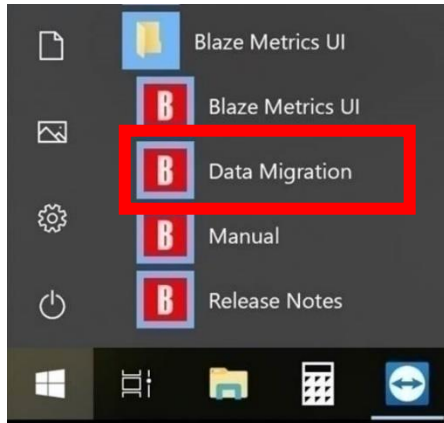


New Data Format and Migration of Old Data

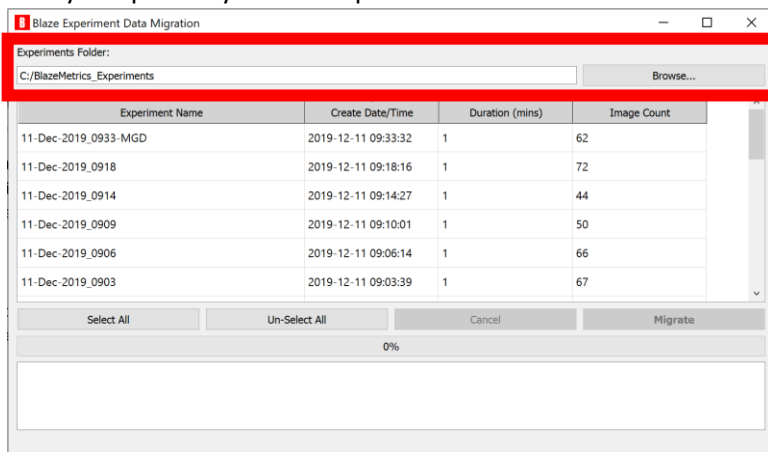
The 2020 A release uses a SQLite database format to store experimental data. This format accelerates data transfer and backup and simplifies data access for external modelling. SQLite can be read by MATLAB, R, and Python. If you require further information, please contact Blaze.

Data taken with 2019 C and earlier releases must be migrated to the new format before opening with the 2020 A or later Office or UI versions. The Data Migration utility retains a copy of the data in the old format and creates a copy in the new format; be sure there is enough disk space since the amount of data will approximately double. Instructions for migration are given below:

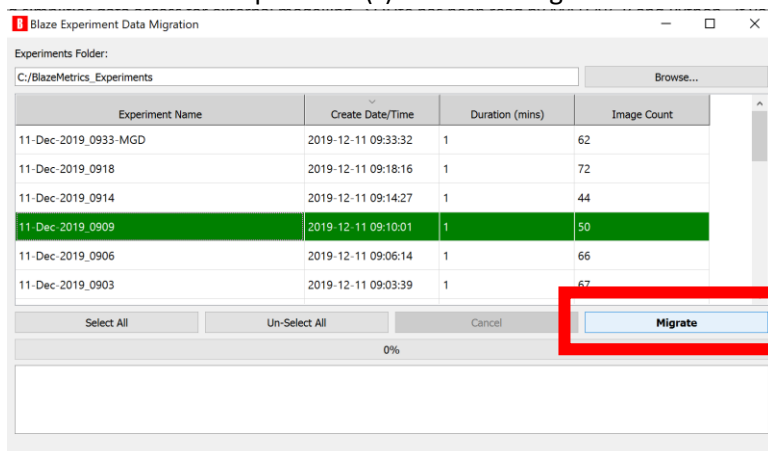
1. Start the Blaze Data Migration software.



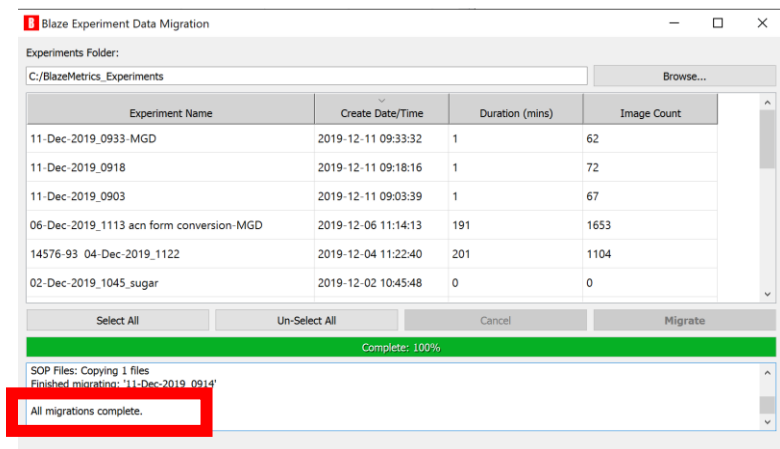
2. Verify the pathway for the Experiments Folder is correct. If not type in or use browse to set the correct location.



3. Select the desired experiment(s) and click 'Migrate'



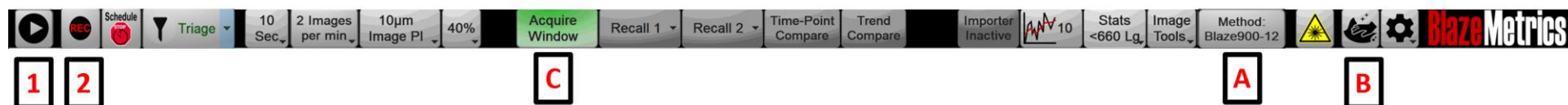
4. When migration of the file(s) is complete a notice will appear



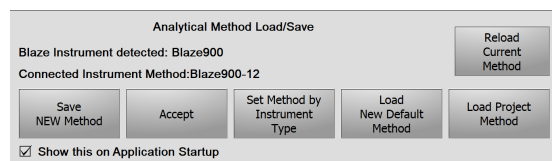
5. The new experiments will be in a new folder with “-MQD-SQL” appended to the original name. All new folders will be in the same experiments folder pathway as the original files.

6. To exit the software, click on the X in the upper right corner.

Quick Steps to Data



The software will start and recommend the Method based on the model. Accept or 'Load Project Method'.



- A. The selected Method is shown under the Method button, to change press the Method button, select 'Load Project Method', and choose desired analytical method.
1. Press the play button  to start acquiring images.
2. Press the REC button  to initiate data saving. It will prompt for a file name, the default name is date-month-year_time, e.g., 01-Jun-2020_1415. To stop recording data click on the REC button again. To pause data recording press the  pause/play button.
- B. Press the Clean button  to temporarily switch the unit into special settings for window cleaning. Wipe window with Kimwipe until clean or particles/streak change position. After this button is deselected, the system will resume the previous settings. **LASER SAFETY WARNING: Never clean the window when operating Raman (i.e., when the Raman Excitation is On). Follow all instructions for the internal and external excitation sources.**
- C. The view mode is set to Acquire Window  when the software starts. The acquisition view shows real time edge to edge chord length distributions, statistical trends, live images, and allows user annotation of the run file. Recall 1 and 2 and Time-Point and Trend Compare     are for review of historical data. A green background appears on the selected view mode e.g.,  indicates Recall 1 is selected.



Be Aware! If you are operating a Blaze Platform or earlier Blaze with Raman, you **MUST** make sure to follow the safety requirements for Class 3b lasers.

The software has different views optimized for different parts of the workflow. An overview is given below, refer to the specific sections in the manual for additional details:

Acquire Window

This view contains all the primary displays and functions for live data acquisition including display of the current live image, two set and five pinned images from the current process, a 'visual trend' of the current process, statistical trends, edge to edge chord length distributions from all images, annotation records, and annotation entry for the current run.

Recall 1

This view is a data review mechanism. It allows recall of images, trends, and distributions. The pin function automatically selects eight points in time allowing for comparison of images and distributions within an experiment. These pins can be moved by the user to the desired time. The eight displayed distributions are of the closest measurement to the time of the corresponding image. Statistics for the distributions are displayed in the statistics table.

User specified distributions and images from Recall 1 are sent to Sample Compare where they can be compared to Recall 2 and the Live experiment.

Recall 2

This performs the same functions as Recall 1 but on a second separate file.

Sample Compare

This view allows direct comparisons of images, distributions, statistics, and experiment information from the live experiment, Recall 1 and Recall 2. This is done by marking pins of interest for 'Send to Compare'. Up to 12 pins can be compared.

Keys to Collecting the Right Data

Understanding what is going on in a complex particle system isn't easy—the following steps can ensure the necessary data is available to facilitate that process.

- A) For multi-component mixtures, whenever possible, it is best to first obtain images of the individual components. It's best in the process solution but in any solution will be helpful. If there is limited material, images can still be taken by inverting the probe (make sure the window is above eye level) and taking images of the particles sitting on the window in air. For many small vials it is also often possible to image through the vial wall. It's much easier to understand what is happening in a multi-component process when you know what each component looks like beforehand.
- B) This approach is even more important for Raman. Obtain spectra of the solvent(s) and dry powders of the different crystal forms individually so that the appearance and/or disappearance of peaks in the Raman spectra can be correctly assigned.
- C) Obtain a set of background images in solution before the formation or addition of particles- i.e., at the start of the experiment, and be sure to store them (*make sure triage is off*). That way if

there is any dirt stuck on the window it can be identified as such.

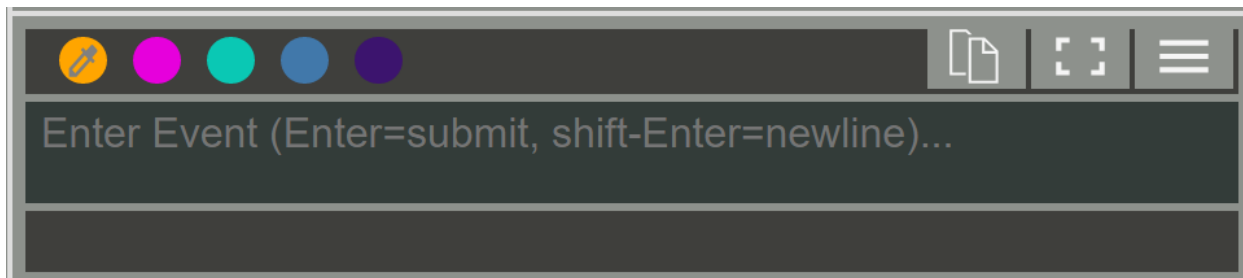
- D) Just before the formation or addition of particles *make sure triage is turned on*. Triage will help evaluate thousands of images per minute to identify particles that already exist in your system prior to the intentional formation or addition of particles. These particles may be inert and of no consequence, or they may be a contaminate that will have a significant impact on your process. Or you may identify the formation of unexpected particles at an unexpected temperature etc.

This can also be quite useful when in a dissolution step prior to initiating your process. Quite often, although the system may seem fully dissolved to the eye, Blaze will identify the particles still present.

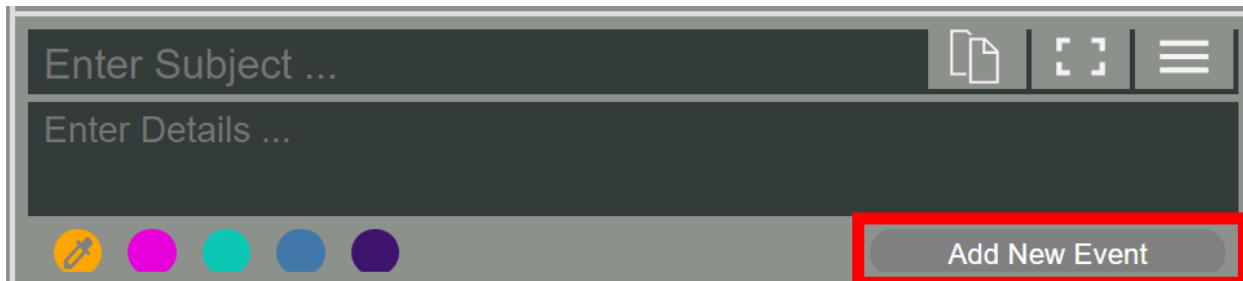
Annotating an Experiment

In live acquisition user annotations can be added at any time when data is being recorded. Annotations can be set to either a short or long form.

The **short form annotation** allows entry of nearly unlimited length in the event field, the first 18 characters are displayed as the subject. Simply type in the annotation e.g., “added seed” and press the enter key  on the keyboard. To move to a new line press ‘shift+enter’. The event is recorded at the time the enter key was pressed. Annotations can be assigned a specific color from the available choices.

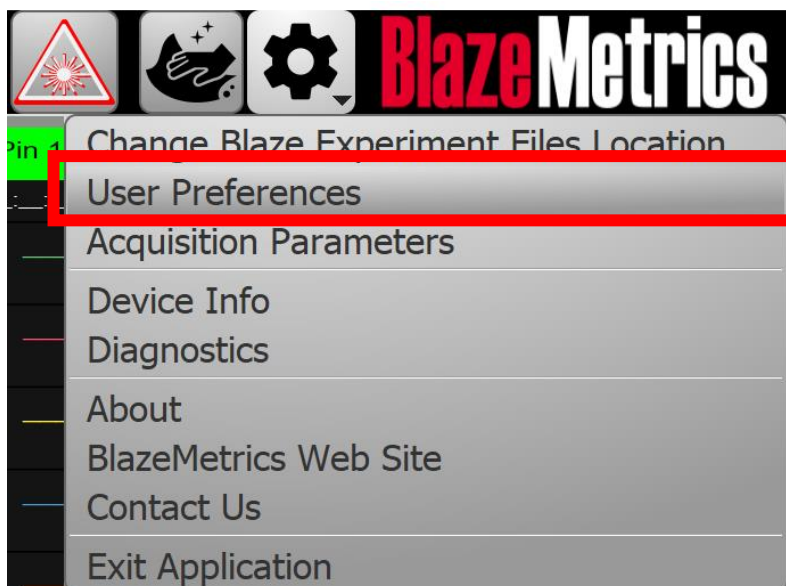


The **long form annotation** allows for an 18-character subject and a nearly unlimited description in the details field. When the entry is complete, click ‘add new event’ and it is recorded at the time the enter key was pressed. Annotations can be assigned a specific color from the available choices.

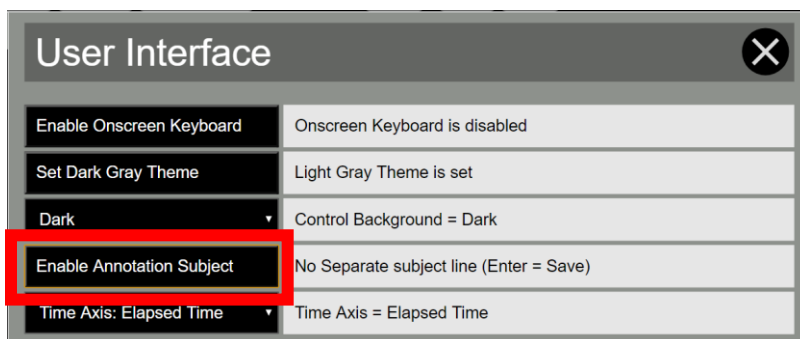


For both short and long annotations, the subject will be visible in the timeline overview, note the first 8 characters are visible in all viewing modes. The details description of the long form annotation will appear when hovering the mouse over the subject in the timeline overview, with up to 20 characters displayed per line.

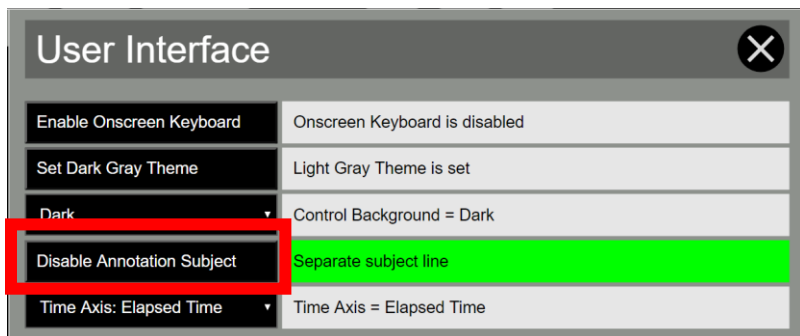
To switch between short and long form click on “User Preferences” under the Settings icon:



Enable Annotation Subject indicates short subject only annotation, recorded as soon as the enter key is pressed. Click on black button ‘Enable Annotation Subject’ to switch to long form annotation.



Disable Annotation Subject indicates long form subject + details annotation, recorded when ‘add new event’ is pressed. Click on black button ‘Disable Annotation Subject’ to switch to short form annotation.



Note: the annotation uses the same timeline (x-axis) as the trends. The exact time of an annotation is when it is entered and is not the same as the time assigned to a measurement or image.

Automatic Annotations

The Blaze software automatically creates annotations whenever data acquisition parameters are changed. These annotations are given specific colors:

Dark red = parameter turned off e.g., triage off, auto laser off

Dark green = parameter turned on e.g., triage on, auto laser on

Yellow = parameter variable changed e.g., image plane target set to 40 microns, measurement duration set to 10 seconds, etc.

The time stamp is for when the action started, it is not the completion time. For example, it records when the image plane started to move to its target position of 40 microns, not when it reached 40 microns.

Note: the image savings rate is not automatically annotated but can be found in the experiment info section for any time-point.

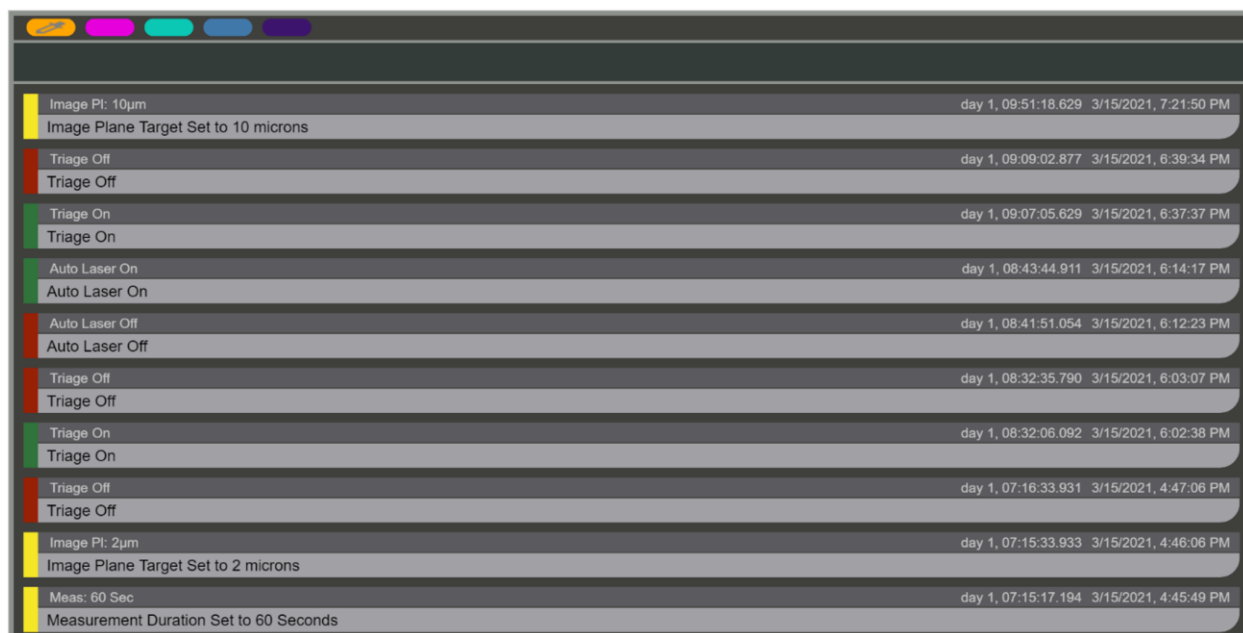
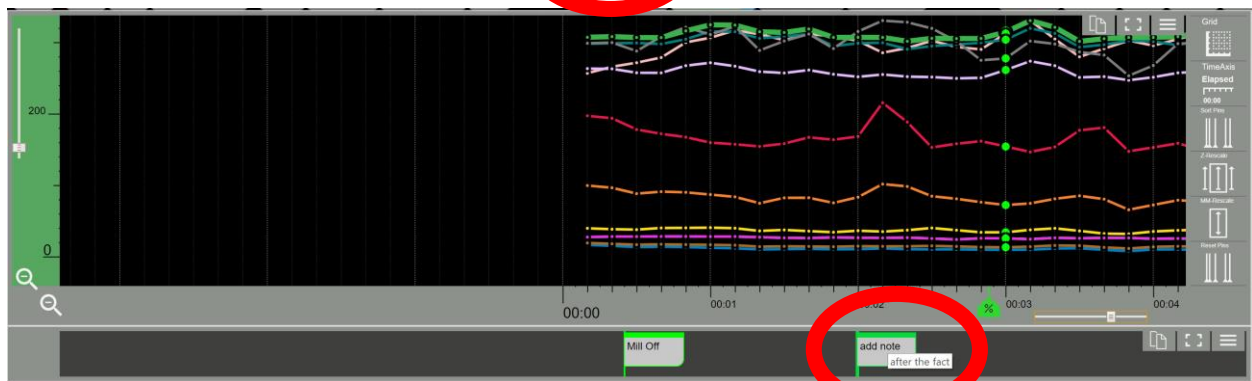
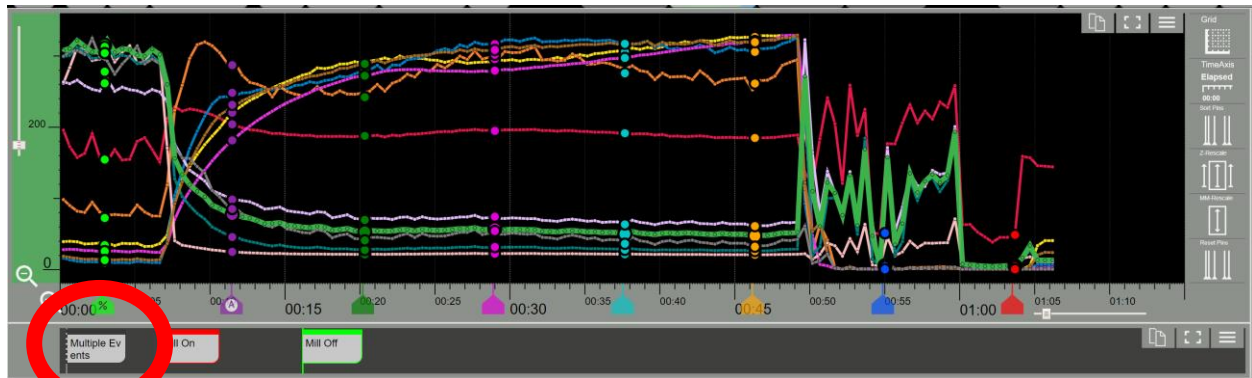


Image Pt: 10µm	day 1, 09:51:18.629	3/15/2021, 7:21:50 PM
Image Plane Target Set to 10 microns		
Triage Off	day 1, 09:09:02.877	3/15/2021, 6:39:34 PM
Triage Off		
Triage On	day 1, 09:07:05.629	3/15/2021, 6:37:37 PM
Triage On		
Auto Laser On	day 1, 08:43:44.911	3/15/2021, 6:14:17 PM
Auto Laser On		
Auto Laser Off	day 1, 08:41:51.054	3/15/2021, 6:12:23 PM
Auto Laser Off		
Triage Off	day 1, 08:32:35.790	3/15/2021, 6:03:07 PM
Triage Off		
Triage On	day 1, 08:32:06.092	3/15/2021, 6:02:38 PM
Triage On		
Triage Off	day 1, 07:16:33.931	3/15/2021, 4:47:06 PM
Triage Off		
Image Pt: 2µm	day 1, 07:15:33.933	3/15/2021, 4:46:06 PM
Image Plane Target Set to 2 microns		
Meas: 60 Sec	day 1, 07:15:17.194	3/15/2021, 4:45:49 PM
Measurement Duration Set to 60 Seconds		

Modifying or Adding Annotations in Review Mode

In the 21 CFR Part 11 version of Blaze software and files generated by it, it is not possible to edit an annotation, or to shift the time point of an annotation. It is possible to add a review comment in the 21 CFR Part 11 version of Blaze software.

To add an annotation to a completed experiment, open that experiment in recall 1 or 2. Enter the annotation using the annotation field as described above. The new annotation will be put at the very start of the experiment. Zoom into the very start of the experiment (center the start of the trend before zooming), click hold and drag the annotation to move it to the desired time point.



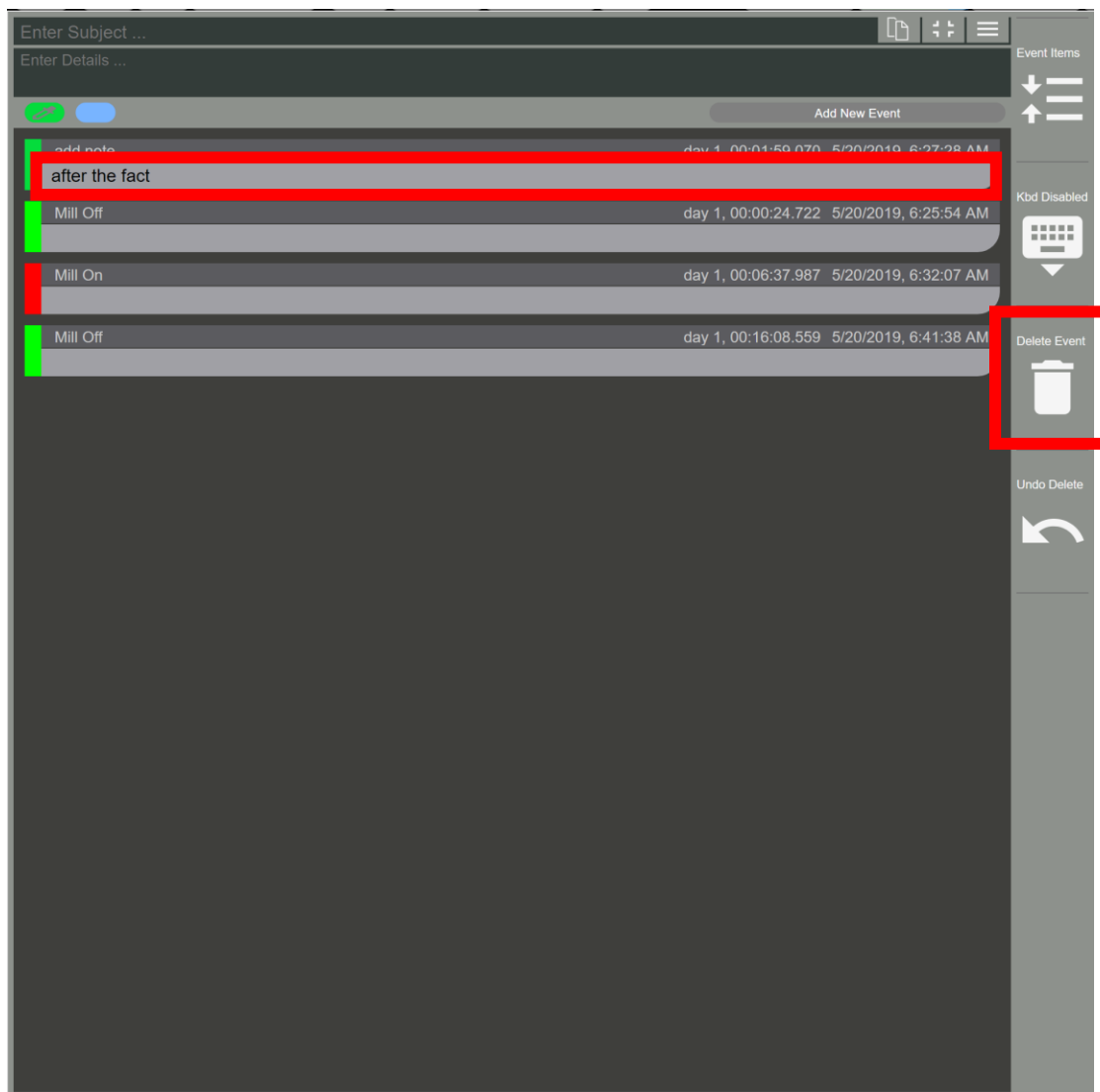
The following instructions apply only to the non-21 CFR Part 11 version of Blaze software and files generated using it.

To edit or delete an annotation first maximize the annotation display:



To delete a note: Select it by clicking in either field and then click delete event.

To edit a note: Select the details field text. Click outside of the annotation when done. Only the second field (description) can be edited. For a long form annotation, the subject cannot be edited. For a short annotation, changing the description will also affect the subject line which is derived from the first 18 characters of the description.



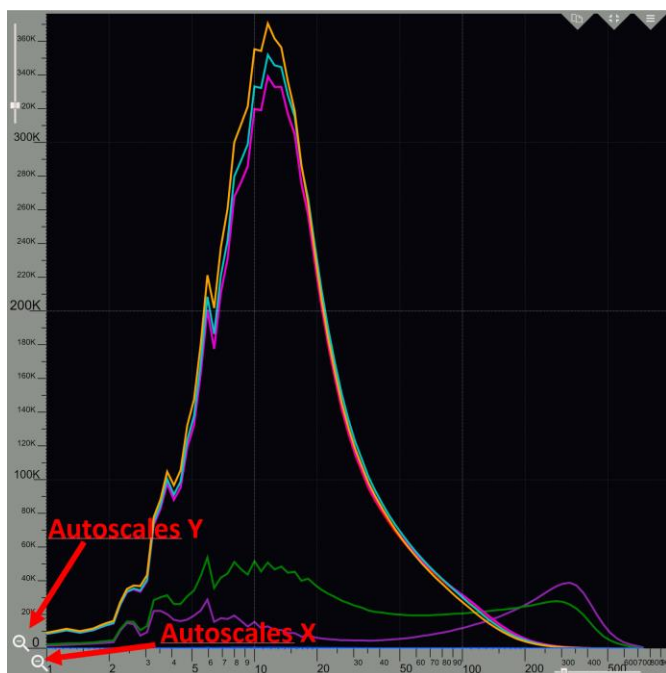
General Display control

To maximize a display, click on the frame control  in the upper right corner of the window. ONLY ONE FRAME CAN BE MAXIMIZED AT A TIME. The Maximized display window can be restored to original size by clicking on the frame icon to re-enable those functions.

To access additional controls for that individual display, click on the menu control  in the upper right corner of the window. A series of additional controls will become visible. Click on a control to activate or de-activate it. Detailed descriptions of these controls can be found later in this manual.

Distribution and Trend Autoscaling

The advanced chord length distribution (A-CLD) and trend display have two separate magnifying glass controls  for the X and Y axis. To reset the zoom, click the magnifying glass control  on the respective axis.



Zooming in X

Trends and A-CLD: the horizontal slider  can be used to zoom in X. Going to the right increases the zoom, going to the left decreases the zoom. To reset, click the magnifying glass control  closest to the horizontal slider.

Images: zooming occurs in X and Y simultaneously using the vertical slider. Going up increases the zoom, going down decreases the zoom. To reset, click the magnifying glass control  in the lower left of the window.



vertical slider, move up to zoom in, move down to zoom out

Alternative method: with the cursor in the statistics trend, visual trend, or annotations window hold down the left mouse button and scroll up to zoom in or scroll down to zoom out. To reset click the magnifying glass control  closest to the horizontal slider.

With a touchscreen: in the statistics trend, visual trend, or annotations window put two fingers next to each other and then spread apart to zoom in, put two fingers apart from each other and then bring together to zoom out. To reset, touch the magnifying glass control  closest to the horizontal slider.

Zooming in Y

Trends and A-CLD: the vertical slider can be used to zoom in Y. Going up increases the zoom, going down decreases the zoom. To reset, click the magnifying glass control  closest to the vertical slider.

Images: zooming occurs in X and Y simultaneously using the vertical slider. Going up increases the zoom, going down decreases the zoom. To reset click the magnifying glass control  in the lower left of the window.



vertical slider, move up to zoom in, move down to zoom out

Alternative method: with the cursor in the statistics trend window hold down the shift key and hold down left mouse button and scroll up to zoom in or scroll down to zoom out. To reset click the magnifying glass control  closest to the vertical slider.

With a touchscreen: Put two fingers next to each other and then spread apart vertically to zoom in, put two fingers apart from each other and then bring together vertically to zoom out. To reset touch the magnifying glass control  closest to the vertical slider.

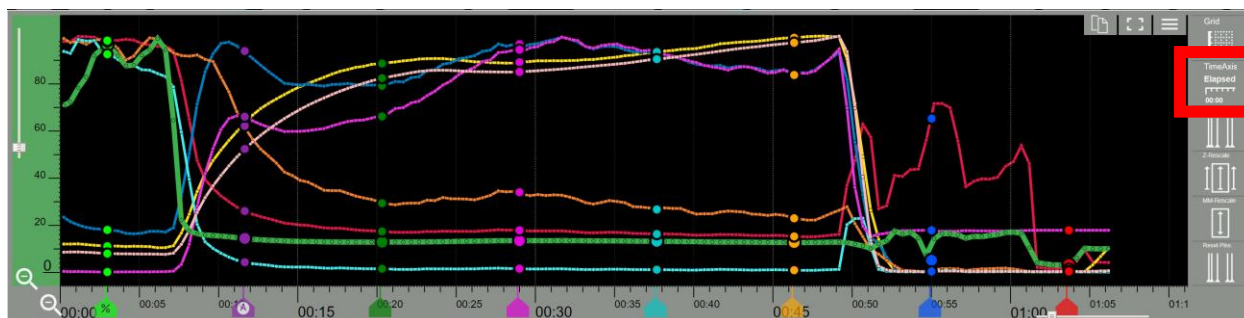
Panning (Moving) in X or Y

With a mouse: in the statistics trend, visual trend, annotations or Image windows, hold the left mouse button down and move in the desired direction. To reset, click the magnifying glass control  on the X or Y axis.

With a touchscreen: in the statistics trend, visual trend, annotations or Image windows press with one finger and move in the desired direction. To reset touch the magnifying glass control  on the X or Y axis.

Trend Display

The trend display shows up to twelve trends from any combination of statistics calculated from the distributions or OPC data through the Blaze Importer. The best starting point is using the preset statistics. When needed, customization can be done as described in the Stats Config (statistics configuration) section of the manual. This shows the default Blaze900 statistics for a milling process:



The X axis is either elapsed time since the start of experiment or computer local time. To switch between them click the elapsed/local time button in the upper right of the trend window.

Y values of the individual trends typically differ by several orders of magnitude”; for ease of viewing, all trends are normalized so that each trend is fully visible. To see an individual Y scale, press the radio button of the desired trend in the statistics table in the upper right portion of the display. The desired trend will become thick, and the Y axis color will match the desired trend color. To hide any specific trend, uncheck the square box.

	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
hh:mm:ss	00:03:00	00:11:40	00:20:20	00:29:00	00:37:40	00:46:20	00:55:00	01:03:40
☒ E2E Median LW	0.0 %	-85.3 %	-86.9 %	-86.2 %	-86.5 %	-87.0 %	-94.8 %	-96.9 %
☒ E2E Mean SW	0.0 %	-73.5 %	-82.4 %	-81.9 %	-83.5 %	-84.5 %	-33.4 %	-98.5 %
☒ E2E Ct LW(1-10)	0.0 %	477.5 %	706.6 %	711.5 %	750.2 %	806.2 %	-99.5 %	-99.8 %
☒ E2E Ct LW(50-120)	0.0 %	425.2 %	342.8 %	441.3 %	420.1 %	371.2 %	-99.8 %	-100.0 %
☒ E2E Ct LW(140-280)	0.0 %	-36.8 %	-70.3 %	-65.5 %	-72.9 %	-76.8 %	-100.0 %	-100.0 %
☒ E2E Ct SW(300-660)	0.0 %	-95.5 %	-98.5 %	-98.4 %	-98.9 %	-99.1 %	-100.0 %	-100.0 %
☒ E2E Chisquare SW	0.0000	5.86K	5.87K	8.39K	8.31K	7.44K	1.58K	1.58K
☒ HDR-TU	0.0 %	569.3 %	954.2 %	987.8 %	1057.1 %	1146.6 %	-97.1 %	-97.1 %
☐ stat_9 (turned off)	nan %	nan %	nan %	nan %	nan %	nan %	nan %	nan %
☐ stat_10 (turned off)	nan %	nan %	nan %	nan %	nan %	nan %	nan %	nan %
☐ stat_11 (turned off)	nan %	nan %	nan %	nan %	nan %	nan %	nan %	nan %
☐ stat_12 (turned off)	nan %	nan %	nan %	nan %	nan %	nan %	nan %	nan %

The pins (triangular markers) on the trend determine the time points for the statistics table as well as which images and distributions are selected. To move a pin, click on the triangular marker and drag it to the desired time point. **Note:** the red pin of the live acquire window is always assigned to the current image and distribution and cannot be moved.

Additional functions are described in the Trend section of Chapter 8 Advanced Functions.

Image Display

The live image display is in the lower right of the display. The X and Y scale of the image are always in units of microns.

Zooming of images is always simultaneous in both X and Y.



Use the vertical slider, move up to zoom in, move down to zoom out.

To reset, click the magnifying glass control  in the lower left of the window.

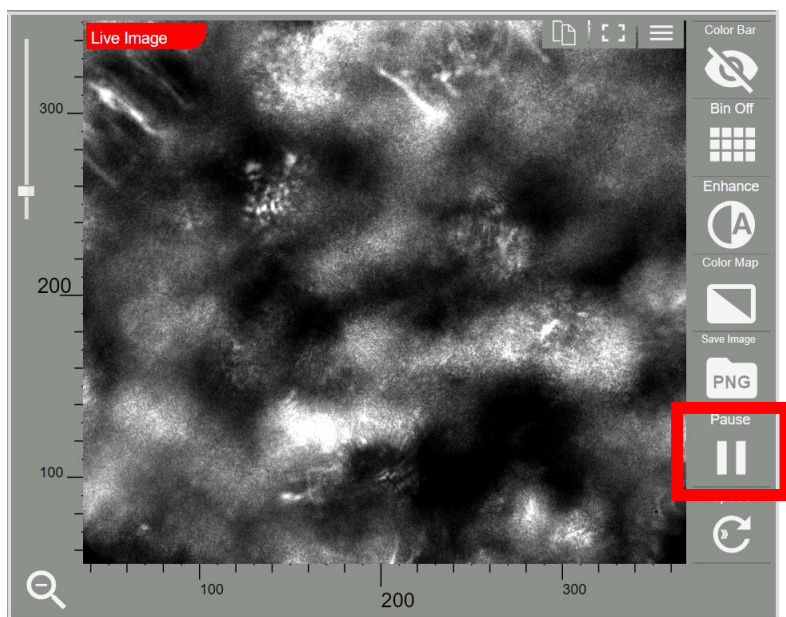
Alternative methods of zooming:

To zoom in with the mouse move the cursor over the desired portion, hold left mouse button, and scroll up using the mouse scroll button. To zoom out hold left mouse button and scroll down. To reset click the magnifying glass control  in the lower left of the window. Note: many mice support a clickable scroll wheel, this allows “click-scrolling” which is sometimes easier than trying to hold down the left button while scrolling a wheel.

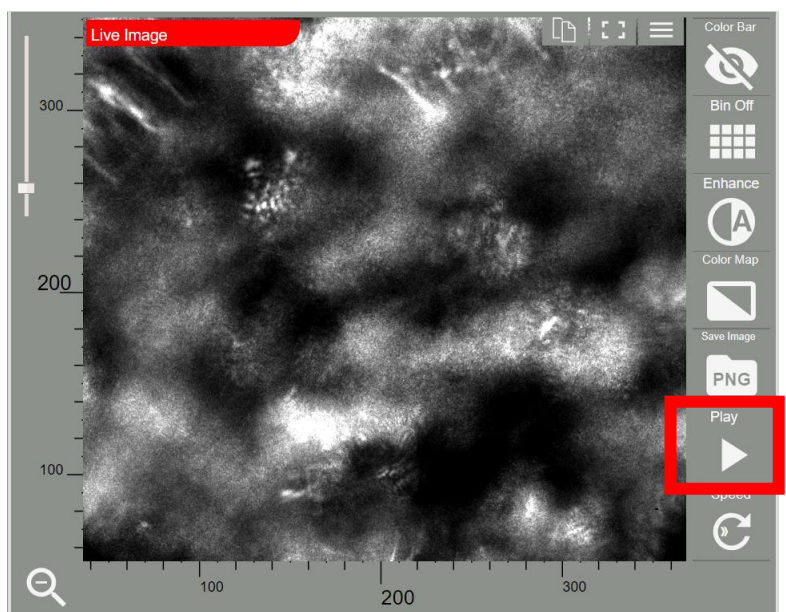
To zoom in with a touchscreen place two fingers on the desired portion and spread apart. To reset, touch the magnifying glass control  in the lower left of the window with one finger.

Live Image Display

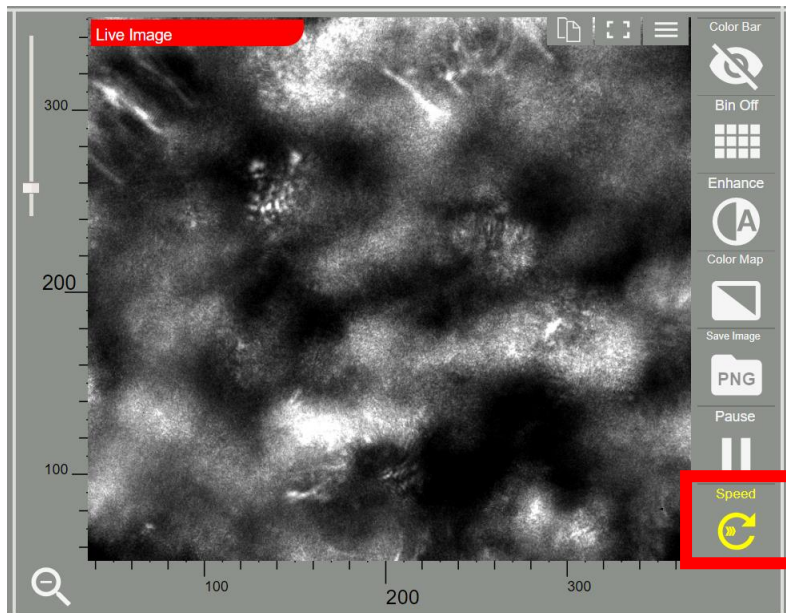
The live image display is in the lower right of the display. By default, it continuously updates when the Blaze is measuring. To pause the current live image, click on the pause button shown below:



To resume updating the live image click on the play button:



The update rate can be changed by clicking on the speed button. With each click it updates faster until it cycles back to the slowest speed. A white color button indicates a slower speed, when white, the image is displayed at full pixel resolution. At high speeds, the button turns yellow to indicate the image is displayed at lower resolution. This does not affect image saving or particle analysis, it only applies to the display of the live image.

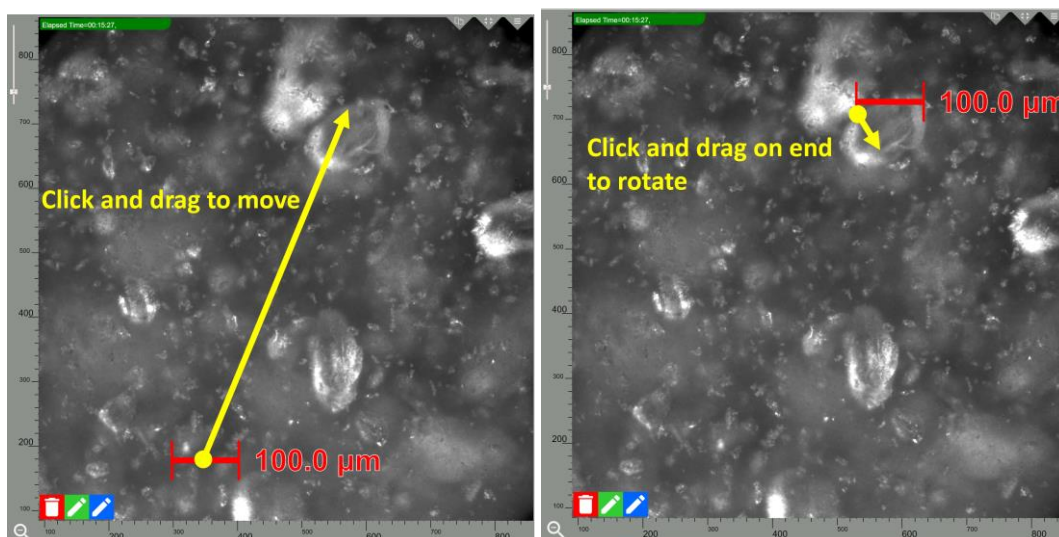


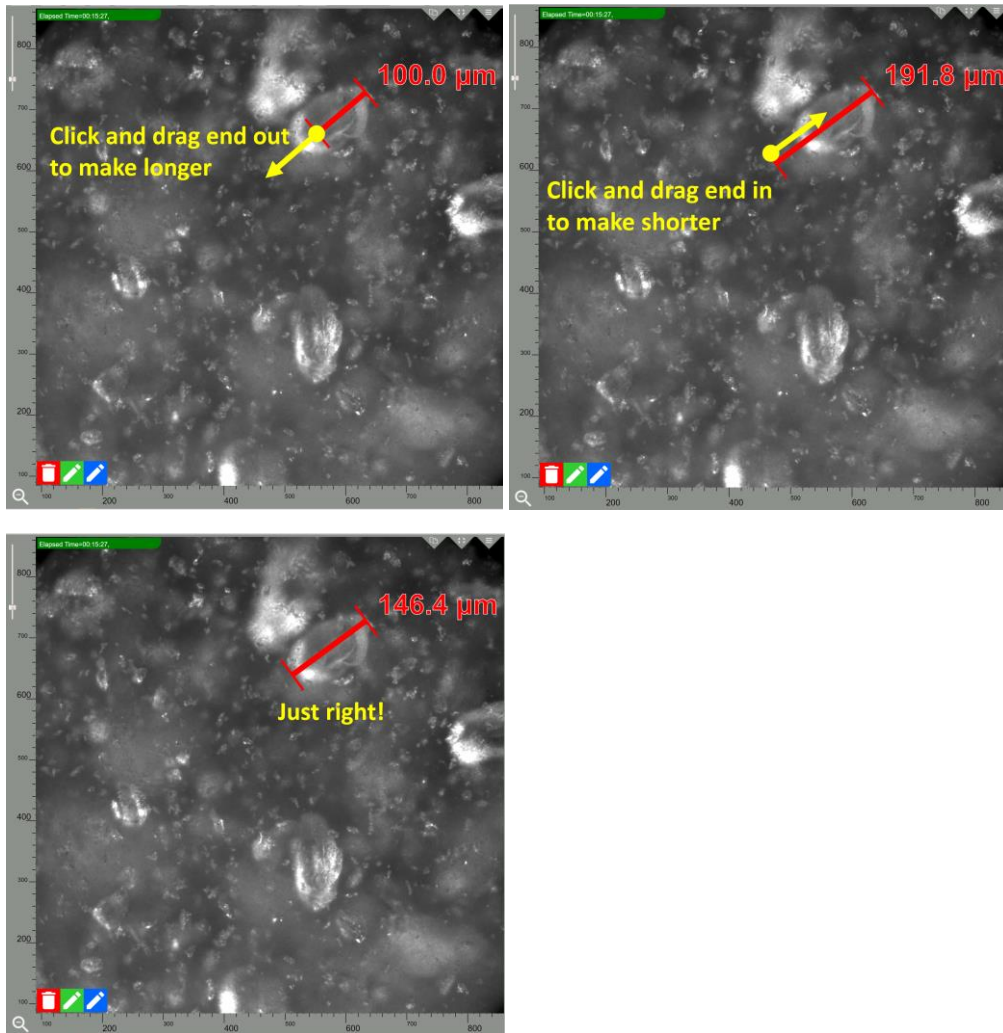
Refer to the Triage section of the manual for how to display all images or only triaged images in the live display.

Image Measurement Tool

A measurement tool is automatically included in the image display. To move the tool, click in the middle of the line and drag to the desired location. To shorten or lengthen the tool, click directly on the outside line at either end and drag inwards or outwards. To change the orientation of the tool, click directly on the outside line at either end and move up or down to rotate as needed.

To add more measurement tools left click or touch the colored pencil icon to place it in the image. Up to three measurement tools can be applied in any order, each has a unique fixed color (red, green, or blue). Measurement tools can be erased by clicking on the matching color trash icon.

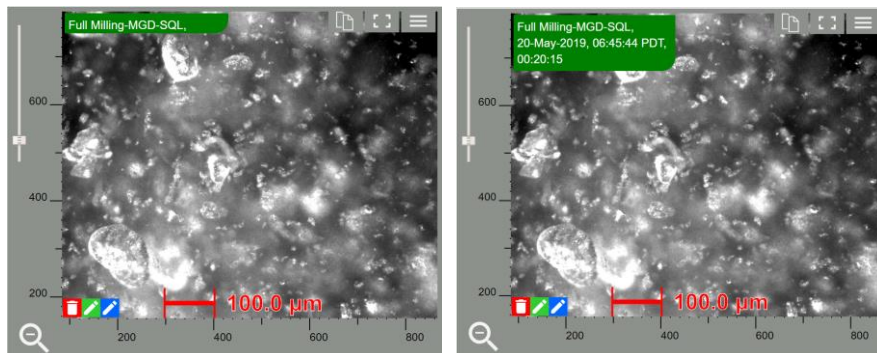




Any displayed tools and measured values are included in images copied using the clipboard function described in the 'Exporting Displays to Reports' section in the Data Analysis and Reporting chapter.

Image Information

The colored area in the upper left shows the file name. Touch or click on the colored area to show additional information: date and time image was taken (displayed in local time on computer) as well as the elapsed time. Touch or click on the colored area again to reduce the displayed information.



Visual Trend (Image Slices)

The visual trend shows image slices as the process changes. The software uses a special algorithm to go into the images and pull out the most resolved part of the image to display in the visual trend—these are not thumbnails of the entire image. Up to 45 ‘slices’ are displayed, they are always equally spaced in time and in sequence from earliest on the left to latest on the right. When zooming on the trend time (x-axis) the visual trend will update to match the same time period.

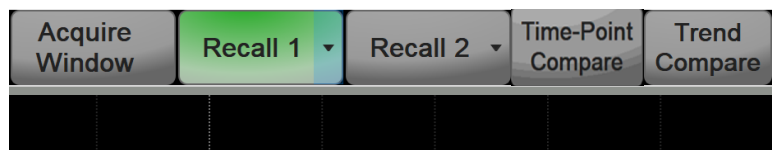
Selecting Individual Images

When in the Acquire Window, the live image is always displayed in the right most location and marked by red pin 8. An additional seven points in time are automatically selected, their associated images, statistical values, and distributions are displayed as well. They can be adjusted by dragging the pins (triangle markers) at the bottom of the trend axis. Right click on a pin to make it the ‘Active Pin’ and then use the left or right keys on the keyboard to move the selection one image at a time. Note: the live image pin cannot be made the active pin.

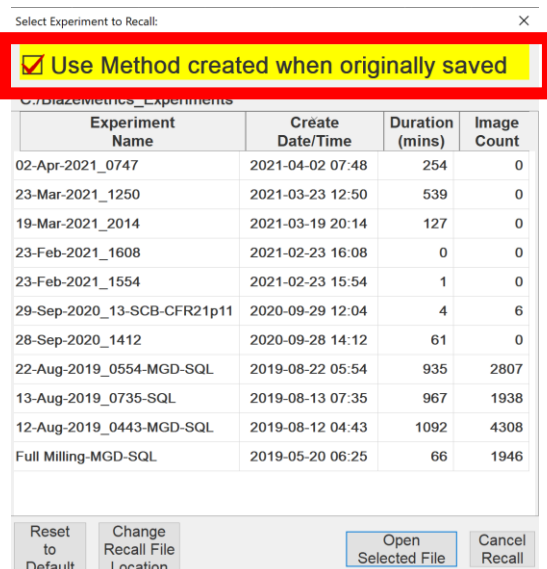
When in Recall Mode, eight equally spaced points in time are automatically selected on the trend access, their associated images, statistical values and distributions are displayed as well. They can be adjusted by dragging the pins (triangle markers) at the bottom of the trend axis. Right click on a pin to make it the ‘Active Pin’ and then use the left or right keys on the keyboard to move the selection one image at a time.

Recalling and Reviewing Data

Click directly on the Recall 1 or Recall 2 button to open a file.

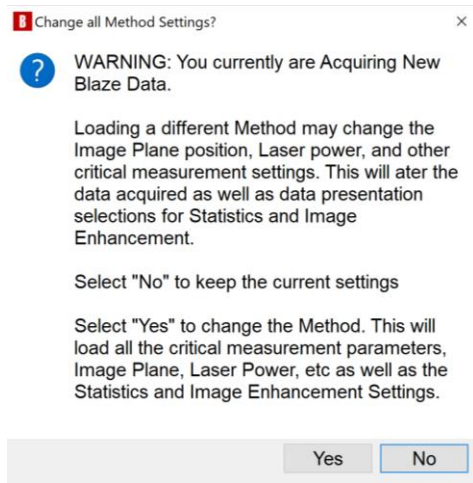


If “Use Method...” is checked, the recalled file’s Method is loaded and applied to the live experiment and other recalled file. **If running live uncheck “Use Method...”**.



Double click on the desired experiment to open it or click it once to select and then click 'Open Selected File'. Images, trends, and distributions of the recalled file will automatically be displayed in Recall 1.

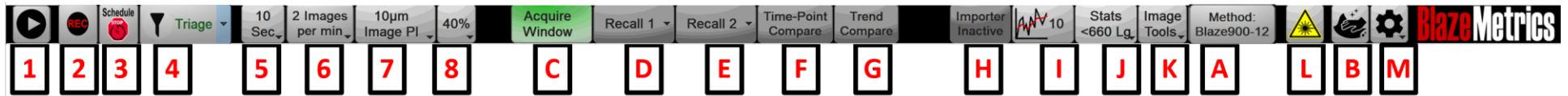
If "Use Method..." is checked and the Blaze is acquiring data, this confirmation window will appear:



Chapter 8: Advanced Operation

This chapter describes the individual software functions in greater detail (including those used by intermediate level users to create Methods).

Full Menu Bar Descriptions



- | | |
|-------------------------------------|--------------------|
| 1. Play | A. Method |
| 2. Record | B. Clean |
| 3. Schedule Experiment Stop | C. Acquire Window |
| 4. Triage | D. Recall 1 |
| 5. Save Measurement Every (seconds) | E. Recall 2 |
| 6. Images per Minute | F. Sample Compare |
| 7. Image Plane Position | G. Trend Compare |
| 8. Laser Energy | H. Importer |
| | I. Averaging |
| | J. Statistics |
| | K. Image Tools |
| | L. Laser Indicator |
| | M. Settings |

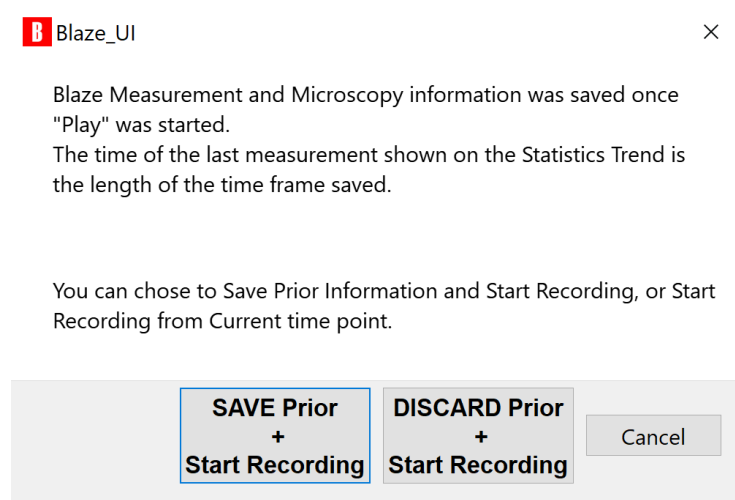
Button functions described in detail under button name headings that follow

Play

Pressing the play button  starts the measurement but does not automatically start saving data. Once pressed, the play button changes to . To stop acquisition, press the pause button, data taken this way will not be saved. To save data taken after play is pressed the record button must also be pressed.

Record

If the record button  is pressed after pressing play the following dialogue box appears:

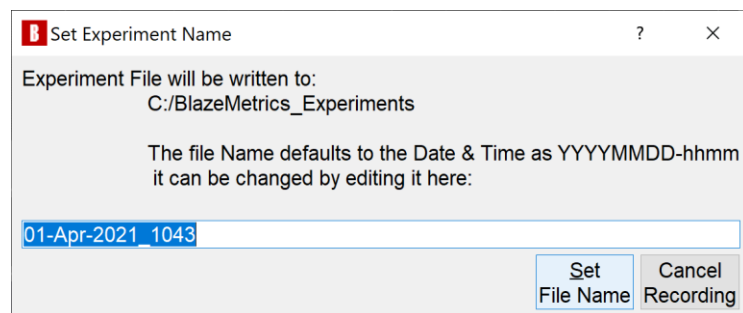


Typically, the probe should be placed in solution well prior to any process changes of interest so "discard prior + start recording" can be selected without losing any useful images or data.

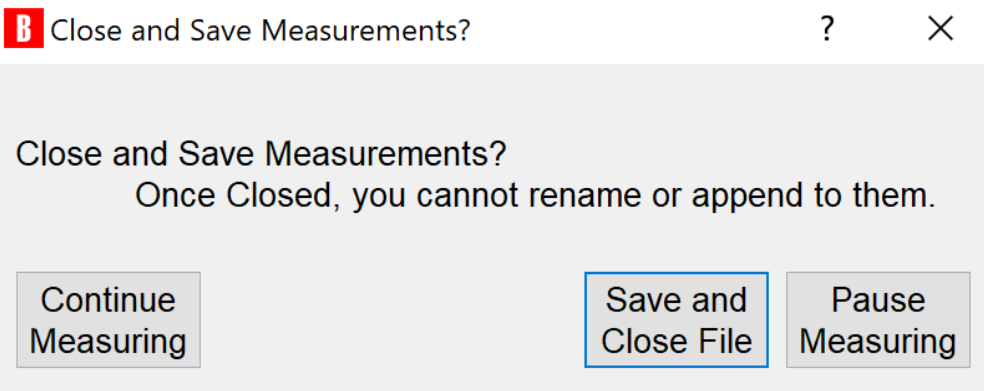
However, if the early images and data are important, select "save prior + start recording" to save all data since pressing play.

Images and data taken after pressing record will be saved for either choice.

A default file name (date + time) is proposed, accept or modify the name and press 'Set File Name'.



Note: if 'Save Prior' was selected the default file name appears while the experiment is running and is changed to the user set file name when the experiment is done. If 'Discard Prior' was selected or the Record button was pressed without pressing play, then the user set file name will appear immediately. When recording is active the button appears as a stop button , when stop is pressed a dialogue appears:



To save and close the file, click on “save and close file”. The default file name is the date and time at which recording started using the format DD-month-YYYY-HHMM. The directory for saving defaults is to C:\BlazeMetrics_Experiments. This can be changed under the Settings Button to Change Blaze Experiment Files Location. Do not use C:\SOP_Defaults for storing experimental data. The file name can be changed subject to the following criteria:

The run file name must be from 5 to 65 characters long, allowed characters are:

Letters, numbers, spaces and these 18 special characters: ~!@#\$\$%^&()_+={}[]

It is possible to create a run file that cannot be loaded if it is named in one of these two ways:

- A. Using a majority of special characters, (characters other than letters or numbers) which can make the path length too long to access some files.
- B. Using a percent sign followed by a 2-digit number (e.g. %20). Windows sees this as a special designation and will prevent the Blaze application from finding the data files.

To pause data recording click . The record button appearance does not change, it remains as .

Pausing the measurement is useful in cases such as removing the probe from a stirred reactor vessel, when air bubbles will pass in front of the probe, moving the image plane or any other case in which the particles the probe sees will not be representative of the process and result in images and data which could be misinterpreted.

To continue recording data click . The stop button  can be clicked at any time to stop and save the experiment.

If the record button  is pressed without pressing the play button, then data is saved right away. Note: this is not recommended because laser will not be automatically calibrated which will affect the HDR turbidity measurement.

Schedule Experiment Stop

The schedule experiment stop button  allows recording to be stopped at a scheduled time. To use this function first select play  and record  and then press . Select the stop date and time (only future dates and times are allowed).

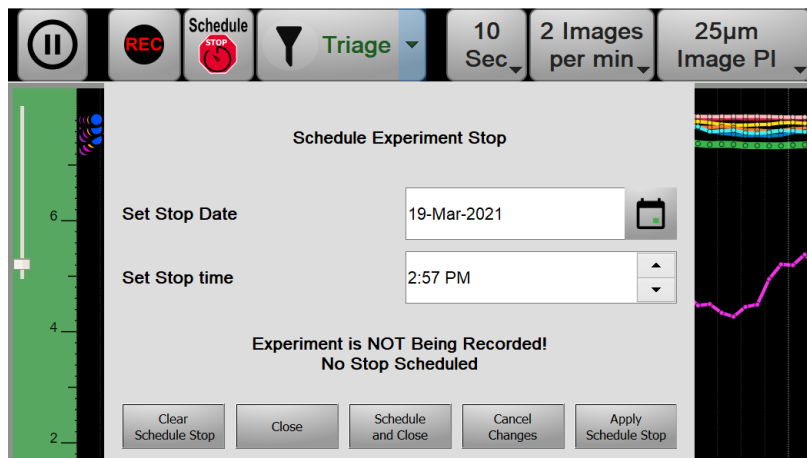
Click ‘Schedule and Close’ (this applies the selected stop date and time and closes the window). The button will change to  indicating a stop is scheduled.

Click ‘Apply schedule Stop’ (this applies the selected stop date and time and keeps the window open).

To cancel scheduling click 'Cancel Changes'.

To clear an already scheduled stop click 'Clear Schedule Stop'.

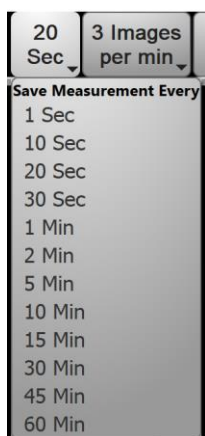
To dismiss the schedule dialogue window, click on the schedule experiment stop button again.



Save Measurements Every (seconds or minutes)

The save measurements button  controls the time period over which each particle system characterization measurement is made. The basic particle system characterization analysis package analyzes images and creates a 1d edge-to-edge chord length distribution and other statistics. The Blaze 400 and 900 acquire up to 58 images per second and analyze as many of them as possible. The Blaze 320 acquires up to 17 images per second and analyzes as many of them as possible. The results are normalized to a per image value.

This setting does not affect image saving. Measurement duration choices range from 1 second to 60 minutes in fixed intervals which can be accessed by clicking on the button.



The chord length distribution measurement data does not require significant storage space.

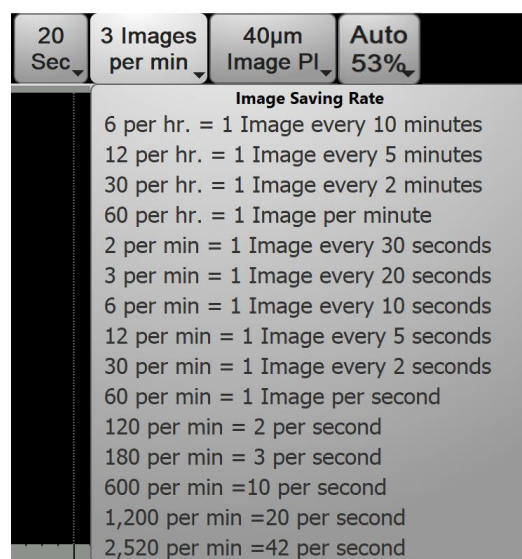
Remember all readings of a save measurements period are grouped together, the reported value is the average value over the save measurements period. If the change occurs faster than the save

measurements period, then the transition will not be clearly visible. For example, if the change occurs within 30 seconds it is better to set a save measurements period of 10 seconds so the transition will be clearly visible, a save measurements period of 1 minute will not capture when the transition occurred.

Also note the live image window often updates at a greater rate than what is set up for saving so not every image seen is saved. Use of triage ensures representative or high edge contrast images are saved depending upon the triage setting.

Images per Second, Minute, or Hour

The images per minute button  controls how many images are saved per second, minute or hour. The saving of images is independent of the measurement duration. The saving rate is given in different time units. Images are saved evenly spaced in time, with the highest ranked (by triage) image saved at each interval.



Each image is high resolution and high dynamic range which means a hard disk can fill up quickly if too many images are saved. The next section provides some recommendations.

Recommended Measurement and Image Saving Settings

Use the type of run and expected run time to choose the images per minute setting. Be sure there is enough disk space before starting an experiment.

In general, the narrower the particle size distribution, the smaller the particles are, the more representative any single image will be. On the opposite end, if there is a wide distribution, with infrequent particles at the tails of either end of the distribution, then any single image is less representative, and more images need to be evaluated to get a true understanding of the system.

When running a seeded crystallization, a high image savings rate should be used just prior to and for several minutes after the seeding. This allows observation of seed behavior such as dissolution, dispersion, healing, floating seeds, etc. After the seeds are well dispersed and growth begins, the image savings rate can be reduced.

Note: these tables assume that triage is not limiting the number of images saved. If triage is limiting the number of images saved the resulting file size will be smaller.

Blaze applies loss-less real time compression (i.e., image file size is made smaller while keeping the original image quality) whenever possible to minimize file size while retaining the highest quality images and data. Very fast image savings rates and other processes running on the computer CPU may limit the degree of compression that can be applied in real time. **The smaller size is typical**, largest size is the maximum possible file size (no compression is applied to the data).

For runs where the process is understood, and the goal is to verify it behaves as expected:

run time	Measurement duration	Image savings rate	Approx. run file size [GB]
15 min	10 sec	60 images/min	3.6 to 7.2
30 min	10 sec	30 images/min	3.6 to 7.2
1 hour	10 sec	30 images/min	7.2 to 14.4
2 hours	20 sec	12 images/min	5.8 to 11.5
4 hours	30 sec	12 images/min	11.5 to 23.0
8 hours	1 min	6 images/min	11.5 to 23.0
12 hours	1 min	3 images/min	8.7 to 17.3
16 hours	1 min	2 images/min	8.7 to 17.3
1 day (24 hours)	1 min	2 images/min	11.5 to 23.0
2 days	2 min	60 images/hour	11.5 to 23.0
4 days	5 min	30 images/hour	11.5 to 23.0
7 days	10 min	12 images/hour	8.1 to 16.1

For runs where the process is not understood, and maximum information is desired

run time	Measurement duration	Image savings rate	Approx. run file size [GB]
<2 min	10	2520 images/min*	20.2 to 40.3
<5 min	10	1200 images/min *	24.0 to 48.0
15 min	10	180 images/min	10.8 to 21.6
30 min	10	120 images/min	14.4 to 28.8

1 hour	10	60 images/min	14.4 to 28.8
2 hours	20	30 images/min	14.4 to 28.8
4 hours	20	12 images/min	11.5 to 23.0
8 hours	30	6 images/min	11.5 to 23.0
12 hours	60	6 images/min	17.3 to 34.6
18 hours	60	3 images/min	13.0 to 25.9
24 hours	60	3 images/min	17.3 to 34.6

*High image saving rates require using the solid-state C drive as the storage location. External drives are significantly slower and may not be able to save images at the requested rate. If an external drive is used it should be a solid-state drive with USB 3 bus speed of 500 GB/s or better.

Note: The April 2021 software release has improved the laser illumination, allowing fewer images to be saved while significantly increasing the precision of the trends and image quality. Future developments will continue to reduce file size without affecting data quality.

Recommended Data Transfer and Backup Frequency

Data should be transferred from the Blaze computer on a regular basis to ensure enough disc space for future experiments. Blaze supplied computers have a 1 TB SSD, it is recommended to transfer data every two to four weeks to free up 400 GB of space. (This assumes running experiments daily and a savings rate of 2 images/minute.)

Triage

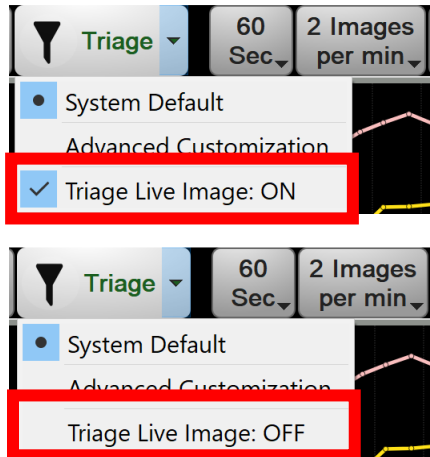
The Blaze unit acquires up to 58 high resolution images per second for particle system characterization. The particle system analysis routines include their own set of particle selection criteria and are independent of user selected Triage.

User set Triage is used only to select images for viewing and saving to the file, it has no impact on any particle sizing or turbidity analytics. Triage selects images based on their score ranking which is calculated from their quality and uniformity. By default, quality contributes 95% of the score of the image and uniformity contributes 5%. This can be adjusted to save images exclusively based on quality (e.g., 100% scores images solely on quality) or on uniformity (e.g., 0% scores images solely on uniformity) or a user determined combination of both. The highest ranked images are saved at the rate specified under 'Images Per' .

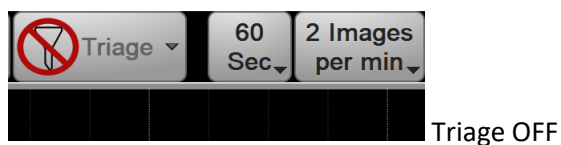
Quality evaluates the images for high visual acuity (e.g., more well defined) whereas uniformity evaluates images by how representative they are. By using triage with any combination of quality and uniformity the saving of low information content images (e.g., out of focus particles) is greatly reduced. Note: for systems with very few particles the highest ranked images are more likely to include low information content images than for a system with a higher particle concentration.

Triage can be turned off entirely in which case images will be saved regardless of image information content or quality of the image. This is not recommended, as the results will include images with no meaningful information.

By default, the live image window always displays images which have passed triage. Triage of the live image display can be turned off by unchecking 'Triage Live Image' under the Triage pulldown menu. It may be worthwhile to observe random images to assure the triage parameters are selecting the set of images desired. The 'Triage Live Image' has no effect on the images saved.

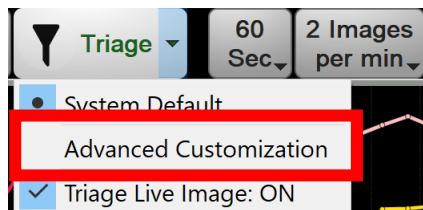


To turn off triage entirely click on the triage button, and it will display the Triage Off button shown below. To turn triage on click the button again and it will return to its original appearance.

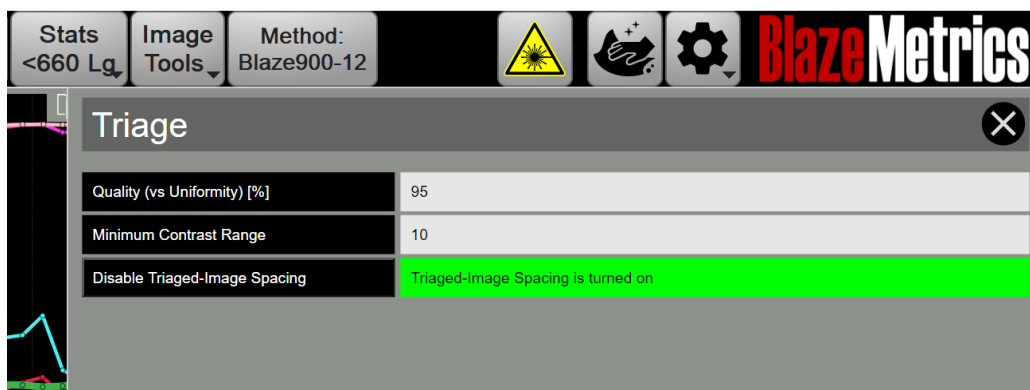


Advanced Triage Parameters

Advanced settings can be accessed from the 'Advanced Customization' choice under the triage button pulldown



The triage parameters appear on the right of the screen



‘Quality (vs Uniformity) [%]’ determines how the score of an image is calculated. In the default settings 95% of an image’s score is based on quality, the remaining 5% is based on uniformity. For an even contribution of both quality and uniformity to the score set this to 50%. To score images only based on quality set this to 100%. To score images only based on uniformity set this to 0%.

‘Minimum Contrast Range’ rarely needs adjustment and should only be adjusted if ‘Quality (vs Uniformity) [%]’ does not yield the desired results. Reducing this number has a net effect similar to increasing the ‘Quality (vs Uniformity) [%]’ value. Increasing this value has a net effect similar to decreasing the ‘Quality (vs Uniformity) [%]’ value. Contact Blaze Metrics for further information.

‘Disable Triage-Image Spacing’: by default, Triage-Image spacing is turned on. This ensures saved images are spaced in time by 50% of the measurement interval. This feature is most useful when the process is changing faster than the measurement interval and the image savings rate is slow. If this is disabled, then the saved (highest ranked) images may be very closely spaced in time, especially if the material is undergoing a transition where particles go from ‘quality’ to a less well-defined state—thereby losing valuable information about a transition. When disabled, the images are saved entirely based on ranking, when they appear within the measurement does not affect what is saved.

Image Plane Position

The Image Plane position button  is used to control the position of the image plane by use of a motorized stage built into the Blaze probe. There is an allowed travel range of the motor: the probe is designed to optimize the useful range. The image plane position is defined relative to the outside surface of the window. A value of zero is at the surface of the window, a negative value is inside the window, a positive value is further into the solution. The Image Plane Position sensor is $\pm 2\mu\text{m}$, hence the image plane for measurement should not be set closer than $+2\mu\text{m}$ even for $<5\mu\text{m}$ particles. The Image Plane Depth of Field is unrelated to the Image Plane Position. The Image Plane Depth of Field is fixed by the optics and not changed by moving its location. By moving its location, you are not ‘changing the focus’ you are simply changing where you are focused. The Image Plane depth of field is 1/3 the size (less range in the Z axis) for the Blaze 400 model than the Blaze 900 model and hence can be used for smaller particles and higher solids loading.

The Best Images will be taken with the Image Plane as close to the window as possible for your system. The reason for this is that any attenuation of the light by the solution, on the way out and on the way back, will be minimized. In addition, particles will not get in between the probe window and the image

plane. If this happens, the particles closer to the window are 'out of focus' and hide those particles 'in focus' in the image plane. In addition, as solids concentration increases, and/or particle size decreases (creating more surface area and limiting light penetration) locating the image plane close to the window reduces the impact the change in the particle system will have on the analytics and image quality.

Note, it is best NOT to move your Image Plane position during a run unless significant changes in the particle system have occurred (e.g., 200µm cubic particles convert into 300µm long 10µm wide needles, in that case, starting with a 120µm image position may be appropriate, but to correctly image the needle, assuming good mixing and/or high solids, would likely require a 10µm image plane position. An automated Intelligent Focus is under development for these types of situations.

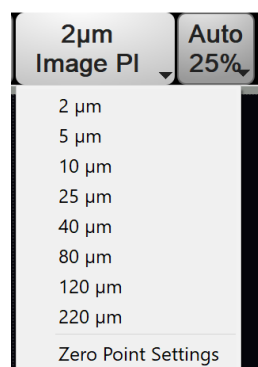
It is best not to record while moving the image plane position. The effect of movement strongly depends on the size range of particles under investigation. The smaller they are, the more the impact. The higher the solids, the more the impact.

Note the Image Plane Position will be different between the Blaze 400 and Blaze 900 even for the same application due to the difference in field of view and depth of field.

So, as a rule of thumb, always choose an image plane position that is as close to the window as your mixing and particle size will allow (i.e., half the size of the expected average particle size).

The optimal Image Plane position depends upon the application, model used, and quality of mixing. For most systems, a non-optimal but consistent image plane yields the best process information. The Triage will select the quality images, and the analytics will derive the data uniformly.

For poorly mixed systems, particles may not be presented to the probe window at all. In that case an Image Plane Position of 220µm may be required. But it is MUCH better to improve the mixing, than move the image plane out further into the slurry. For example, if the system changes, and the mixing improves, and the solids concentration increases, now the 'in focus' particles are hidden behind the out of focus (out of image plane) particles that are located between the image plane and the window. Commonly used positions are available as a drop-down list by selecting the Image Plane Position icon.



Appropriate image plane positions based on application are given in the following table:

Application	Comments	Blaze 400 Setting	Blaze 900 Setting
Fine particle monitoring	Particles <10 µm. Also, for needles <10 µm in width regardless of length.	2 or 10µm	10 µm
Later stages of milling	Where particles small and numerous	10 µm	10 µm
Crystallization	Reasonable mixing, particles primarily >10 µm	25 µm	80 µm
	Reasonable mixing, long fine needle system	2 or 10µm	10 µm
Large Particles	Reasonable Mixing, Particles primarily >80µm	120 or 220 µm	120 or 220 µm
All	Poor mixing, particles not coming close to window	120 or 220 µm	120 or 220 µm
Hard spheres	To monitor diameters of spheres >80 µm >150µm	120 µm 220 µm	120 µm 220 µm
Surface of large particles	Surface will be in focus, perimeter not	25 µm	40 µm
Outline of large particles	Perimeter will be in focus, surface not	120 µm	120 µm

In the event of window coating often very good images can still be obtained when the Image Plane Position is moved past the window coating. This is very helpful in the event of unexpected problems. It should be noted that proper probe position and mixing often can avoid coating issues, though coating cannot always be avoided.

To adjust the Zero Reference Position please refer to the window reference section of this manual.

Laser Indicator

The laser will automatically go into standby mode when the software is started and remain in standby mode unless manually shut off or the software is exited. The laser button is a bright yellow color when

the laser is in standby mode or pulsing. To manually turn off the laser click the laser button and it will turn a white color or turn the Key on the Main enclosure. Once the key is turned off, both the key and software icon must be turn on again to restart the laser (this is by design).



Laser is ON



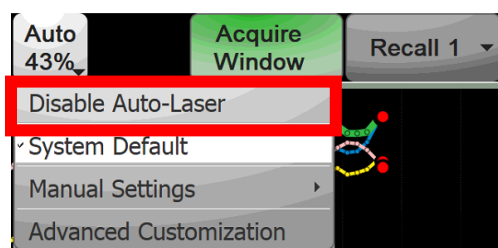
Laser is OFF

Laser Energy

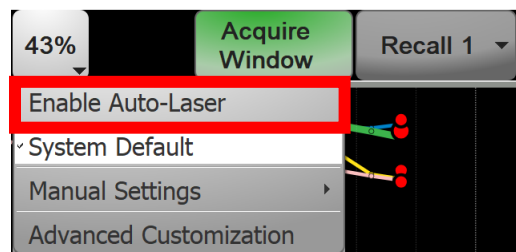
The energy level of the laser is automatically controlled by default and constantly adjusts the energy level to maintain a uniform backscatter intensity from the particle system. It is strongly recommended to leave the laser energy on auto mode. Variations in particle reflectivity and total particle area during a process require very different laser power settings at each step of the process (think of crystallization from nucleation to growth). The software can take care of this automatically without requiring constant user intervention.

In special cases the automatic control parameters can be modified or the laser energy can be set to fixed levels. Please consult with Blaze Metrics if this is needed. To restore factory settings, click on 'System Default'.

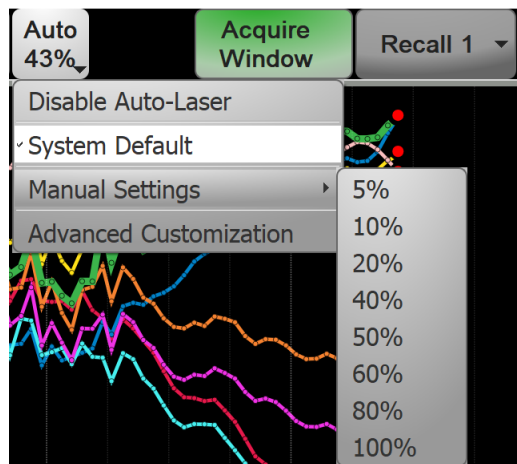
To keep the laser energy at its current level, click 'Disable Auto-Laser' and the laser will remain at the most recent output.



To return to automatic control, click on 'Enable Auto-Laser'. Note: 'Auto' is only displayed in the tool bar when the laser is automatically controlled.

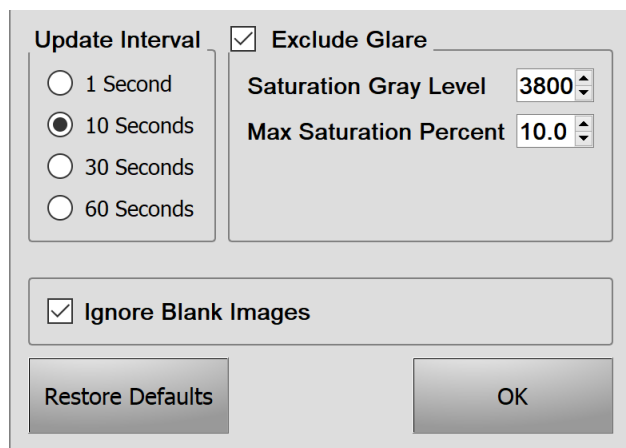
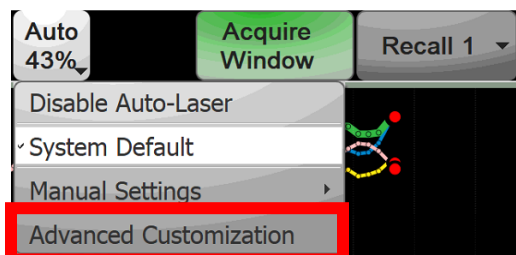


To manually set the laser to a fixed level, click on 'Manual Settings' and select from the available laser energy levels:



To return to automatic control, click on 'Enable Auto-Laser'. Note: 'Auto' is only displayed in the tool bar when the laser is automatically controlled.

The 'Advanced Customization' command allows the automatic control scheme to be adjusted for special applications in a separate dialogue box:



Update Interval: sets how quickly the auto-laser adjusts: use a short time for fast processes and longer times for slower processes with few particles.

Exclude Glare: excludes pixels above the user defined level from being evaluated for setting the laser energy, used when bright particles interfere with the darker particles of interest.

Ignore Blank Images: excludes nearly or totally black images from being evaluated for setting the laser energy.

Overview of Blaze Platform Raman Controls

For safety a password is required to activate the 785 and/or 532 nm Raman modes. Blaze provides the password key when training new users or installing a new instrument. Please contact support@blazemetrics.com if required.

There are **five different laser control modes** of the internal 785 nm laser, additionally the power level can be set. The 785 nm Raman Modes can be accessed by selecting the pulldown menu of the laser icon on the top toolbar.

There are **three different laser control modes** of the internal 532 nm laser. The 532 nm Raman Modes can be accessed by selecting the pulldown menu of the laser icon on the top toolbar.

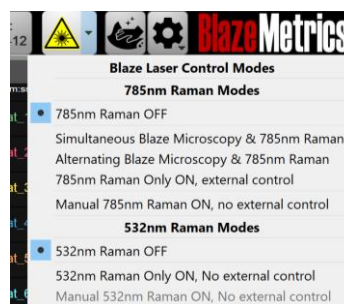
785 nm Raman Modes

785 Off

In this mode Blaze Microscopy, CLD and HDR-TU measurements are performed, and the internal 785 nm laser is always off. Use this mode if no 785 nm Raman measurements are being done.



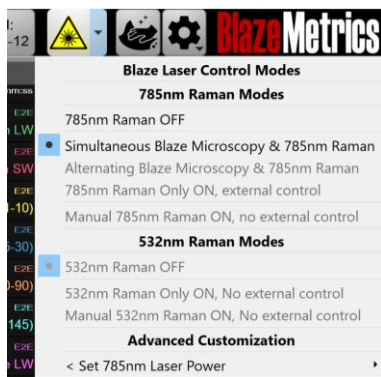
Note: this mode does not shut off the external 785 nm laser, that must be shut off from the Raman system, i.e., using Wasatch, Tornado, or Kaiser software or hardware.



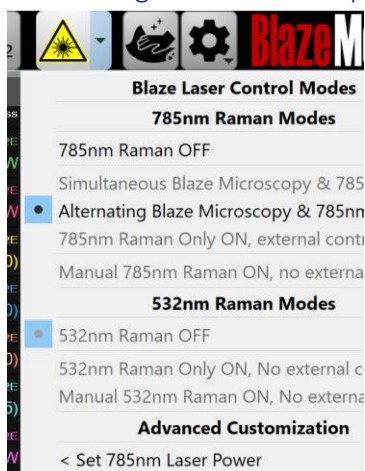
Simultaneous Blaze Microscopy & 785 Raman

This mode allows microscopy and 785 Raman spectroscopy to be done simultaneously, i.e., exactly at the same time. This is the recommended mode when both Microscopy and Raman are required. The exception to this is if the 532 nm laser used for Blaze Microscopy induces enough fluorescence in the 785 nm Raman spectra to interfere with the Raman measurement.

In this mode the internal 785 nm laser is always enabled, note that it will only turn on when triggered by the external laser. The external laser is controlled by PanoramaWasatch for Wasatch Raman systems, Tornado SpectralSoft for Tornado systems, or Raman RunTime/iCRaman for Kaiser systems.



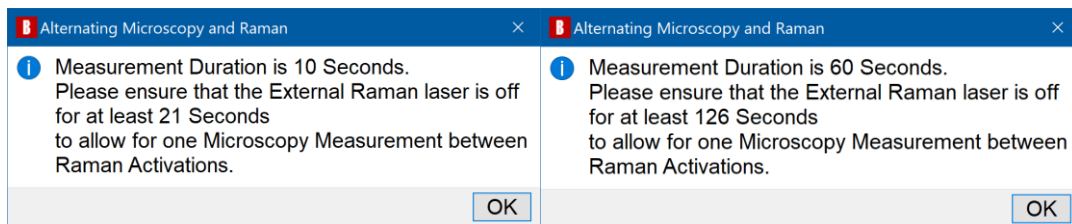
Alternating Blaze Microscopy & 785 Raman



Use this mode if 532 Microscopy induced fluorescence affects the 785 nm Raman measurements. In this mode the 532 nm laser is turned to a minimum pulse frequency and intensity whenever a 785 Raman measurement is being made. Blaze Microscopy, CLD, and HDR-TU measurements will not be recorded when the 785 nm laser is on. If the 785 nm laser is on too long relative to the Blaze measurement duration, no Blaze measurements will be recorded.

The Blaze trends will show a series of data points, followed by a time with no data points, followed by another series of data points. The period with no data points is when the 785 Raman measurement is being made.

Raman must be off for at least 2.1x longer than the Blaze measurement period. The software will automatically calculate and display a recommended Raman off period based on the currently selected Blaze measurement duration



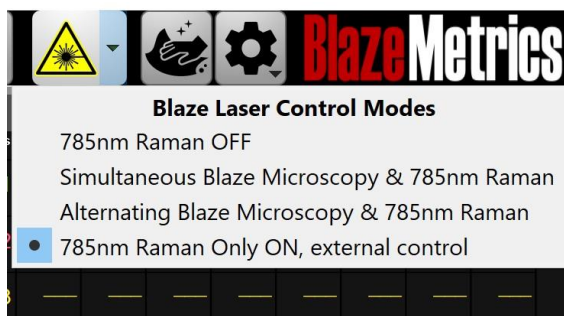
For 2 Blaze measurements the EXTERNAL Laser should be OFF for 3 Measurement durations + at least 3 seconds.

For 3 Blaze measurements the EXTERNAL Laser should be OFF for 4 Measurement durations + at least 3 seconds.

For 4 Blaze measurements the EXTERNAL Laser should be OFF for 5 Measurement durations + at least 3 seconds.

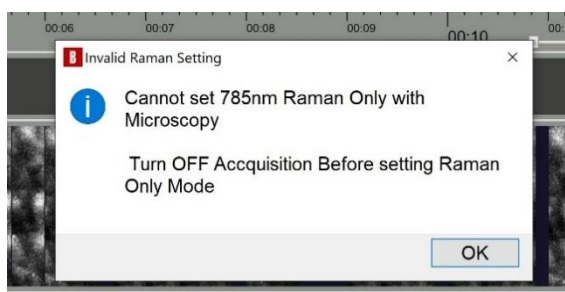
785 Only

In this mode the internal 532 nm laser is significantly reduced in power and frequency. The green 532 nm light will be an additional visible indicator that the 785 Raman laser is active but is not intended for Microscopy use. The display will show a live image which updates less often and uses less illumination light, no images will be saved. Use this mode if no Blaze measurements (Microscopy, CLD, HDR-TU) are being done.



If the Blaze Microscopy is running it must be stopped first. If Microscopy is running the Blaze UI will open a reminder window:

- Click OK to stop the Microscopy
- Then select Raman only mode again.



Manual 785nm Raman ON, no external control

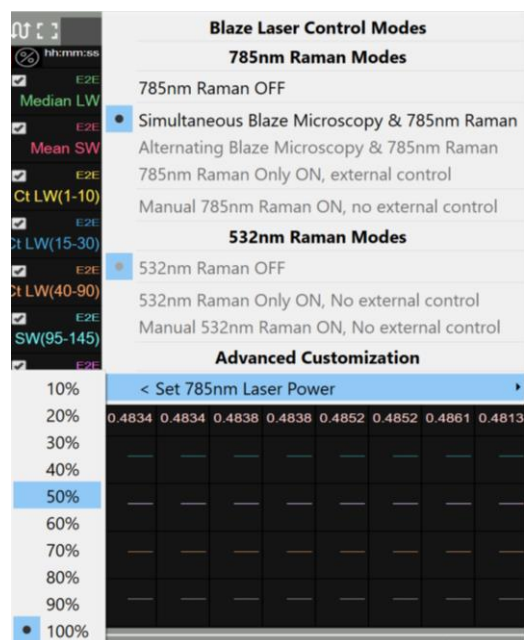
This mode turns on the internal 785 nm laser, it is not synchronized with the Raman spectrometer. This mode is only for use with spectrometers which do not have their own 785 nm laser. This only applies to certain Wasatch models.



In this mode the internal 785 nm laser is always enabled and is not affected by the external laser. This mode should only be used with Wasatch spectrometers without a built in 785 nm laser. This should not be used with Tornado or Kaiser systems which always include a built in 785 nm laser.

Set 785 nm Laser Power

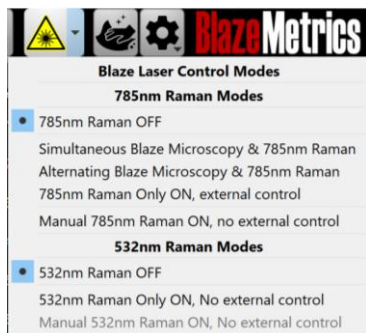
This controls the power of the internal 785 nm laser. The default is 100% or full power. Laser power should only be reduced if the Raman signal is saturated at minimum exposure time. Depending upon spectrometer the minimum exposure time is 37 to 100 milliseconds.



532 nm Raman Modes

532 Off

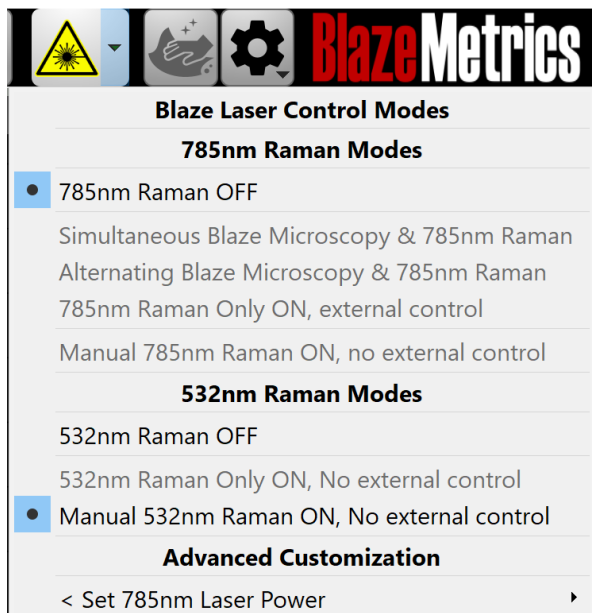
In this mode Blaze Microscopy, CLD and HDR-TU measurements are performed, and the internal 532 nm operates in microscopy mode.



Manual 532 nm Raman

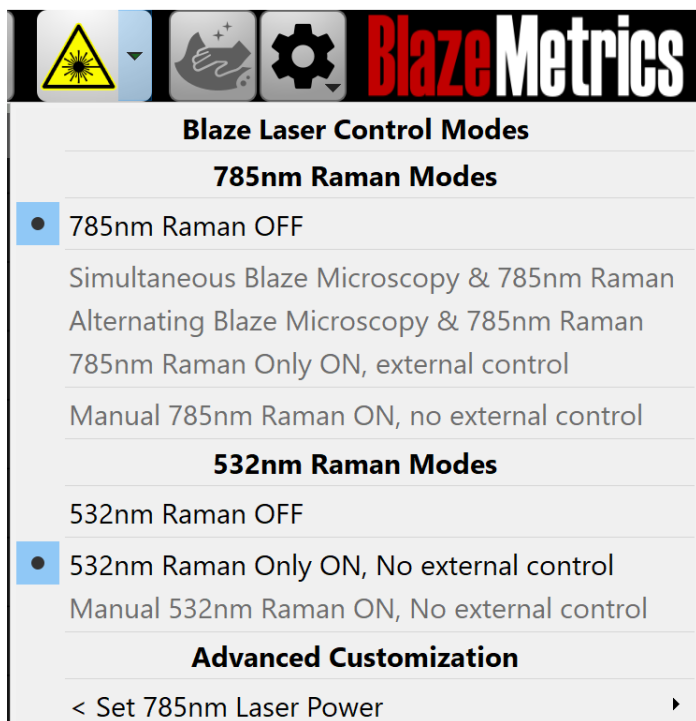
This mode allows manually alternating between 532 nm Raman and Blaze Microscopy, CLD and HDR-TU measurements.

In this mode switches the internal 532 nm laser to higher frequency pulses to give more 532 nm Raman signal with the 532 nm laser operating as a Class 3B laser. When this mode is active there are no Blaze Microscopy, CLD and HDR-TU measurements. This mode can be activated when a Blaze experiment is running.



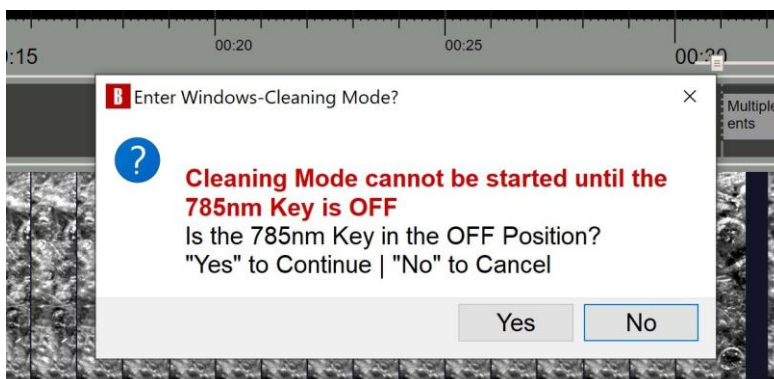
532 nm Raman Only

Use this mode for Raman only measurements. This mode can only be switched on if no Blaze experiment is running. The internal 532 nm laser pulses at higher frequency for maximum excitation power and will operate at Class 3B.



Window Cleaning

To enter the window cleaning mode the internal 785 nm laser must be disabled. Turn the 785 key on the Blaze to OFF and click yes to enter window cleaning mode. Don't forget to turn the key back on when done.



785 nm Laser Activity Indicator

If the internal 785 nm laser of the Blaze is active the laser warning tool icon will flash red. If the 785 nm laser is off and the 532 nm laser is active, the laser icon will remain black.

785 nm laser active:

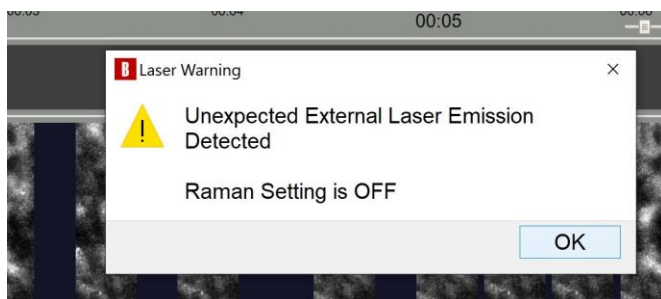


785 nm laser not active:



External Laser Warning

If the external 785 nm laser is active when not expected (i.e., when running in 785 nm off mode) this warning will appear:



Start Up Sequence: Blaze UI & PanoramaWasatch - Same Computer

1. Connect all hardware
2. Power on all hardware
3. Start PanoramaWasatch
4. Start BlazeUI

If there is a Panorama communication error with Wasatch hardware:

1. Exit Panorama
2. Unplug USB cable from Wasatch
3. Turn the Wasatch off and on again
4. Reconnect USB cable to Wasatch
5. Restart Panorama



Note: If the Wasatch is turned off and on again with the USB connected it may interfere with the Blaze UI communication to the Blaze hardware. If the USB to the Wasatch is disconnected this will not happen. This is a known issue that occurs regularly but not on all systems.

Alternatively, exit the Blaze UI and then turn the Wasatch off and on again. **ONLY** use this method if Blaze data acquisition can be interrupted.

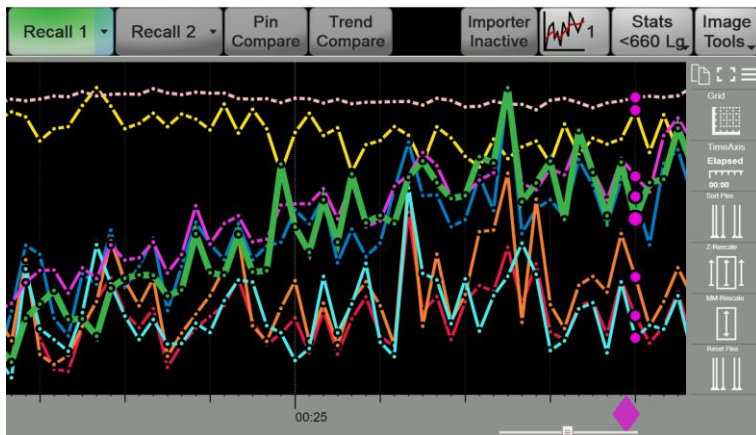
Averaging

This applies averaging to trends by averaging the previous N measurements together, where N is the selected number of measurement points to average. The default averaging depends upon the method used, typically it is N=6 or 10. This processing operation is applied after data acquisition, it does not change the original measurement data and can be reversed at any time.

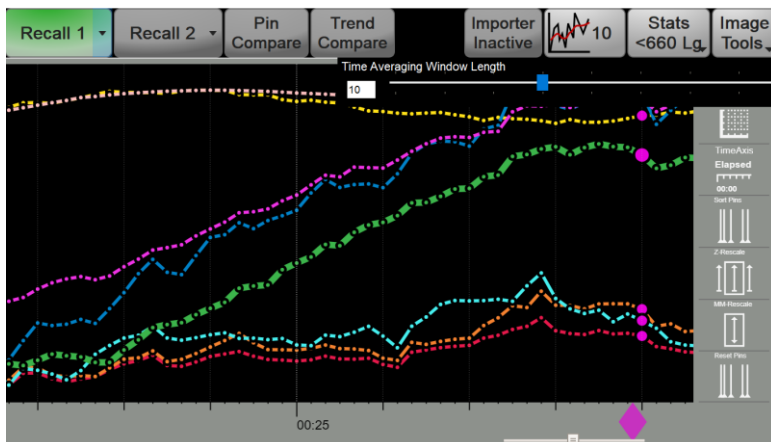
Note: the default averaging is restored when the reset to default values is chosen in the statistics configuration dialogue.

To change the averaging, click on the averaging button  and move the slider to the desired number of measurement points to average. The greater the averaging value, the more statistically robust the data but the greater the aliasing. The lower the averaging value the faster the trends respond to change. Whenever a new value is selected all the trends are automatically recalculated.

Value is 1 i.e., no averaging applied:



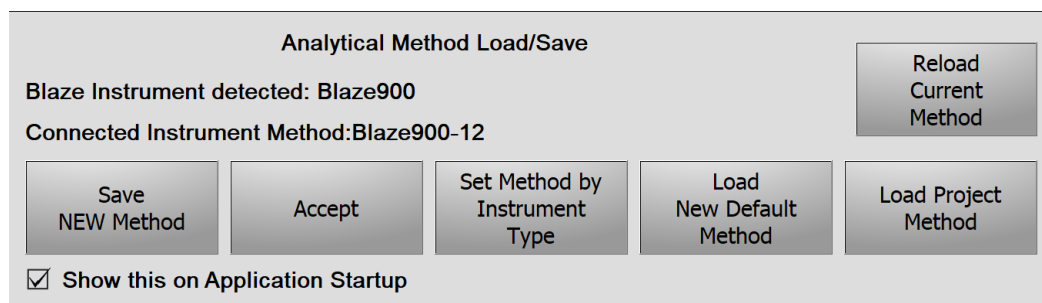
Value of 10 will average the past 10 measurements:



Averaging is by default not applied to any time gaps in measurements. Averaging across time gaps can be turned on from the pull-down menu at the averaging icon.

Method

When the software starts, it displays a dialogue asking which analytical method to use:



The default Method is based on the model and Blaze factory defaults. A complete list of these can be found in C:\BlazeMetrics\SOP_Folder_Defaults

The currently used Method is displayed as part of the Method button  on the Menu Bar. To change or create a new Method, click the Method button  and the dialogue box of options above will appear.

To load a factory default Method, click on 'Set Method by Instrument Type'. This will detect which instrument model is connected and load the Blaze factory default for it.

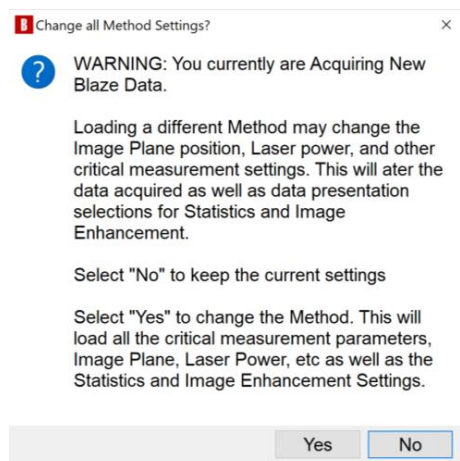
When an experiment is finished, the last settings used are automatically saved as a Method for that experiment together with the data. When the data is recalled, the associated Method will be applied.

Note: the Method only reflects the settings at the end of the experiment and will not contain any history of prior values.

Note: for experiments saved with software release 2020 A (version 148.02) the Method is saved with the experiment file. Experiments saved with a prior version of the software will not have a Method saved with them.

The Method is applied to the live file and all recalled files.

To prevent accidentally changing measurement conditions during live data acquisition a confirmation dialogue appears:



If there is no active live data acquisition or when using the Blaze Office software, no confirmation dialogue appears. Note: the newly loaded Method will be applied if live data acquisition is started.

To load a user created Method select 'Load Project Method'. These are saved under C:\BlazeMetrics\SOP_Folder_Projects

To create a new Method based on the current setup parameters select Save NEW Method. This will be available as a project Method.

The methods will vary by application and will differ between Blaze models even for the same application.



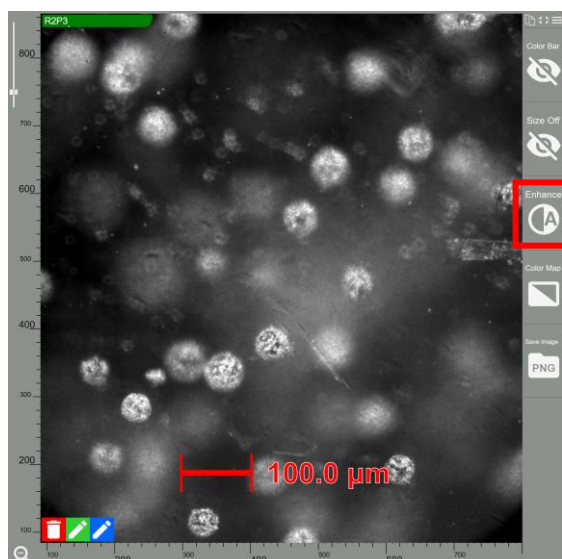
Do not store experimental data in either C:\BlazeMetrics\SOP_Folder_Defaults or C:\BlazeMetrics\SOP_Folder_Projects , doing so may interfere with software functioning.

Image Tools

These affect the display of live and recalled images. All Blaze images have more gray levels than can be displayed on a computer monitor. The gray scale can be adjusted so that these differences are visible on the monitor. Adjustments do not change the saved images or particle sizing and can be reversed at any time.

The optimal image tool settings are highly application dependent. The defaults have been chosen to provide good contrast for typical Blaze applications and can be optimized further. The best way to determine the optimal settings for a particular image and application is to change them and see if the image has improved or not.

By default, enhancement (the adjusted settings) is on, it can be turned off and on by clicking on the menu control  in the upper right of the image and clicking the enhance button from on  to off . When turned on it applies all the selected settings from the image tools.



Which image tool settings are best depends upon the particle system and the goal(s) of the process. There is no single group of settings that works for all applications. Find out what works for a specific process and application goal by adjusting the different settings.

Again, image tool settings do not affect the saved image, A-CLD's, trends, or HDR-Turbidity measurements.

A general guide to how the settings effect image display is given below:

Image Tools

Minimum Black Level Applied: 30

Image Binning: 1

Gamma: 0.80

White Level Minimum Percent: 0.0025

Black Level Minimum Percent: 2.000

Maximum White Level Applied: 3800

Auto Gamma - off ☐ Click to Enable

Pixel Interpolation - ON ☒ Uncheck to Disable

Color Saturated Pixels - off ☐ Click to Enable

Maximum Black Level Applied: 4000

Minimum Gain Applied: 0

Maximum Gain Applied: 500

Done System Defaults Undo Latest Changes Reset to Method Settings

Minimum Black Level Applied

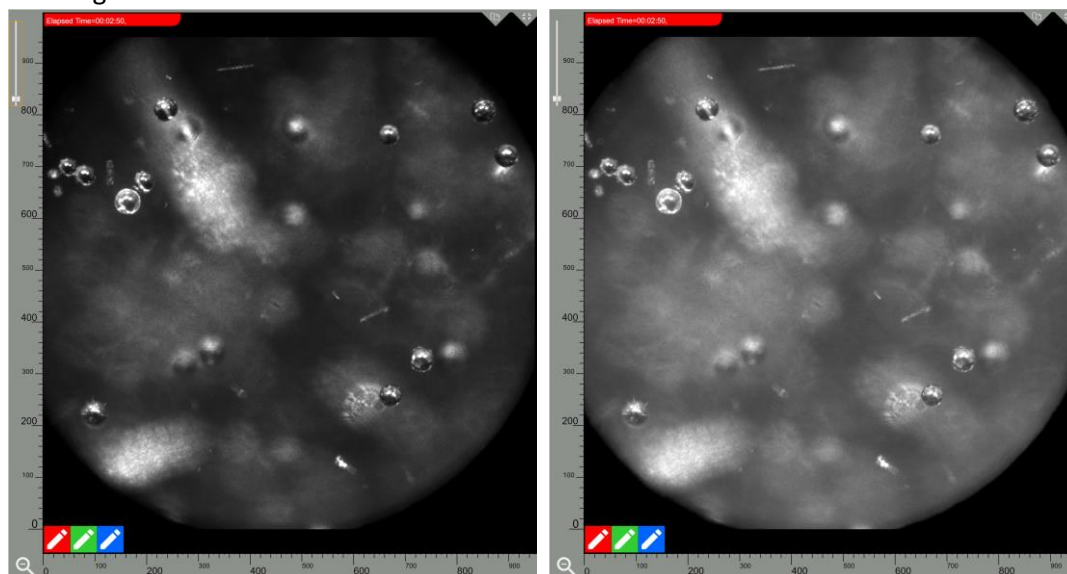
This makes any pixel below the set value appear as pure black. This is applied in addition to the black level minimum percent and gamma settings. Setting this value lower is useful if the particles of interest scatter light very poorly. However, low values also bring out things generally not of interest such as transitory gradients in the solution, camera noise, etc. Setting this value higher will make the background darker and increase the contrast of particles against the blacker background.

Binning

Binning is used to increase the image contrast when working with very low reflectivity particle systems. When binning is applied it increases the amount of light while reducing the spatial resolution in X and Y. Binning groups the light from adjacent pixels in the image. A value of 1 means no binning, a value of 2 means 2 x 2 pixels are binned (grouped) together, 3 is 3 x 3 pixels, and so on. The higher the binning the brighter the image will become and the lower the image resolution will be. Too much binning will saturate the image (make it white).

Gamma

Gamma is a powerful setting which controls the gray scale function. The value of 1 applies a linear gray scale so that a pixel of recorded 50% intensity is exactly 50% between black and white on the display, a pixel of 25% intensity is only 25% of maximum brightness, etc. When the default enhancement setting is ON, coupled with a few bright particles, it can result in weakly scattering particles being rendered as nearly black. The lower the gamma value the brighter the image, the higher the gamma value the darker the image.



In the above example, gamma on the left is set at 1 and gamma on the right is set at 0.6. In “dark” images (few or weakly backscattering particles are present) the optimal gamma is typically less than 1, however values of less than 0.3 are not recommended due to increased noise. In “bright” images (many scattering particles are present) the optimal gamma is typically greater than 1. This gamma is the same concept as is used in digital photo rendering.

White Level Minimum Percent

This tool is primarily used for particles with poor backscatter properties. This value determines what percent of the highest intensity pixels will be rendered white. In some cases, a particle system with poor backscatter may not be readily visible, but the information is captured by the Blaze. Using this tool allows the Blaze to take the non-visible range and make it visible. By allowing the brightest pixels to be saturated white, the darker portion of the image can use more of the available gray range and become more visible to the eye.

This adjustment is made by increasing the white level minimum percentile. Use the slider bar to set the desired % value. This value determines what percent of the pixels will be brought into the visible range. Also note, if there are particles or parts of particles that are already visible, they may become saturated to enable vision of the poor backscatter particles. For example, in formulations, a poor backscatterer

such as sodium starch may be in the presence of micro crystalline cellulose, a good backscatter. To see the starch, it is possible the MCC will have to saturate.

Another point to keep in mind is that all enhancement tools create noise. The noise created by Gamma is of a different type than the White Level Minimum. Hence combining these tools, each within its acceptable noise region, can often create the optimum visual impact.

Black Level Minimum Percent

This function works in the same way as White Level Minimum Percent except it applies to the darkest pixels in the image. Both Black and White Level Minimum Percent values can be applied at the same time.

Maximum White Level Applied

This makes any pixel above the set value appear as pure white. This applies in addition to the white level minimum percent and gamma settings. Setting this value lower saturates more of the image and allows more of the gray range to be used to bring out details of the darker portions of the image. It is the counterpart of the minimum black level applied setting. Use of the 'Color Saturated Pixels' function can identify which pixels are saturated white.

Auto Gamma

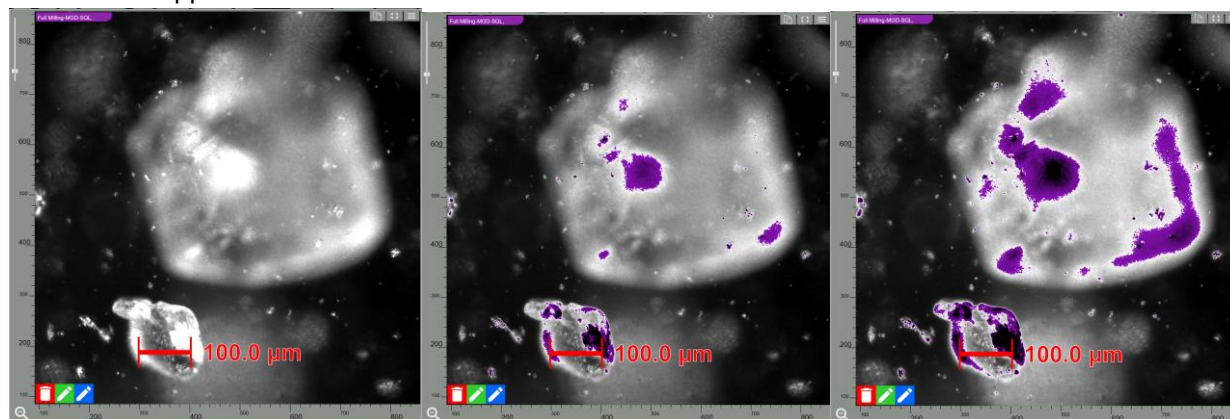
When this box is checked the gamma value is automatically adjusted to enhance contrast in the image. Depending upon the application and image, this may or may not bring out the desired contrast e.g., dark particles may appear brighter while less detail is seen in bright particles or vice versa. A manually selected combination of image tool settings may yield a superior result, again this is highly application and image dependent.

Pixel Interpolation

Sufficient zooming in on an image makes individual image pixels larger than the pixels of the monitor display, this creates a 'pixelated' image. When off, the pixilation remains unchanged, when on, it enables smoothing. It can be useful for particles <10um. It does not change the original image or statistical data.

Color Saturated Pixels

When this box is checked, the pixels which are saturated (i.e., completely white) are colored purple. Enabling and adjusting the 'Maximum White Level Applied' allows easy visualization of saturated pixels and optimization of the 'Maximum White Level Applied' and 'White Level Minimum Percent' settings. Note: this setting is not stored in any Method and turned off by default. In this example the 'Maximum White Level Applied' is reduced from 3800 to 500.



System Defaults and Undo Latest Changes

Click on 'Undo Latest Changes' (button shown in Image Tools settings screenshot above) to go back to the settings applied at the end of the previous image tool session. 'System Defaults' returns to the generic starting image tool settings of the Blaze software.

Again, image tool settings do not affect the saved image, A-CLD's, trends, or HDR-Turbidity measurements.

Stats Config (Statistical Configuration)

This controls the statistical analysis performed on the measured A-CLD. It includes channel grouping, weighting of the distribution, range analyzed, and the statistical analysis applied. The button will display the type of configuration applied, for example:



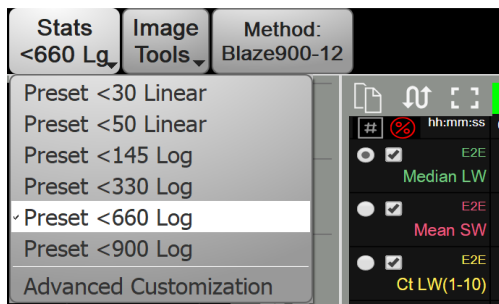
shows the Preset <660 Log is being used.



shows a customized stats config is being used.

Presets

There are five preset statistical configurations that can be accessed by the pull-down arrow on the 'Stats' button:

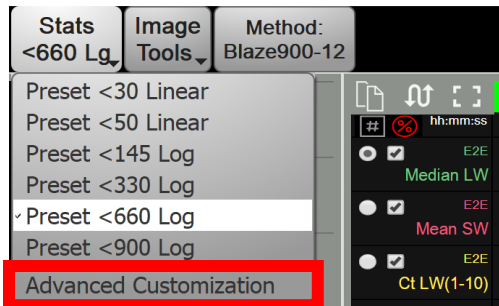


Choose the preset based on the particle size of interest. With presets, the data can be reanalyzed differently with a single click.

The selected preset is applied to all experiments both live and recalled.

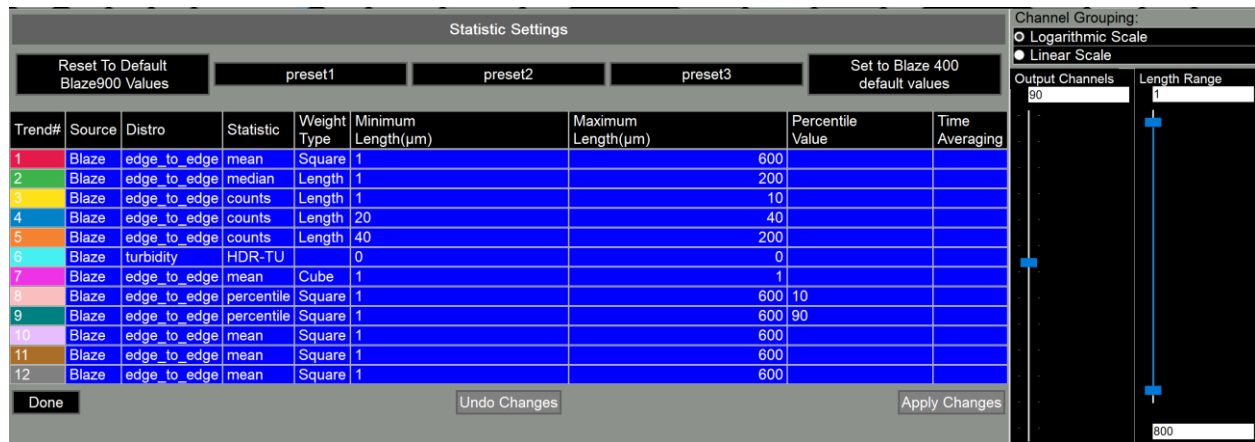
Advanced Customization

Infrequently a customized statistical analysis may be needed. If this is the case, select 'Advanced Customization' from the pull-down arrow on the 'Stats' button:



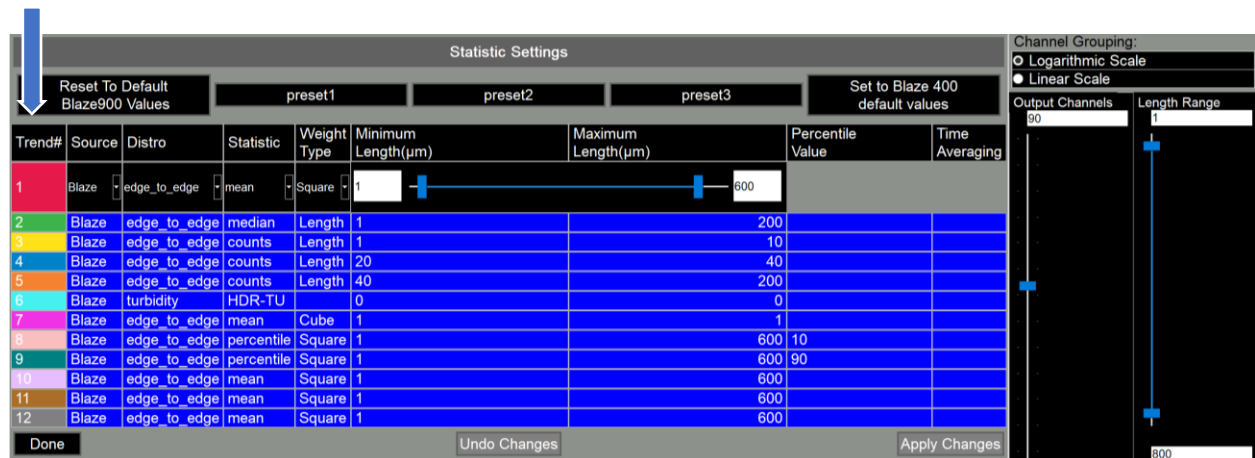
The data is processed in the following sequence:

- 1) Channel grouping is applied
- 2) Weighting is applied based on the total distribution
- 3) Subrange is taken
- 4) Statistics are calculated



Trend

This is a sequential list of the defined size distribution trends. The color and sequence of colors is fixed. Click on the desired trend to select it:



Source

This determines the data source, Blaze or external (i.e., OPC through the Blaze Importer). To use the Blaze Importer to read in Systag or MT automated lab reactor data please contact Blaze Metrics.

Distro

This determines which type of data is used.

Edge_to_edge

Edge_to_edge is commonly referred to as the chord length distribution where chords are determined by the length of a line across the particle between any two edge points. Other chord length measurement types (such as centroid or Feret diameter) will be designated as a separate source by a unique name when implemented in the future.

Turbidity

This specifies High Dynamic Range Turbidity (HDR-Turbidity) as a data source. HDR-Turbidity is described further in a separate section of this manual.

Statistic

This defines which statistic is applied to the chord length distribution (a.k.a. moment of the distribution). For "statistic" the choices are:

Mean: mathematical average of the distribution after weighting and ranging are applied.

Mode: highest value of the distribution after weighting and ranging are applied.

Median: mid-point of the distribution (half values above, half below) after weighting and ranging are applied.

Percentile: chord length which corresponds to the selected percentile after weighting and ranging are applied. For percentile, the additional field percentile value needs to be set as well. Note: the reported value is a statistical percentile which may not correspond to a measured value in the dataset. For example, the dataset has chords at 209 and 210 microns, the reported 50th percentile is 209.5 microns.

Counts: total number of chords in the distribution after weighting and ranging are applied. Count values are always normalized for the measurement period and are in units of counts/second.

Logcounts: Log base 10 representation of the total number of chords in the distribution after weighting and ranging are applied.

ChiSquare: compares two distributions using the formula from Pearson's chi square test. A reference distribution must be selected for each experiment. The larger the value the more different the distributions are from each other. See chi square section for more details.

Click on the inverted triangle on the right side of the column and select the desired statistic:

Trend#	Source	Distro	Statistic	Weight Type	Minimum Length(μm)	Maximum Length(μm)	Percentile Value	Time Averaging
1	Blaze	edge_to_edge	median	Length	1		660	
2	Blaze	edge_to_edge	mean	Square	1		660	
3	Blaze	edge_to_edge	counts	Length	1		10	
4	Blaze	edge_to_edge	counts	Length	50		120	
5	Blaze	edge_to_edge	counts	Length	140		280	
6	Blaze	edge_to_edge	counts	Square	300		660	
7	Blaze	edge_to_edge	chiSquare	Square	30		660	
8	Blaze	turbidity	mean	Length	0		0	
9	-Off-		median	Length	0		0	
10	-Off-		percentile	Length	0		0	
11	-Off-		counts	Length	0		0	
12	-Off-		logCounts	Length	0		0	

Weight Type



For both scan derived* and Blaze chord length distributions (CLD), the number of chords measured is proportional to their probability of measurement. For example, the edge (short) chords of a sphere have a lower probability because there is less area where edge chords can be measured, whereas the most common chords are those near the diameter because there is more area, hence a greater probability of measurement. For this reason, all chord measurements are inherently weighted by their chord length. In other words, the 'as measured' data is innately length weighted. To clear up the discrepancy with older chord length based technologies, the table below shows the correlation between the incorrect nomenclature and the correct nomenclature:

	Scanning Technology*	Blaze
Chords as measured	Unweighted	Length weighted (LW)
Chords multiplied by length	Length weighted	Square Weighted (SW)
Chords multiplied by length^2	Square Weighted	Cube weighted (CW)
Chords multiplied by length^3	Cube weighted	Not available

*Scan derived CLD includes FBRM® and ORM® (registered trademarks of Mettler Toledo and Sequip respectively).

For "weight type" the choices are:

"length": chords as measured with no additional weighting applied. Noted by LW in the statistics table.

"square": each chord is multiplied by its length and the resulting total is added to the square weighted distribution. Noted by SW in the statistics table.

"cube": each chord is multiplied by the square of its length and the resulting total is added to the cube weighted distribution. Noted by CW in the statistics table.

Click on the inverted triangle on the right side of the column and select the desired weighting.

Trend#	Source	Distro	Statistic	Weight Type	Minimum Length(μm)	Maximum Length(μm)	Percentile Value	Time Averaging
1	Blaze	edge_to_edge	mean	Square	1	600	100	Time
2	Blaze	edge_to_edge	median	Length	1	200		
3	Blaze	edge_to_edge	counts	Length	1	10		
4	Blaze	edge_to_edge	counts	Length	20	40		
5	Blaze	edge_to_edge	counts	Length	40	200		
6	Blaze	turbidity	HDR-TU		0	0		
7	Blaze	edge_to_edge	mean	Cube	1	1		
8	Blaze	edge_to_edge	percentile	Square	1	600	10	
9	Blaze	edge_to_edge	percentile	Square	1	600	90	
10	Blaze	edge_to_edge	mean	Square	1	600		
11	Blaze	edge_to_edge	mean	Square	1	600		
12	Blaze	edge_to_edge	mean	Square	1	600		

Minimum and Maximum Length

These control the range of the distribution used to calculate the statistic. Both the minimum and maximum lengths are in units of microns, for example a minimum value of 50 and a maximum value of 100 will calculate the statistic based on the 50-100 micron portion of the distribution. Drag the slider or enter the value in the text box to adjust the minimum and maximum lengths.

When the channel grouping is set to a logarithmic scale the minimum length cannot be less than 1. If a value of less than 1 (including 0) is entered it will be ignored and the minimum length used will be 1.

Note that the statistic minimum and maximum lengths must be within length range set for the channel grouping, any value outside of the channel grouping length range will be ignored and replaced by the appropriate limit of the channel grouping length range.

Trend#	Source	Distro	Statistic	Weight Type	Minimum Length(μm)	Maximum Length(μm)	Percentile Value	Time Averaging
1	Blaze	edge_to_edge	mean	Square	1	600	100	Time
2	Blaze	edge_to_edge	median	Length	1	200		
3	Blaze	edge_to_edge	counts	Length	1	10		
4	Blaze	edge_to_edge	counts	Length	20	40		
5	Blaze	edge_to_edge	counts	Length	40	200		
6	Blaze	turbidity	HDR-TU		0	0		
7	Blaze	edge_to_edge	mean	Cube	1	1		
8	Blaze	edge_to_edge	percentile	Square	1	600	10	
9	Blaze	edge_to_edge	percentile	Square	1	600	90	
10	Blaze	edge_to_edge	mean	Square	1	600		
11	Blaze	edge_to_edge	mean	Square	1	600		
12	Blaze	edge_to_edge	mean	Square	1	600		

Percentile

The percentile indicates the value below which a given percentage of chords in all measured chords falls. For example, the 50th percentile is the value below which 50 percent of the chords may be found (this is commonly referred to as D50). The percentile is in units of microns. Drag the slider or enter the value in

the text box to adjust the percentile value from a value of 0 to 99%. Note: a percentile value of 50 returns is the same statistic as the median.

Trend#	Source	Distro	Statistic	Weight Type	Minimum Length(μm)	Maximum Length(μm)	Percentile Value	Time Averaging
1	Blaze	edge_to_edge	percentile	Square	1	600	90	
2	Blaze	edge_to_edge	median	Length	1	200		
3	Blaze	edge_to_edge	counts	Length	1	10		
4	Blaze	edge_to_edge	counts	Length	20	40		
5	Blaze	edge_to_edge	counts	Length	40	200		
6	Blaze	turbidity	HDR-TU		0	0		
7	Blaze	edge_to_edge	mean	Cube	1	1		
8	Blaze	edge_to_edge	percentile	Square	1	600	10	
9	Blaze	edge_to_edge	percentile	Square	1	600	90	
10	Blaze	edge_to_edge	mean	Square	1	600		
11	Blaze	edge_to_edge	mean	Square	1	600		
12	Blaze	edge_to_edge	mean	Square	1	600		

Chi Square

Chi square is calculated by comparing the selected distribution to the reference distribution for that same experiment according to the formula:

$$\chi^2 = \sum_{i=1}^n \frac{(O_i - E_i)^2}{E_i}$$

Where E is the reference distribution value, O is the distribution for comparison, and i corresponds to the individual channels of the channel grouping. By definition chi square is always positive. **Due to the extremely high number of counts of the Blaze, the calculated chi square value is divided by 1000 to improve the readability of the displayed value.**

Selecting % display for the stats table does not affect the value of chi square since it is already a comparative value.

In Sample Compare mode, the value of chi square is always calculated relative to the reference distribution within the same experiment (i.e., live, Exp 1, Exp 2). There is no calculation of chi square that applies across different experiments.

High Dynamic Range Turbidity (HDR_Turbidity)

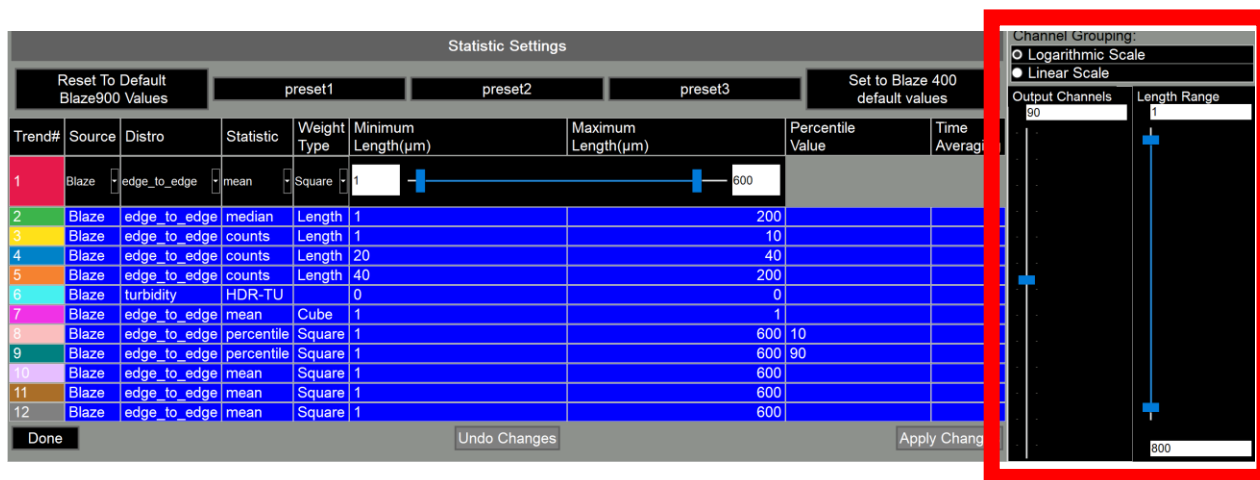
Unlike typical turbidity meters, Blaze has enabled the HDR_Turbidity with 18-bit resolution (most turbidity meters are 8 bit). 18 bit is 262,144 steps from the blackest we can get the background, to the brightest white Blaze can measure as compared to the 256 steps of 8 bit. Another big difference from classic turbidity meters is the auto laser adjustment. As the backscatter increases, the laser decreases its intensity and vice versa. This enables a much greater dynamic range from black (100% laser) to white (only 5% laser). The HDR_TU takes these laser changes into account.

Blaze HDR_Turbidity can also see change when the particles are smaller than Blaze's ability to measure chord length. In other words, when an image has some shades of gray, but no transitions visible for the chord length, the Blaze HDR_Turbidity will track changes in this sub visible range.

Future releases of Blaze software will include additional useful aspects of the turbidity data that are not currently displayed. These functionalities will be free of charge for Blaze customers.

Channel Grouping

Individual chord measurements are grouped by dimension before statistical analysis and display in the chord length distribution. This control affects both the distributions and statistical trends.



The channel groups can be either on a log or linear basis. The log scale channel group width is smaller for shorter chords than for longer chords. The linear scale channel group width is the same for any chord dimension. Select the radio button to switch between log and linear scale. The chord length distribution display X axis will automatically change to log or linear to match the selected grouping. The distribution display X axis can be reset manually to view a log grouping on a linear axis and vice versa (not common).

Adjusting the number of output channels will increase or decrease the width of the individual channel groups. A small number of channels increases statistical robustness but also reduces sensitivity to dimensional changes. A high number of channels increases sensitivity to dimensional changes but also reduces statistical robustness. Drag the slider or enter the value in the text box to adjust the number of output channels.

The length range sets the upper and lower limits for chord lengths included in the distribution and statistical trends. The lower length range must be 1 or greater when using log channel grouping, if 0 is set it will be ignored and the lower length range will use 1. To create channels below 1 micron the linear scale must be used. The upper length range is limited by the field of view of the probe. 900 microns is the upper limit when using the Blaze 900. Drag the slider or enter the value in the text box to adjust the upper and lower length ranges.

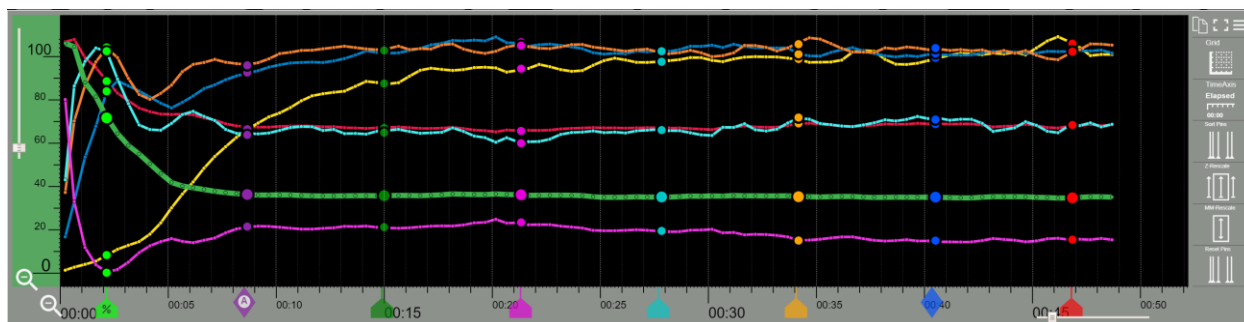
The default channel group settings are log scale, 90 output channels, 1-900 micron length range. This typically identifies process changes. Contact Blaze Metrics to discuss if further optimization is useful for a specific application goal.

Applying Changes

Click “Done” after making changes to apply them. The statistical trends and distribution display will automatically be recalculated, and the display updated.

Trend Window

This window displays trends of statistics over time and is used to select images, statistics, and distributions at specific points in time. It controls which data are displayed in the stats table, distribution window, Sample Compare, and individual image displays.



The statistics used for trending are configured using the stat config button, individual trends can be turned on/off in the stats table—as described in the Stats Table section of the manual.

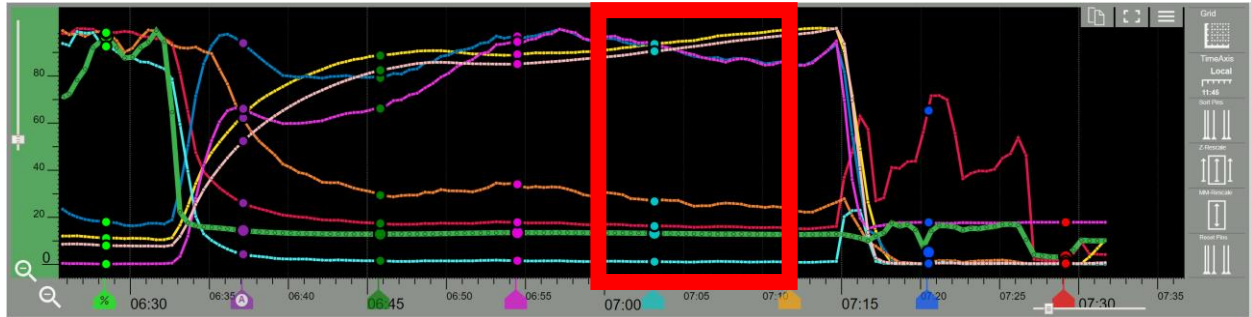
Time Axis

The x axis of the trend is always time. Elapsed time refers to time since the start of the experiment (data recording), it is a relative time displayed in hours, minutes, or seconds as appropriate. Local time refers to the date and time the measurement was made. Blaze data is saved in GMT format and displayed using the local time zone of the computer. If an experiment was recorded in London UK at 9 am on the 13th of June then the same experiment will show it was recorded at 1 am on the 13th of June when opened with a computer set to San Francisco USA local time. This is due to the 8-hour time difference. To switch between elapsed and local time click on the time axis button on the right side of the trend.

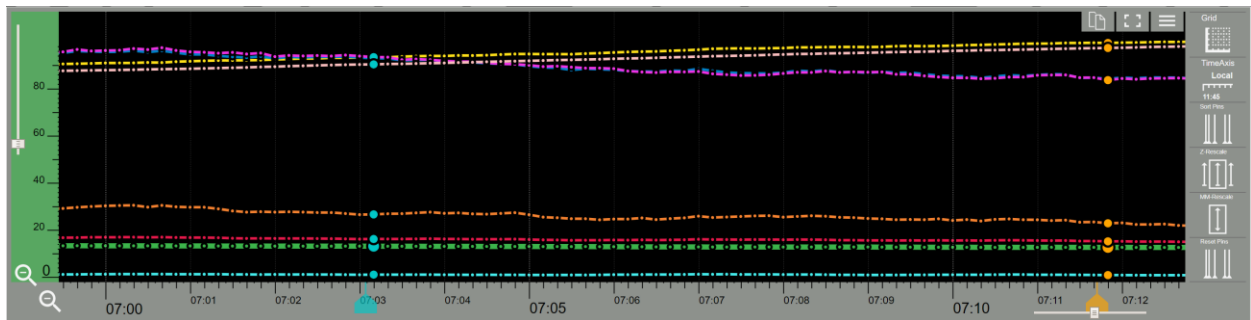


Y Axis

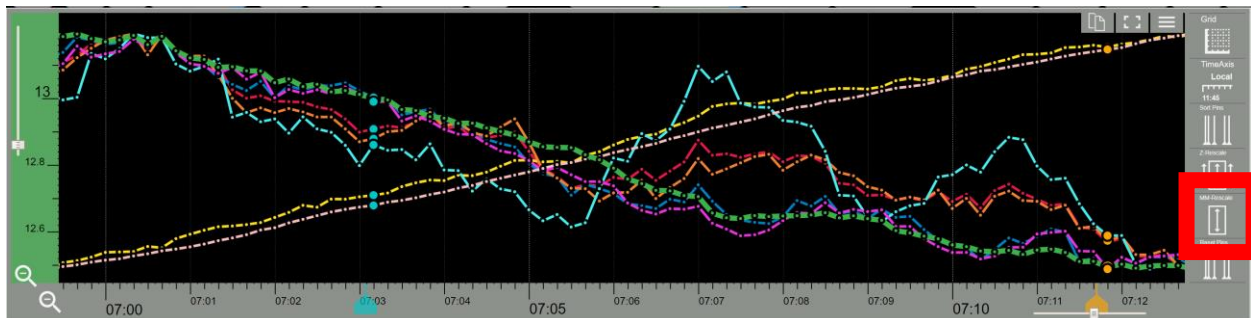
The Y axis of the trend is normalized for all trends except for the one which has Y axis scale selected in the stats table (round radio button). By default, a recalled file is shown full scale in time and in Y. After zooming in on the time axis click on MM-Rescale to auto scale the Y axis for the new time window



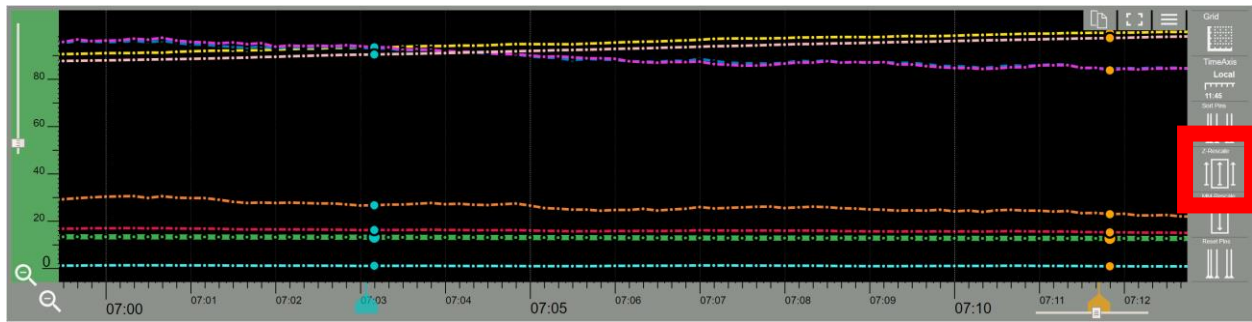
Zoom into the above area, it is hard to see the change in the trend



MM Rescale button scales Y axis for the minimum/maximum within the zoomed time frame



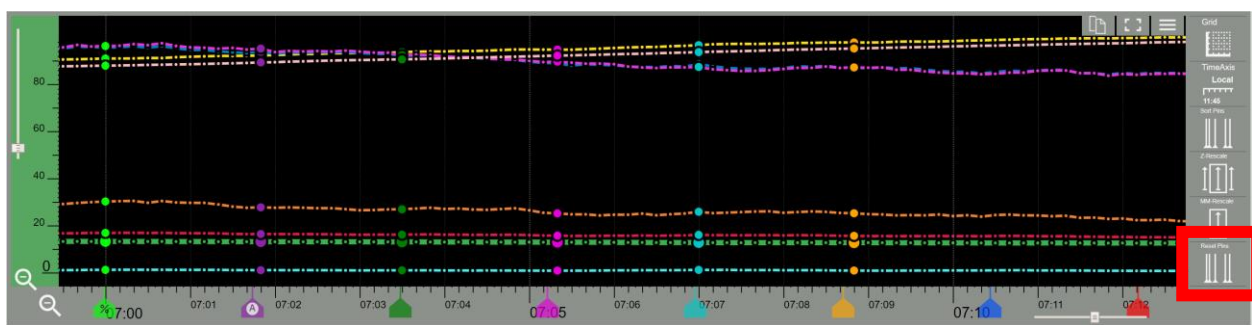
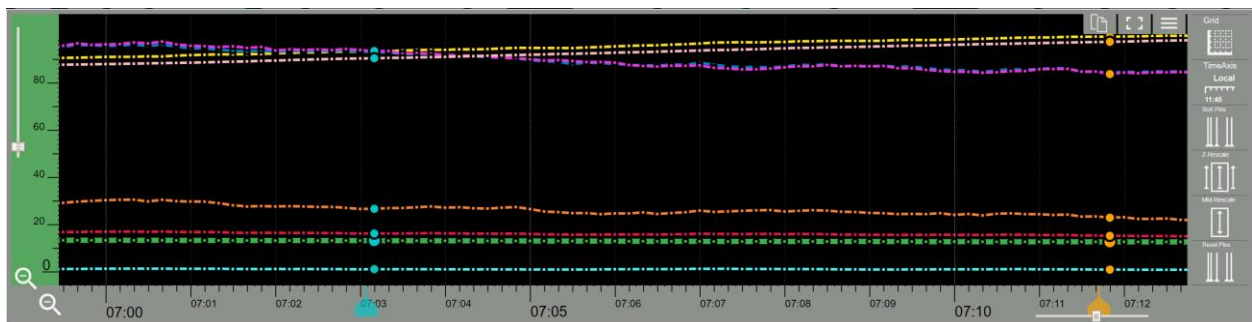
Z Rescale buttons scales Y axis for the global (i.e., whole experiment) minimum/maximum



Pins Basic Functions

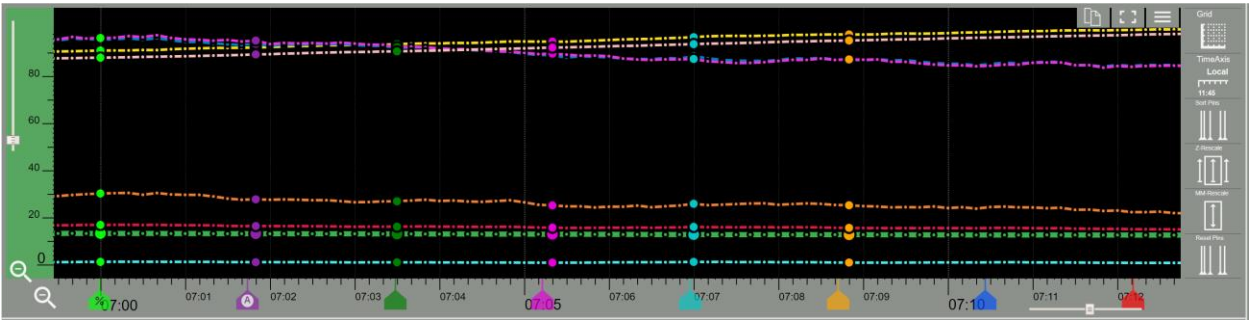
The trend window has 8 pins, each pin determines a time point. The data from these points is used for the stats table value, distribution, and image. Pins can be moved to any point in time except for pin 8 in the acquire window which is always the current measurement. Other pins can be moved manually by click and drag to the desired time point.

Pins can also be automatically spaced evenly across the displayed time range by clicking on the 'reset pins' button on the right side of the trend window.

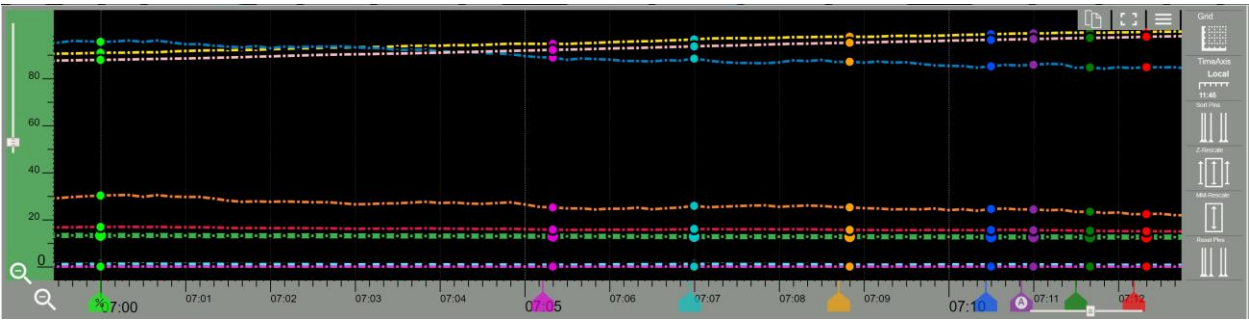


Pins 1 thru 8 have a fixed sequence of colors which makes data presentation more consistent and easier to interpret. If the pins are moved out of order the pin number and color order can be set to the original sequence without moving pins, click on the 'sort pins' button on the right side of the trend window.

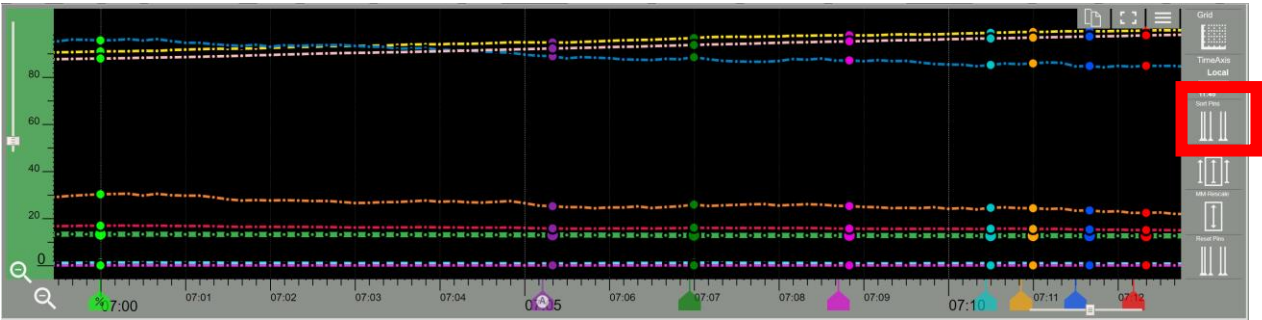
Pins in sequence 1 to 8



Pins 2 and 3 shifted to pins 7 and 8, note the change in color and number sequence

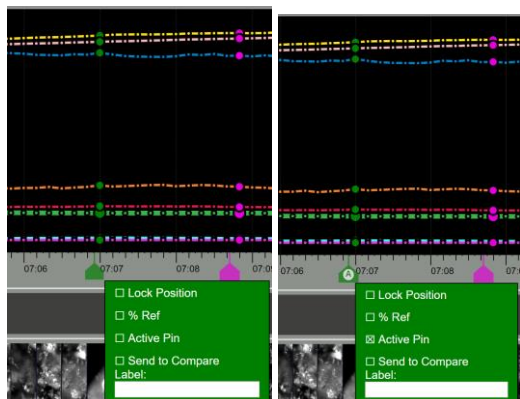


Pin sequence restored without moving the pins. Note the active status was carried to the new pin 2.



Pins for Image Selection and Image Scrolling

Right click on any pin and check the active box. The active pin is marked with an “A”. There can be only one active pin. A pin cannot be both the active and reference pin at the same time.



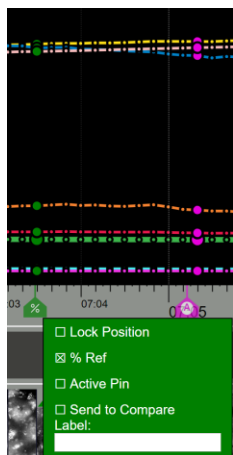
Now use the left or right arrow keys ($\leftarrow$, $\rightarrow$) on the keyboard to select an earlier or later image. One stroke of the arrow key moves one image. This allows the selection of any individual saved image from the entire experiment.

To “animate” the experiment using the selected images:

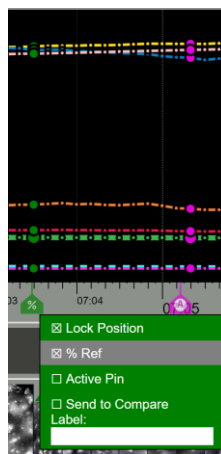
Make the earliest (furthest left) pin 1 the active pin. Press the down key $\downarrow$ on the keyboard, the far-left image will show the image for pin 2. Press again to show the image for pin 3 and so on. To go backwards use the up key $\uparrow$. Note: if this is done using a later pin (e.g., pin 4) as the starting point, the down key $\downarrow$ will cycle through pin 5,6,7,8,1,2,3 and then stop. Use the up key $\uparrow$ to return to pin 4.

Pins for Reference Distribution and Sample Compare

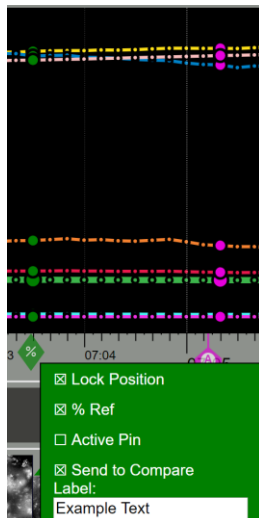
Right click on any pin and check the '% Ref' box. The reference pin is marked with an “%”. There can be only one reference pin per experiment, a pin cannot be both the active and reference pin at the same time. The live experiment, Recall 1, and Recall 2 each use their own reference pin for calculating the % values in the stats table. Lock the reference pin to avoid accidentally moving it during analysis.



Check 'Lock Position' to fix % pin



To compare data from different experiments (Live, Recall 1, Recall 2) move pin(s) to the desired data point(s) in that experiment. Right click on the pin, type in a unique name in the 'Label' field, and check 'Send to Compare'. When done, up to 12 'Send to Compare' pins can be viewed in Sample Compare (see Sample Compare section for further details). Compare pins have a diamond shape.



Live Pin

The live pin cannot be locked or made the active pin. It can be the % reference pin. To show the live image in Sample Compare make sure recording is on and select the live pin for 'Send to Compare'. If data is not being recorded the live image will not display.

Quick Selecting Pins from Visual Trend

To quickly select up to two images from the visual trend:

Left click with the mouse in the visual trend to assign pin 3 (dark green) to the selected image slice.

Right click with the mouse in the visual trend to assign pin 7 (dark blue) to the selected image slice.

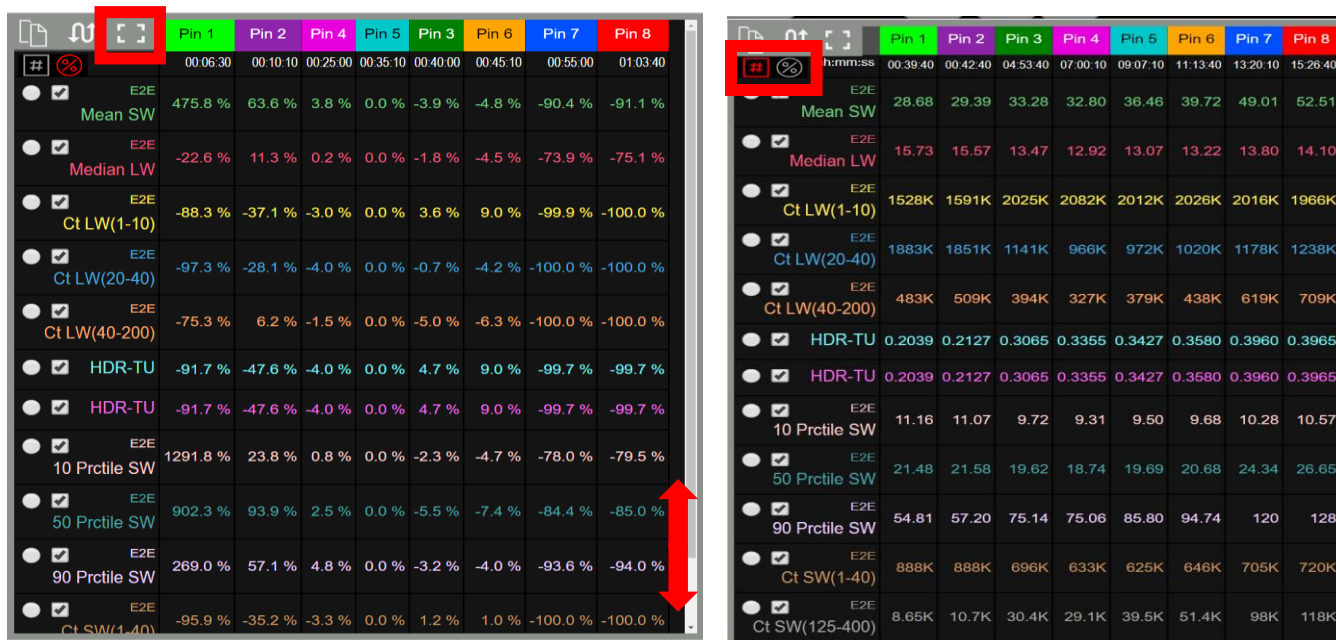
Stats Table

This displays the numerical results of the statistical analysis for selected time points on the trend. Each time point is a column, each statistic is a row. Results are displayed as percentage % values by default. Time point column headers are color coded to match the trend markers. Trend row values are color coded to match the trend line. Up to twelve statistics can be used, move the scroll bar to see the last statistic.

The stats table can be maximized for larger display by clicking on the maximize button  in the upper left.

When maximized all twelve statistics are displayed. Press the minimize button  to return to original size.

Results can also be displayed as an absolute value or as a percentage of the % reference pin. Press on the # or % sign in the upper left of the table to switch between the two displays.



	Pin 1	Pin 2	Pin 4	Pin 5	Pin 3	Pin 6	Pin 7	Pin 8
# %	00:06:30	00:10:10	00:25:00	00:35:10	00:40:00	00:45:10	00:55:00	01:03:40
Mean SW	475.8 %	63.6 %	3.8 %	0.0 %	-3.9 %	-4.8 %	-90.4 %	-91.1 %
Median LW	-22.6 %	11.3 %	0.2 %	0.0 %	-1.8 %	-4.5 %	-73.9 %	-75.1 %
Ct LW(1-10)	-88.3 %	-37.1 %	-3.0 %	0.0 %	3.6 %	9.0 %	-99.9 %	-100.0 %
Ct LW(20-40)	-97.3 %	-28.1 %	-4.0 %	0.0 %	-0.7 %	-4.2 %	-100.0 %	-100.0 %
Ct LW(40-200)	-75.3 %	6.2 %	-1.5 %	0.0 %	-5.0 %	-6.3 %	-100.0 %	-100.0 %
HDR-TU	-91.7 %	-47.6 %	-4.0 %	0.0 %	4.7 %	9.0 %	-99.7 %	-99.7 %
HDR-TU	-91.7 %	-47.6 %	-4.0 %	0.0 %	4.7 %	9.0 %	-99.7 %	-99.7 %
10 Prctile SW	1291.8 %	23.8 %	0.8 %	0.0 %	-2.3 %	-4.7 %	-78.0 %	-79.5 %
50 Prctile SW	902.3 %	93.9 %	2.5 %	0.0 %	-5.5 %	-7.4 %	-84.4 %	-85.0 %
90 Prctile SW	269.0 %	57.1 %	4.8 %	0.0 %	-3.2 %	-4.0 %	-93.6 %	-94.0 %
Ct SW(1-40)	-95.9 %	-35.2 %	-3.3 %	0.0 %	1.2 %	1.0 %	-100.0 %	-100.0 %

	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
# %	00:39:40	00:42:40	04:53:40	07:00:10	09:07:10	11:13:40	13:20:10	15:26:40
Mean SW	28.68	29.39	33.28	32.80	36.46	39.72	49.01	52.51
Median LW	15.73	15.57	13.47	12.92	13.07	13.22	13.80	14.10
Ct LW(1-10)	1528K	1591K	2025K	2082K	2012K	2026K	2016K	1966K
Ct LW(20-40)	1883K	1851K	1141K	966K	972K	1020K	1178K	1238K
Ct LW(40-200)	483K	509K	394K	327K	379K	438K	619K	709K
HDR-TU	0.2039	0.2127	0.3065	0.3355	0.3427	0.3580	0.3960	0.3965
HDR-TU	0.2039	0.2127	0.3065	0.3355	0.3427	0.3580	0.3960	0.3965
10 Prctile SW	11.16	11.07	9.72	9.31	9.50	9.68	10.28	10.57
50 Prctile SW	21.48	21.58	19.62	18.74	19.69	20.68	24.34	26.65
90 Prctile SW	54.81	57.20	75.14	75.06	85.80	94.74	120	128
Ct SW(1-40)	888K	888K	696K	633K	625K	646K	705K	720K
Ct SW(125-400)	8.65K	10.7K	30.4K	29.1K	39.5K	51.4K	98K	118K



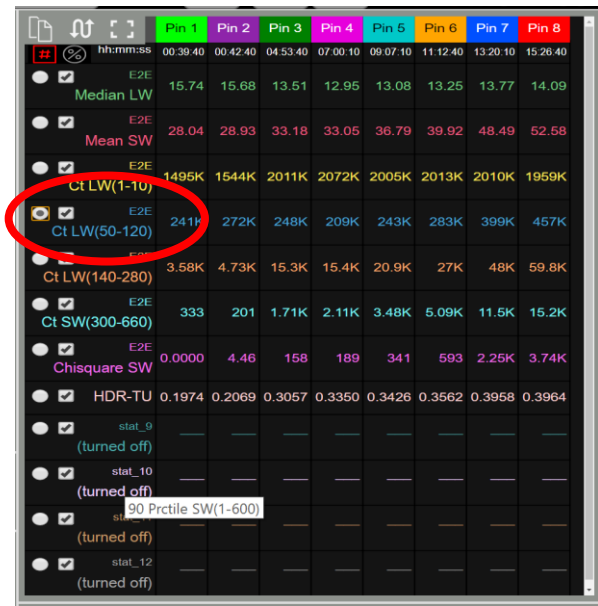
If the measurement at the % reference pin has no measured particles and % is selected, then the stats table will display “nan” (not a number) because it is attempting to divide by the zero value of the % reference pin.



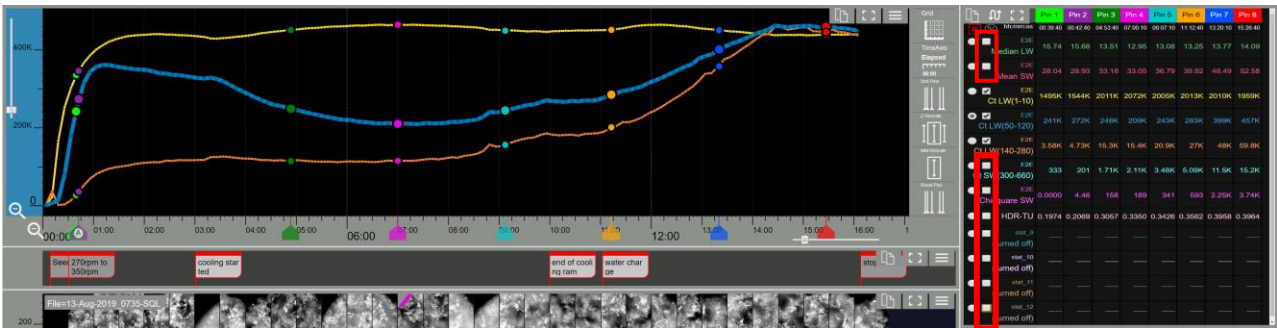
If % is selected, and the displayed statistic for a Pin # is “-100%” it is because either the Pin # value is zero or the value for the % reference pin is far greater than the value for the Pin #.

When in Acquire mode, the Pins 1-7 are for past measurements and the most recent measurement is always assigned to Pin 8. When in Recall 1 or 2 mode, Pins 1-8 can be moved to any position on the trend.

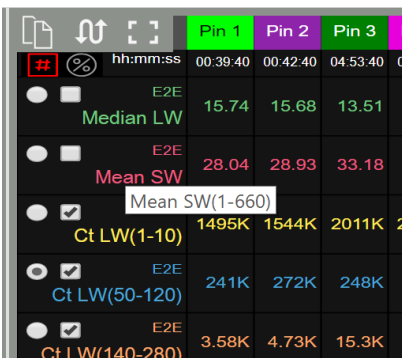
The round radio button is used to select which trend is highlighted and displayed on the Y axis. Only one trend can be selected at a time:



The square check box turns the display of a trend on or off. By default, all trends are displayed, turn off undesired trends to simplify the display:



Hover the mouse over the statistic name and the complete description of the statistic will appear. In this example hovering over the second-row statistic 'Mean SW' shows it is the Mean Square Weight over the chord length range of 1 to 660 microns:



Abbreviations used in the statistics table:

Ct=counts

LW=length weighted

SW=square weighted

CW=cube weighted

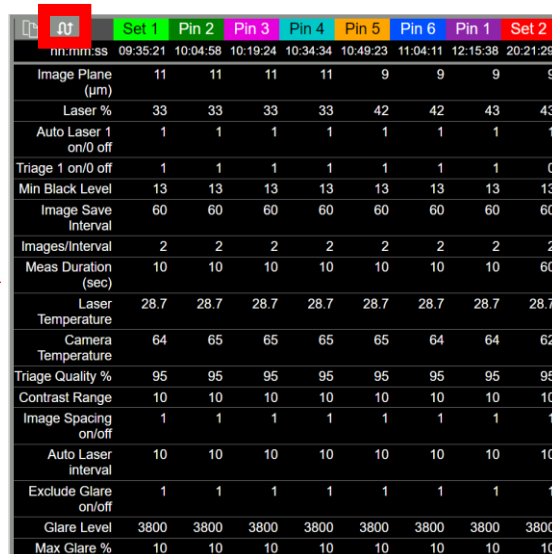
Prctile=percentile , example: 65 Prctile LW = 65th percentile Length Weighted

The time axis of the statistic table is determined by whichever time axis is chosen in the trend (relative or local time).

Pressing the  switches the display from Stats Table to Experiment Info. See Experiment Info section for more information.



	Pin 1	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 2	Pin 8
EZE	0.0 %	0.3 %	0.0 %	0.3 %	-5.9 %	-5.6 %	-8.0 %	42.2 %
Median LW	0.0 %	0.6 %	-1.1 %	1.7 %	20.8 %	-12.9 %	297.5 %	684.8 %
Mean SW	0.0 %	-0.4 %	1.9 %	-0.9 %	-5.5 %	-3.2 %	-5.6 %	22.2 %
EZE	0.0 %	-0.4 %	1.9 %	-0.9 %	-5.5 %	-3.2 %	-5.6 %	22.2 %
Ct LW(1-10)	0.0 %	2.6 %	-4.3 %	7.3 %	-54.5 %	-60.9 %	118.1 %	2488.5 %
EZE	0.0 %	-14.3 %	-57.1 %	14.3 %	9400.0 %	-100.0 %	1187K %	10553K %
Ct LW(20-40)	0.0 %	-14.3 %	-57.1 %	14.3 %	9400.0 %	-100.0 %	1187K %	10553K %
EZE	0.0 %	-14.3 %	-57.1 %	14.3 %	9400.0 %	-100.0 %	1187K %	10553K %
Ct LW(50-120)	0.0 %	-14.3 %	-57.1 %	14.3 %	9400.0 %	-100.0 %	1187K %	10553K %
EZE	0.0 %	-14.3 %	-57.1 %	14.3 %	9400.0 %	-100.0 %	1187K %	10553K %
Ct SW(140-330)	0	0	0	0	2.04K	0	1.87K	51K
EZE	0.0000	0.0514	0.0384	0.1471	7.86K	4.42	6981K	804554K
Chisquare SW	0.0000	0.0514	0.0384	0.1471	7.86K	4.42	6981K	804554K
HDR-TU	0.0 %	0.0 %	0.0 %	0.0 %	-0.8 %	-0.8 %	-6.2 %	-3.1 %
stat_9 (turned off)	nan %	nan %	nan %	nan %	nan %	nan %	nan %	nan %
stat_10 (turned off)	nan %	nan %	nan %	nan %	nan %	nan %	nan %	nan %
stat_11 (turned off)	nan %	nan %	nan %	nan %	nan %	nan %	nan %	nan %
stat_12 (turned off)	nan %	nan %	nan %	nan %	nan %	nan %	nan %	nan %

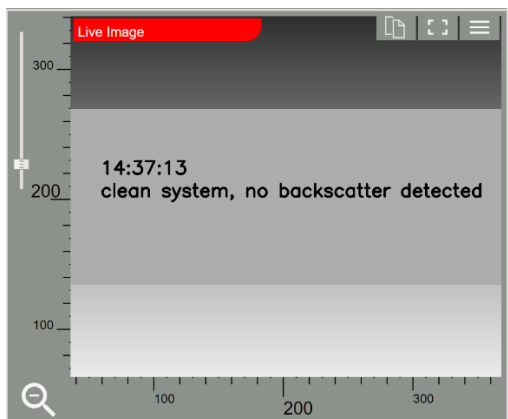
	Set 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 1	Set 2
Image Plane (µm)	11	11	11	11	9	9	9	9
Laser %	33	33	33	33	42	42	43	43
Auto Laser 1 on/off	1	1	1	1	1	1	1	1
Triage 1 on/off	1	1	1	1	1	1	1	0
Min Black Level	13	13	13	13	13	13	13	13
Image Save Interval	60	60	60	60	60	60	60	60
Images/Interval	2	2	2	2	2	2	2	2
Meas Duration (sec)	10	10	10	10	10	10	10	10
Laser Temperature	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7
Camera Temperature	64	65	65	65	65	64	64	62
Triage Quality %	95	95	95	95	95	95	95	95
Contrast Range	10	10	10	10	10	10	10	10
Image Spacing on/off	1	1	1	1	1	1	1	1
Auto Laser Interval	10	10	10	10	10	10	10	10
Exclude Glare on/off	1	1	1	1	1	1	1	1
Glare Level	3800	3800	3800	3800	3800	3800	3800	3800
Max Glare %	10	10	10	10	10	10	10	10

Clean



Never attempt window cleaning when the Raman laser is on. Window cleaning should only be done when in imaging only mode.

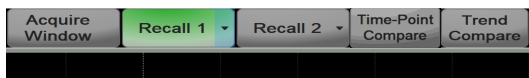
Click on the window cleaning button  and observe the live image window. A clean window in air or a particle free solution will have no detectable backscatter of light and the following message will appear:



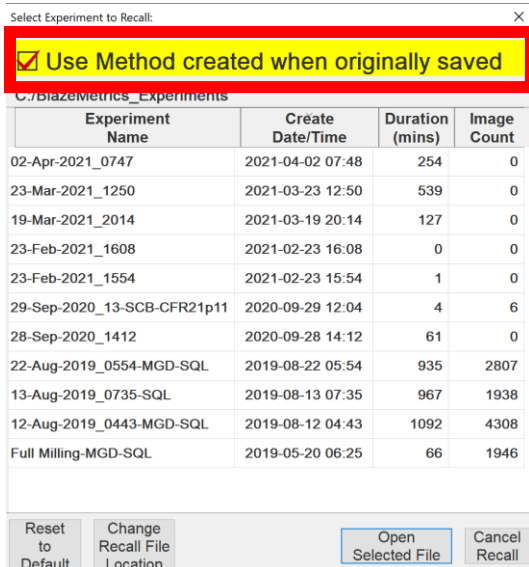
If the window is dirty, individual particles or streaks will be present at fixed positions in the image. To clean the window, wipe it with a dry lint free tissue such as a Kimwipe. If particles appear in different parts of the image after each wipe, then they are loosely adhered and will typically be removed when the probe is immersed in liquid. If the particles/streaks do not change after a dry wipe, wet the wipe with solvent and wipe until removed.

Recall 1

Click directly on the Recall 1 button to open a file.

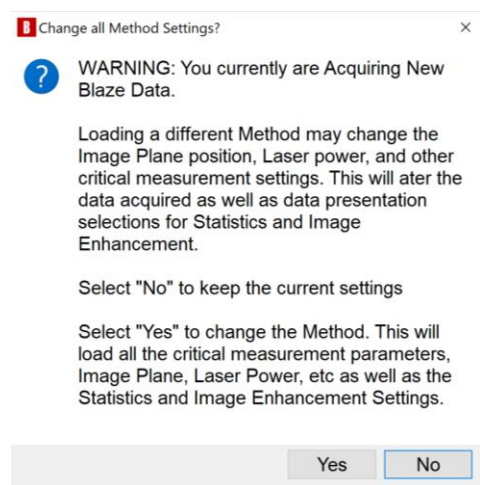


If “Use Method...” is checked, the recalled file’s Method is loaded and applied to the live experiment and other recalled file. **If running live uncheck “Use Method...”**.



Double click on the desired experiment to open it or click once to select and then click ‘Open Selected File’. Images, trends, and distributions of the recalled file will automatically be displayed in Recall 1.

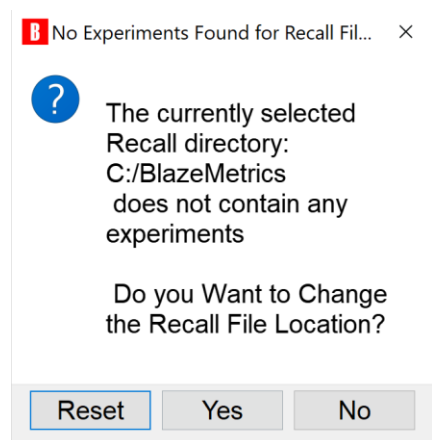
If “Use Method...” is checked while the Blaze is acquiring this confirmation window will appear:



Note: Files taken with early versions of the Blaze UI do not have a saved Method. If “Use Method...” is checked the software will display a notification that no Method can be found and apply the current Method to the newly opened file.

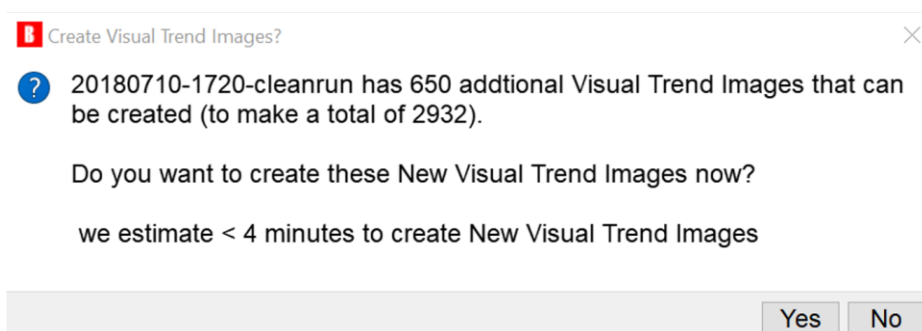
The Select Experiment to Recall window can be resized by dragging on the corners. Click on the column heading to sort by experiment name, creation date/time, or image count. The first click sorts by ascending order, the second click sorts by descending order.

If the desired file is not in the currently set directory, click the ‘Change Recall Files Location’ button to select a different directory. Changing the recall file location does not affect where data from the live view is saved. This is controlled separately by the ‘Change Blaze Experimental Files Location’ under the settings button. If no experimental files are in the currently set directory the software will automatically ask to change the directory:

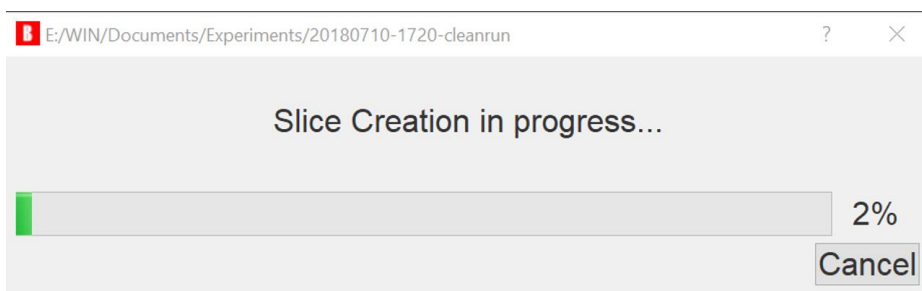


Recalling data can be done while acquiring data for a new run but it is not recommended with large files because it may slow computer response.

Image slices used for the visual trend are not necessarily created for every single image saved. If this is the case, the software will ask if additional image slices should be created when recalling an experiment and provide a time estimate for doing so. Note: if the software is acquiring live data there will be a notice that there are slices to create, but the software will not allow the creation of these slices. This is design feature to avoid affecting live data acquisition.



If 'Yes' is selected a progress bar will appear

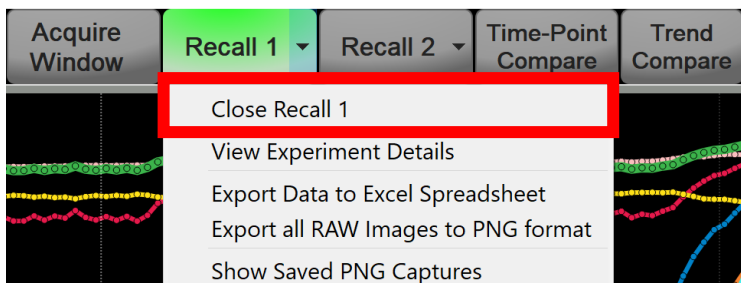


Once the slice creation is completed the progress bar will disappear.

To switch back to a prior view (e.g., live view) click on the desired view button .

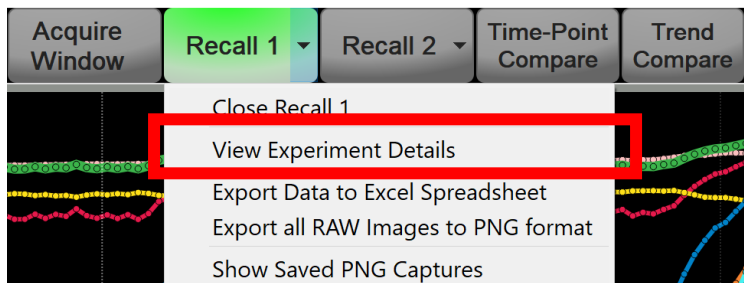
Close Recall 1

To close a file, click on the pulldown arrow on Recall 1 and select 'Close Recall 1'.



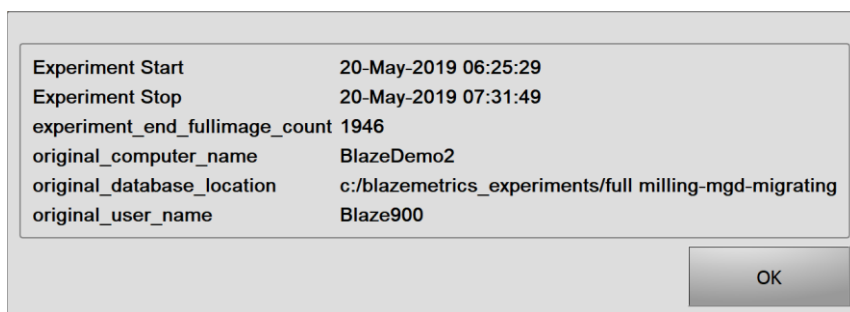
View Experiment Details

This displays details on how the original file was acquired and is necessary for 21 CFR Part 11.

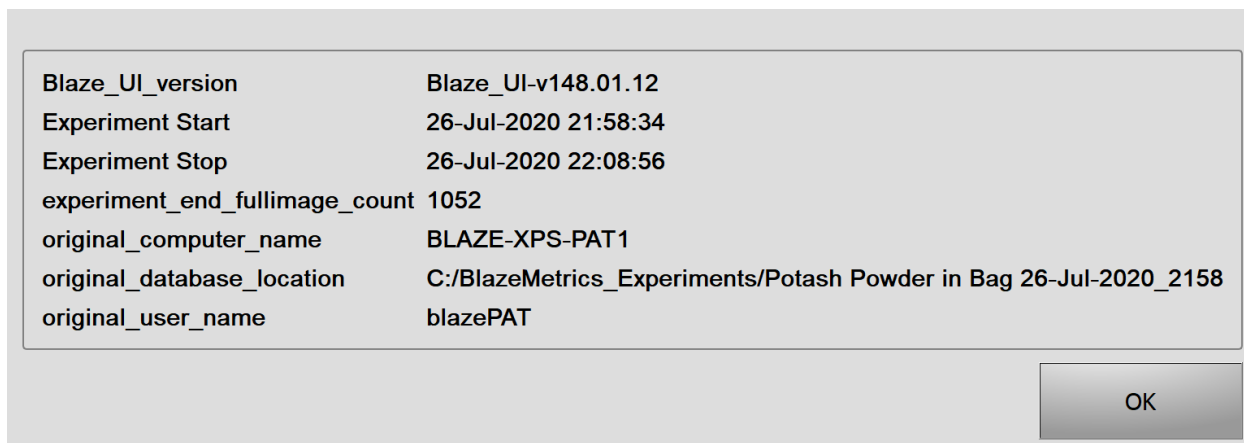


Differing amounts of information will be displayed depending upon the software version originally used to acquire the data.

Experiments done with older software:



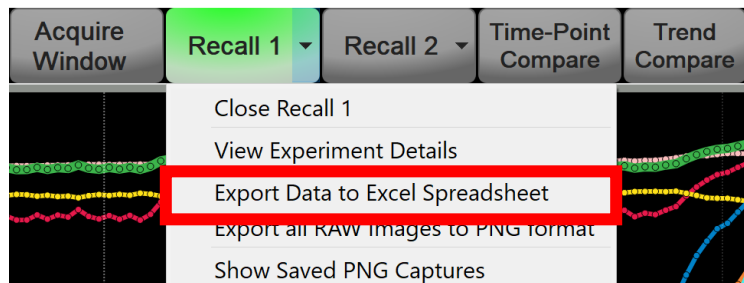
Experiments done with the 2020 A software release:



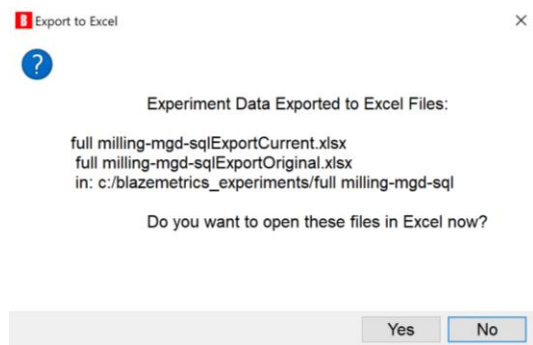
The metadata includes start and stop time of the experiment, how many images were acquired, the name of the computer used to acquire the data, the original location where the data file was saved, and the username from the windows account used to log into the computer during the experiment. Experiments acquired with the most recent release contain the Blaze UI version as well.

Export Data to Excel Spreadsheet

Trends and distributions can be exported directly to an Excel file from within the Blaze UI or Blaze Office software. First apply any data processing (averaging, channel grouping, statistics, etc.) then click on the drop-down arrow on Recall 1 and select 'Export Data to Excel Spreadsheet'.



Export time will depend upon the file size. When complete, a message will appear asking if the files should be opened. Note: Excel must be on the computer in order to open the file.

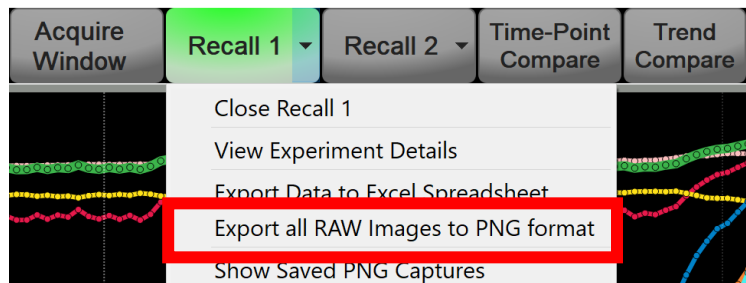


The data is exported both with the processing at the time the data was taken as well as the processing applied when most recently opened. Processing includes statistics, averaging and channel grouping.

The data files are saved as *FilenameExportCurrent.xlsx* and *FilenameExportOriginal.xlsx* within the directory for that experiment, i.e., under the path C:\BlazeMetrics_Experiments\Filename\ . The xlsx format is used by Excel 2007, 2010, 2013, 2016, 2019, Excel (Office) 365. If using a version of Excel prior to 2007, the file will not open. Using Excel 2007 or a later version it can be saved as a backward compatible *.xls format file for use with Excel 2003 and earlier.

Export all RAW Images to PNG format

This function exports all images from the recalled file as PNG files. There are no enhancements (image tools) applied so the images will likely be darker or brighter than it appears in the Blaze UI. The PNGs are saved in C:\BlazeMetrics_Experiments\FileName\rawPNGImages .



Images are named YYYY-MM-DD-HH-MM-SSXXX where XXX is milliseconds.

Windows (C:) > BlazeMetrics_Experiments > 29-Sep-2020_13-SCB-CFR21p11 > rawPNGImages

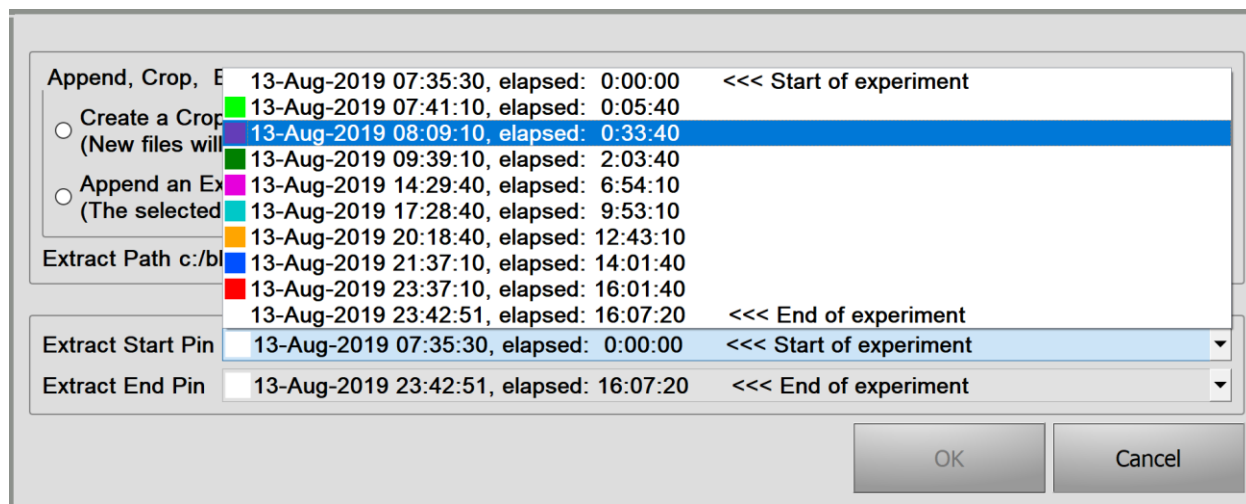
Name	Date	Type	Size	Tags
2020-09-29_12-04-52946_RawImage.png	3/17/2021 1:51 PM	PNG File	3,776 KB	
2020-09-29_12-05-19876_RawImage.png	3/17/2021 1:51 PM	PNG File	3,831 KB	
2020-09-29_12-05-49904_RawImage.png	3/17/2021 1:51 PM	PNG File	3,840 KB	

Please contact Blaze Metrics for further details on how to work with these PNG images.

Append, Crop, Extract Section(s) of Experiment Data

This allows creating a cropped (sub-section) experiment from an originally larger experiment.

First select the start and end points of the cropped file. The start or end of the experiment as well as any of the pinpoints can be selected.



Once both the start and end point have been selected click on 'Create a Cropped...'

Append, Crop, Extract Section(s) of an Experiment File

☐ Create a Cropped Experiment File or Extract a section of an Exp File to create a NEW Experiment File
(New files will be created, Original file will not be altered in any way)

☐ Append an Extract from the current Recall File to the End of a selected Experiment File
(The selected Experiment File WILL BE ALTERED!)

Extract Path c:/blazemetrics_experiments/13-aug-2019_0735-sql

Extract Start Pin 13-Aug-2019 08:09:10, elapsed: 0:33:40

Extract End Pin 13-Aug-2019 17:28:40, elapsed: 9:53:10

OK Cancel

A prompt to name the new file will appear. Click 'Set Name':

Set Extract Name

Extract will be written to:
c:/blazemetrics_experiments

cropped experiment

Set Name Cancel Extract

Then click OK:

Append, Crop, Extract Section(s) of an Experiment File

☒ Create a Cropped Experiment File or Extract a section of an Exp File to create a NEW Experiment File
(New files will be created, Original file will not be altered in any way)

☐ Append an Extract from the current Recall File to the End of a selected Experiment File
(The selected Experiment File WILL BE ALTERED!)

Extract Path c:/blazemetrics_experiments/cropped

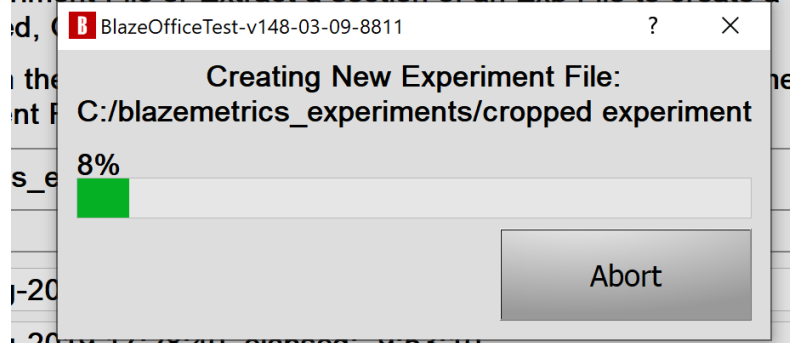
Extract Start Pin 13-Aug-2019 08:09:10, elapsed: 0:33:40

Extract End Pin 13-Aug-2019 17:28:40, elapsed: 9:53:10

OK Cancel

The new file will be created. A status bar will show progress in file creation, the time will depend on how large the new experiment is.

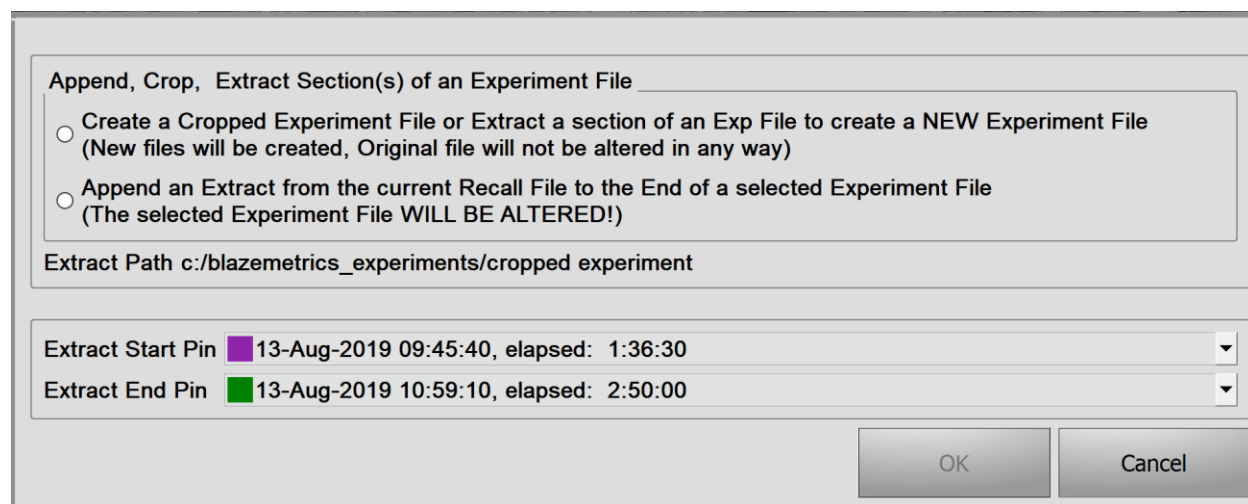
Experiment File or Extract a section of an Exp File to create a New Experiment File



The resulting new cropped file can be opened and processed just like any other Blaze experiment file.

To append or join two experiments together first open the experiment that will be at the end of the joined files. Make sure the experiment file that will be the start of the new joined file is closed. Note this will modify the experiment that will be at the start of the joined file.

Select the start and end points of the section to be appended. The start or end of the experiment as well as any of the pin points can be selected. Once both the start and end point have been selected click on 'Append an Extract...'



Now select the experiment that will be the start of the new experiment file and click 'Append to Selected File':

Select Experiment to Append to ×

c:/blazemetrics_experiments

Experiment Name	Create Date/Time	Dur. (m)
21-Jul-2021_1124	2021-07-21 11:24	
01-Jun-2021_1059	2021-06-01 10:59	
02-Apr-2021_0747	2021-04-02 07:48	
23-Mar-2021_1250	2021-03-23 12:50	
19-Mar-2021_2014	2021-03-19 20:14	
23-Feb-2021_1608	2021-02-23 16:08	
23-Feb-2021_1554	2021-02-23 15:54	
29-Sep-2020_13-SCB-CFR21p11	2020-09-29 12:04	
28-Sep-2020_1412	2020-09-28 14:12	
22-Aug-2019_0554-MGD-SQL	2019-08-22 05:54	
append this	2019-08-13 08:09	
cropped experiment	2019-08-13 08:09	
13-Aug-2019_0735-SQL	2019-08-13 07:35	
12-Aug-2019_0443-MGD-SQL	2019-08-12 04:43	1

Reset to Default Change Recall File Location Append To Selected File Cancel Append

Now click OK:

Append, Crop, Extract Section(s) of an Experiment File

☐ Create a Cropped Experiment File or Extract a section of an Exp File to create a NEW Experiment File
 (New files will be created, Original file will not be altered in any way)

☒ Append an Extract from the current Recall File to the End of a selected Experiment File
 (The selected Experiment File WILL BE ALTERED!)

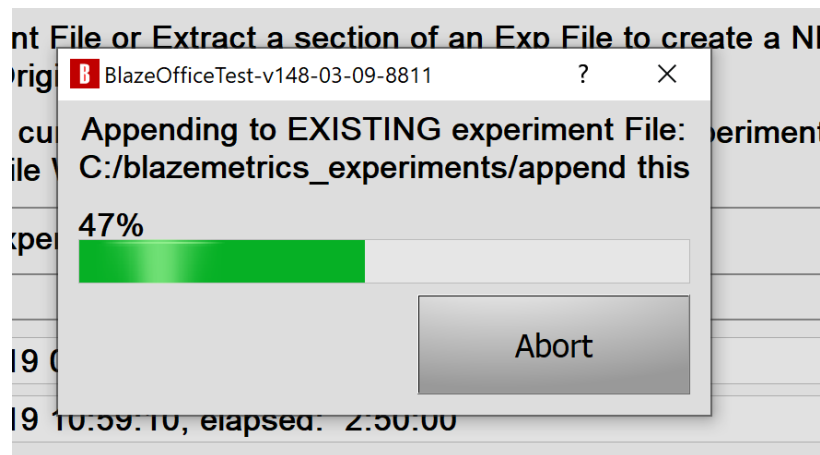
Extract Path c:/blazemetrics_experiments/append this

Extract Start Pin ■ 13-Aug-2019 09:45:40, elapsed: 1:36:30

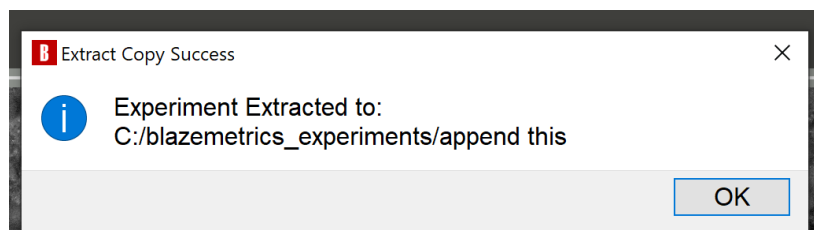
Extract End Pin ■ 13-Aug-2019 10:59:10, elapsed: 2:50:00

OK Cancel

The new appended file will be created.



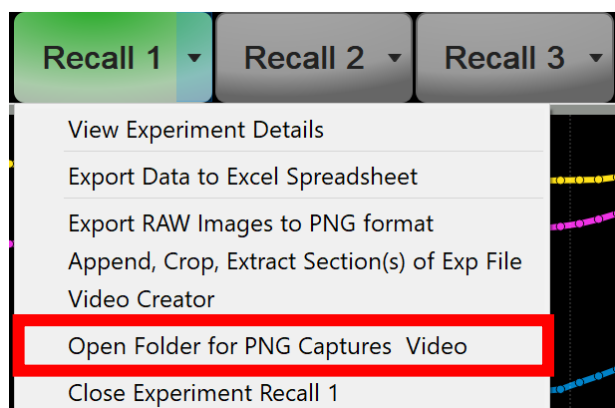
Click on OK when the success window appears.



The resulting newly appended file can be opened and processed just like any other Blaze experiment file. This process can be repeated to join 3 or more files together.

Open Folder for PNG Captures Video

This opens the directory where the clipboard captures of an experiment are automatically stored, e.g., the contents of C:\blazemetrics_experiments\FileName\. Videos, PNG files, and Excel data export can all be found here.



Recall 2

This is the same as Recall 1 except it is applied to a second experiment file.

Recall 3

This is only for Blaze Office software and is the same as Recall 1 except it is applied to a third experiment file. In Blaze UI the current experiment under the Acquire Window is the third set of data.

Experiment Information

Click the  in the statistics table to view the experiment info at the time of each of the pins. Click the  to switch back to the statistics table again.

 	Set 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 1	Set 2
hh:mm:ss	09:35:21	10:04:58	10:19:24	10:34:34	10:49:23	11:04:11	12:15:38	20:21:29
Image Plane (μm)	11	11	11	11	9	9	9	9
Laser %	33	33	33	33	42	42	43	43
Auto Laser 1 on/0 off	1	1	1	1	1	1	1	1
Triage 1 on/0 off	1	1	1	1	1	1	1	0
Min Black Level	13	13	13	13	13	13	13	13
Image Save Interval	60	60	60	60	60	60	60	60
Images/Interval	2	2	2	2	2	2	2	2
Meas Duration (sec)	10	10	10	10	10	10	10	60
Laser Temperature	28.7	28.7	28.7	28.7	28.7	28.7	28.7	28.7
Camera Temperature	64	65	65	65	65	64	64	62
Triage Quality %	95	95	95	95	95	95	95	95
Contrast Range	10	10	10	10	10	10	10	10
Image Spacing on/off	1	1	1	1	1	1	1	1
Auto Laser interval	10	10	10	10	10	10	10	10
Exclude Glare on/off	1	1	1	1	1	1	1	1
Glare Level	3800	3800	3800	3800	3800	3800	3800	3800
Max Glare %	10	10	10	10	10	10	10	10

For continuous parameters, the values are given as follows:

Image plane position [μm relative to window reference position]

Laser [% of maximum power]

Minimum Black Level [intensity]

Image Save Interval [seconds]

Images Saved/Interval [number of images]

Measurement Duration [seconds]

Laser Temperature [°C]

Camera Temperature [°C]

Triage Quality [%]

Contrast Range

Autolaser Interval [seconds]

Glare Level [intensity]

Max Glare [%]

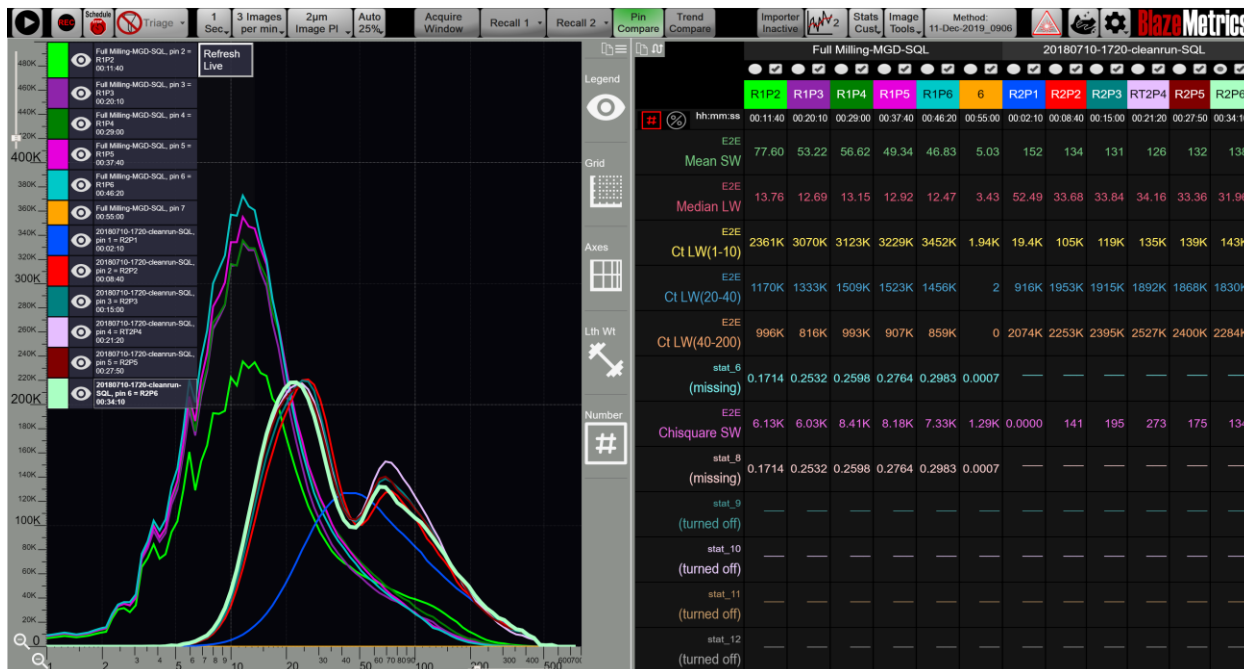
A value of 1=ON, 0=OFF is used for the functions Triage, Triage Image Spacing, Triage Glare and Auto-Laser.

Sample Compare

This view compares images, distributions, and statistics from user selected time points in Acquire Window (Live), Recall 1, and Recall 2. To make data appear in Sample Compare first right click on the desired pin(s) in Acquire Window (Live), Recall 1, or Recall 2. Each pin can be assigned a label.



Then click on the 'Sample Compare' icon:



Note: the colors used under Sample Compare are different from original colors from the original pins. Assign a unique label to each pin to distinguish them more easily, e.g., R1P2 for Recall 1, Pin 2.

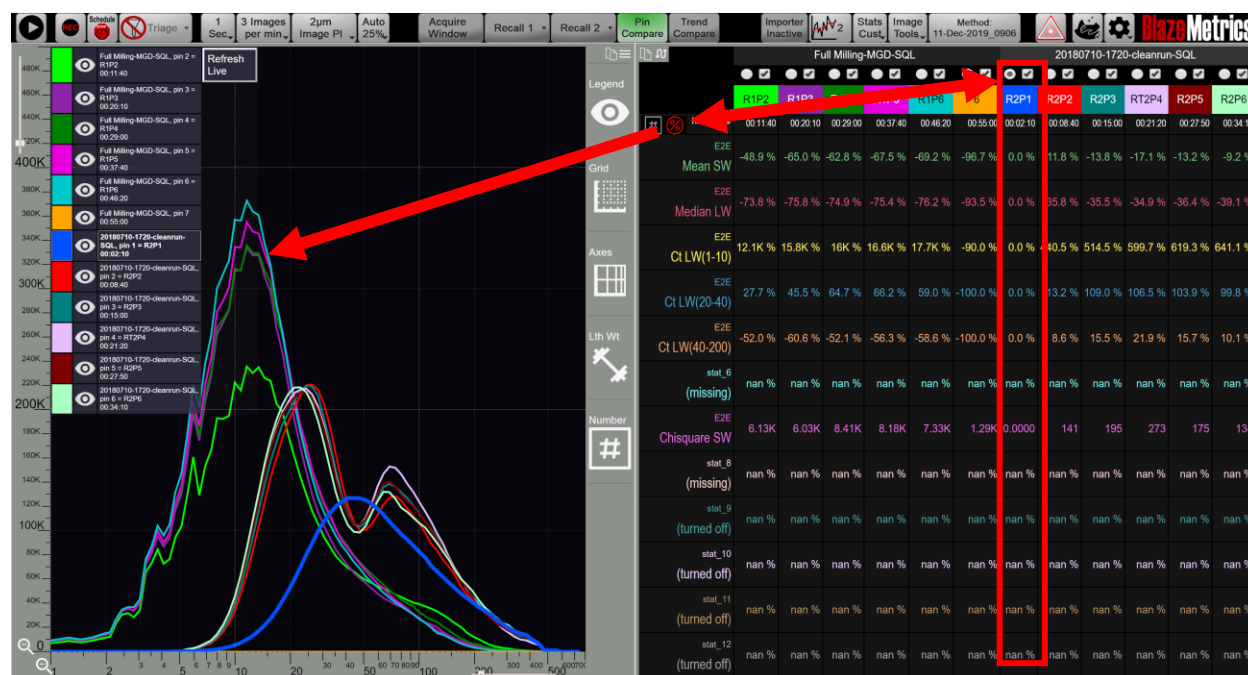
Note: Up to 12 pins can be compared, if more than 12 pins as selected for comparison the priority order is Acquire Window (live experiment), Recall 1, then Recall 2. This table shows some examples:

	Number of Selected Pins			Number of Shown Pins		
	Acquire	Recall 1	Recall 2	Acquire	Recall 1	Recall 2
Example 1	8	4	3	8	4	0
Example 2	3	4	8	3	4	5
Example 3	8	8	8	8	4	0

Note: for the live pin to be displayed data recording must be on.

Distributions are always displayed on the left. Control of the distributions is the same as elsewhere in the software. Times are always relative to the start of that experiment not between experiments.

The display on the right starts with displaying the statistics table. Hover over the color to read the full label of the pin. Select the round radio button of a specific pin to make it the reference. The reference distribution is drawn in bold. Otherwise control of the statistics is the same as elsewhere in the software.

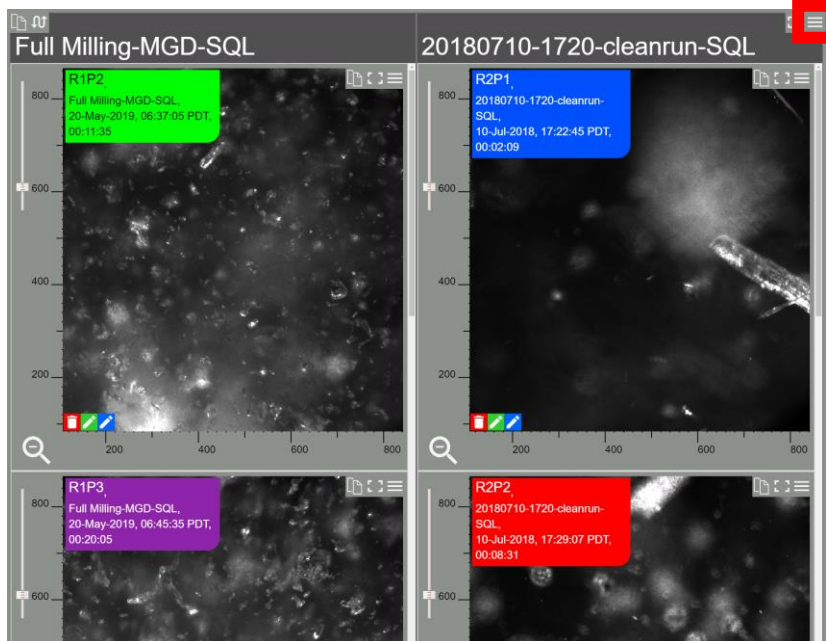


To view the corresponding images, click on the sideways S double arrow icon .

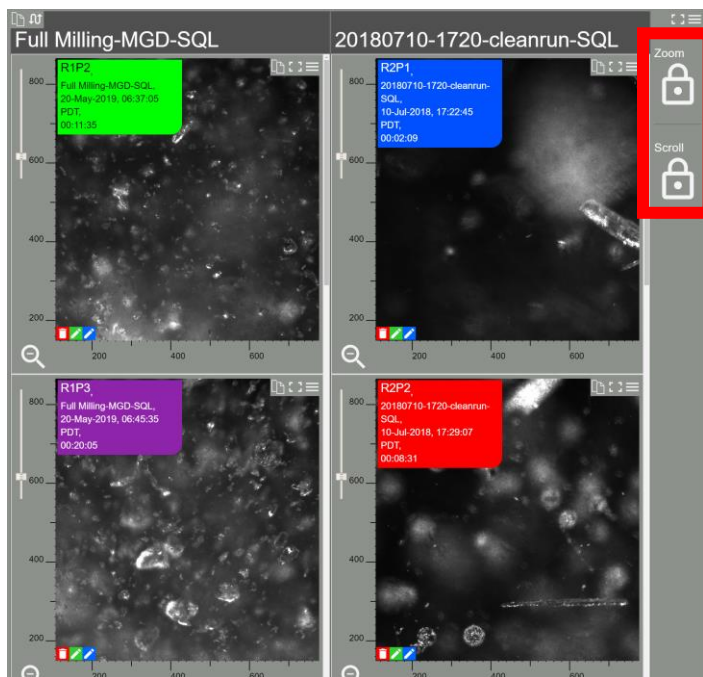
		Full Milling-MGD-SQL						20180710-1720-cleanrun-SQL					
													
		R1P2	R1P3	R1P4	R1P5	R1P6	6	R2P1	R2P2	R2P3	RT2P4	R2P5	R2P6
#	hh:mm:ss	00:11:40	00:20:10	00:29:00	00:37:40	00:46:20	00:55:00	00:02:10	00:08:40	00:15:00	00:21:20	00:27:50	00:34:10
E2E	Mean SW	77.60	53.22	56.62	49.34	46.83	5.03	152	134	131	126	132	138
E2E	Median LW	13.76	12.69	13.15	12.92	12.47	3.43	52.49	33.68	33.84	34.16	33.36	31.96
E2E	Ct LW(1-10)	2361K	3070K	3123K	3229K	3452K	1.94K	19.4K	105K	119K	135K	139K	143K
E2E	Ct LW(20-40)	1170K	1333K	1509K	1523K	1456K	2	916K	1953K	1915K	1892K	1868K	1830K
E2E	Ct LW(40-200)	996K	816K	993K	907K	859K	0	2074K	2253K	2395K	2527K	2400K	2284K
stat_6 (missing)		0.1714	0.2532	0.2598	0.2764	0.2983	0.0007	—	—	—	—	—	—
E2E	Chisquare SW	6.13K	6.03K	8.41K	8.18K	7.33K	1.29K	0.0000	141	195	273	175	134
stat_8 (missing)		0.1714	0.2532	0.2598	0.2764	0.2983	0.0007	—	—	—	—	—	—
stat_9 (turned off)		—	—	—	—	—	—	—	—	—	—	—	—
stat_10 (turned off)		—	—	—	—	—	—	—	—	—	—	—	—
stat_11 (turned off)		—	—	—	—	—	—	—	—	—	—	—	—
stat_12 (turned off)		—	—	—	—	—	—	—	—	—	—	—	—

The acquire window is shown on the left, Recall 1 in the middle, Recall 2 on the right. The earliest images are on the top, the newest images on the bottom. By default, scrolling moves the images from all experiments together. Likewise, zooming is applied to all images together.

To enable independent scrolling and zooming click on the main right window menu control



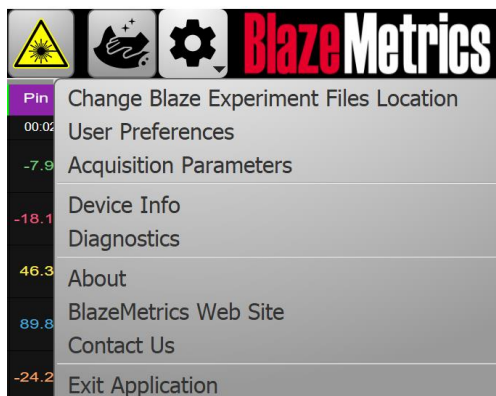
Unlock Zoom or Scroll to allow independent zooming or scrolling of the images. Images can also be panned individually if the Zoom is unlocked. If the Zoom is locked, then all images are panned together.



To view the corresponding experimental info, click again on the  icon. Experimental info will only be displayed for data acquired with Blaze UI 148.02 or higher. An additional click on the  icon returns the right window to the statistics table.

Settings

The settings button  provides access to additional settings and diagnostic information.



Change Blaze Experiment Files Location

Use this to change the default saving location from C:\BlazeMetrics_Experiments to a different selected folder. Note: this location is for saving data, this does not affect the file recall working directory which is set separately.

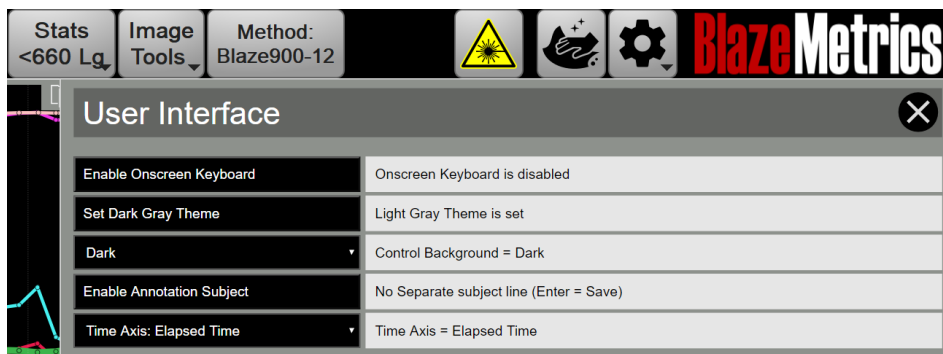


Do not store experimental data in either C:\BlazeMetrics\SOP_Folder_Defaults or C:\BlazeMetrics\SOP_Folder_Projects, doing so may interfere with software functioning.

The solid-state C drive of Blaze supplied computers should be used for optimal computer performance. Saving to an external drive is slower and may result in missing images especially if higher image saving rates are selected.

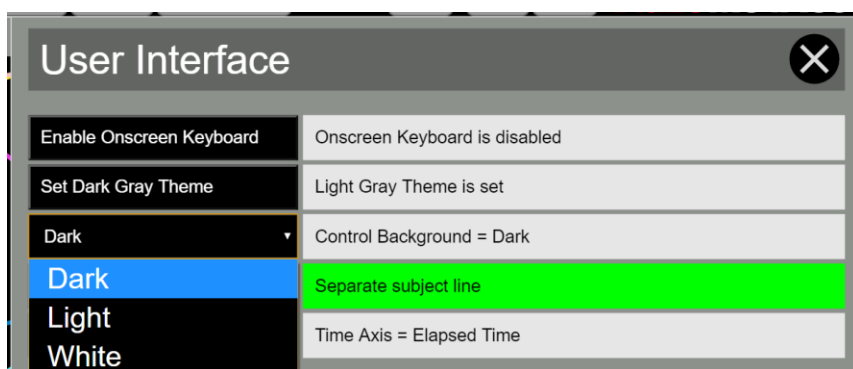
User Preferences

This adjusts the general software display attributes, not image display or data analysis.



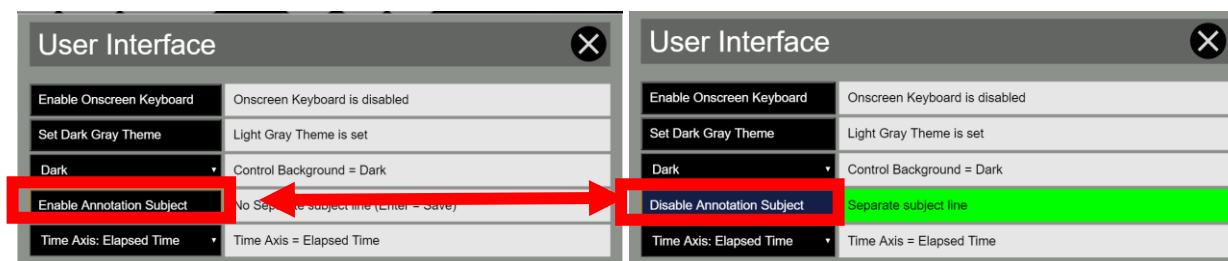
The default settings are light gray theme with a dark background.

The control background can be set to black, light gray, or white and it will change the background color of the distribution and trend graphs.



Enable Annotation Subject—this makes the annotation a long form two field format with ‘add new event’ required for data entry.

Disable Annotation Subject—this makes the annotation a short form one field format where the enter key saves the data entry.



Acquisition Parameters

This section is for Blaze Metrics service use only and is password protected.

Device Info

This field has instrument status and diagnostic information for service. If TeamViewer access to the unit is not available, Blaze may request customers to view and communicate information in this section to assist in Blaze product support.

Device Information

Thermal Monitor

Probe Head Sensor Temperature	63 °C
Laser Heatsink Temperature	23.3 °C

Instrument

Blaze Unit	Blaze900axBB-1.5c-A01
Instrument SN	23605819-OY-5490-91

Camera

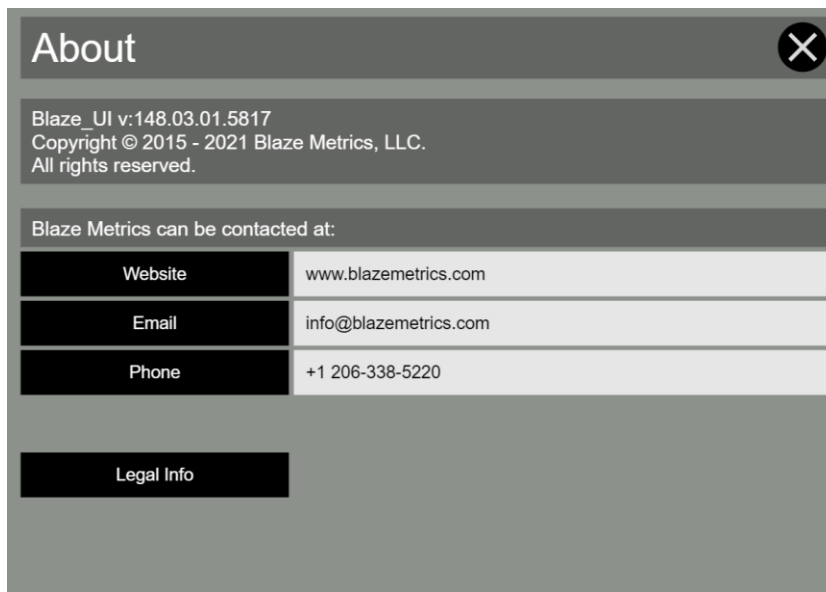
Probe Type Monochrome	Monochrome Probe Type Detected.
Field of View (Pixels)	2044 Px

Diagnostics

This section is for Blaze Metrics service use only and is password protected.

About

This displays the software version and build number as well as the Blaze Metrics contact email and phone number.



[Blaze Metrics Website](#)

This automatically opens the Blaze Metrics website.

[Contact Us](#)

This automatically opens the default web browser to the Blaze Metrics website contact page for feedback including software comments and questions.

[Exit Application](#)

This exits the Blaze software. Alternatively, clicking the X in the upper right corner of the application window also exits the software.

[Legal Info](#)

This opens the end user and software licensing terms in a web browser.

[Distribution Window](#)

The edge-to-edge chord length distributions are automatically displayed over the time period used for the trend display.

Access the control of the display settings by selecting the menu icon  in the upper right.

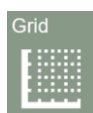


Legend



This switches the display of the legend on or off.

Grid



This switches the background grid lines in the graph on or off.

Axes

This controls the type of x and y axis used. Each press of the button switches the selected type.



this indicates a linear x and linear y axis. This is best used to detect small changes in chord length, especially for larger chord length values. For example, detecting a thin coating on a large particle (e.g., 10 micron coating on 500 micron particle) is best seen with this type. Typically, the channel grouping should match the display, i.e., both set to linear; however, the x axis can be set differently than the channel grouping.



this indicates a log x and linear y axis. This is best used for particle systems with a broad range of chord lengths. This is the most commonly used set of axes and is typically the best choice when working with a new particle system because it provides a good overview. Typically, a log channel grouping is used with a log x axis. This is the default setting.

Weighting



This 'weights' the number of chords by a factor of their chord length. Each press of the button changes the type of weighting.



For both scan derived* and Blaze chord length distribution (CLD), the number of chords measured is proportional to their probability of measurement. For example, the edge (short) chords of a sphere have a lower probability because there is less area where edge chords can be measured, whereas the most common chords are those near the diameter because there is more area, hence a greater probability of measurement. For this reason, all chord measurements are inherently weighted by their chord length. In other words, the 'as measured' data is innately length weighted. To clear up the discrepancy with older chord length based technologies, the table below shows the correlation between the incorrect nomenclature and the correct nomenclature:

	Scanning Technology*	Blaze
Chords as measured	Unweighted	Length weighted (LW)
Chords multiplied by length	Length weighted	Square Weighted (SW)
Chords multiplied by length ²	Square Weighted	Cube weighted (CW)
Chords multiplied by length ³	Cube weighted	Not available

*Scan derived CLD includes FBRM® and ORM® (registered trademarks of Mettler Toledo and Sequip respectively).



"Lth Wt" or LW: chords as measured; no additional weighting is applied. This provides the greatest sensitivity to population changes in small particles and short chords.



"Sq Wt" or SW: each chord is multiplied by its length and the resulting total is the square weighted distribution. This reduces the sensitivity to population changes in small particles and short chords.

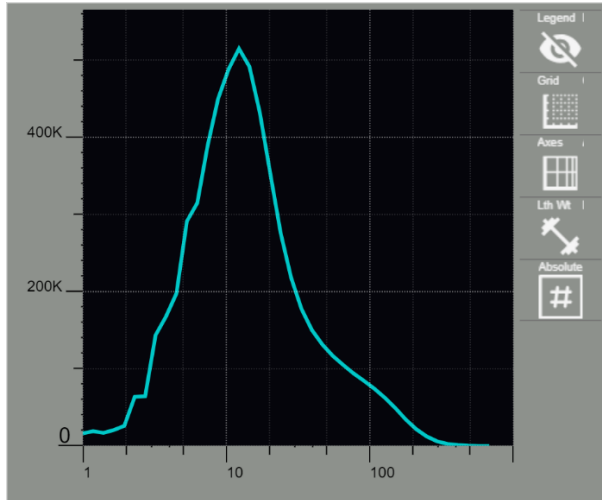


"Cube Wt": each chord is multiplied by the square of its length and the resulting total is the cube weighted distribution. This effectively shows changes in the 'coarse' side of the distribution. For a system of ideal perfect spheres, the resulting chord length distribution would be equivalent to volume based spherical diameter.

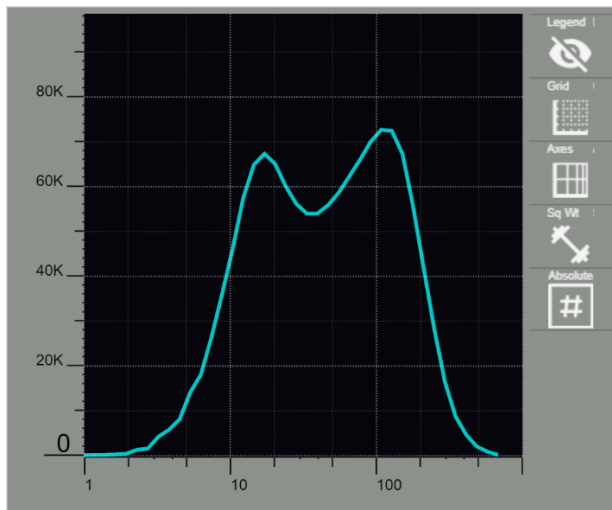
Recommended Weighting

View distributions in both LW and SW to emphasize the fine and coarse end of the distribution respectively as shown below:

LW (Lth Wt) emphasizes fine end of distribution:



Same distribution with SW (Sq Wt) to emphasize coarse end of distribution:



Absolute Number and Percent

This switches the y axis units between the absolute number of chords and a normalized percent value.



Absolute number (also known as a count based distribution). This is sensitive to changes in the number of particles at each chord length. It provides the greatest sensitivity to population changes found in processes such as dissolution and crystallization.



Relative percent (also known as a normalized distribution). The value for each chord is given as a percent of the entire distribution. This is best used when the goal is to track particle dimension and changes in concentration are not of interest. Typically, off-line particle size analyzers present data as a normalized distribution.

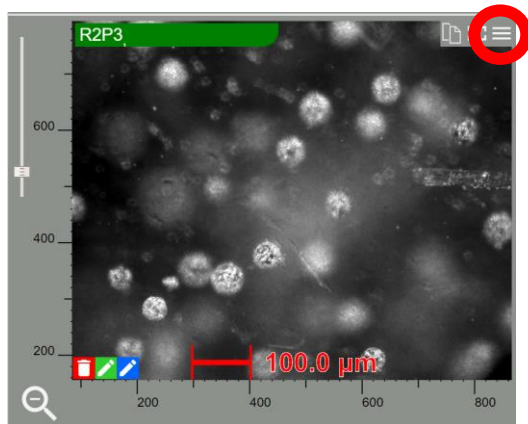


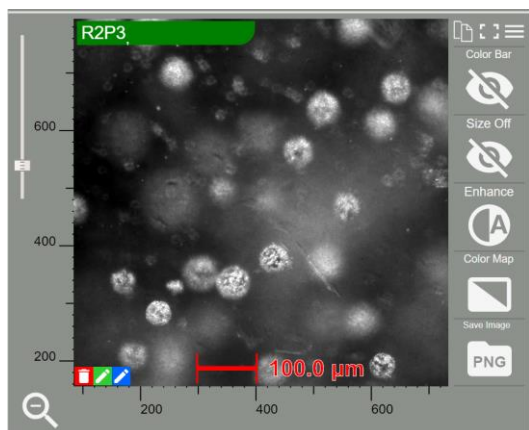
If distributions are visible in absolute number but not relative percent mode, this is because at least one of the distributions has no chord length counts. When there are no counts, it is not possible to normalize the distributions for display. Move the zero count pin to a different time point with counts to enable display in relative percent mode.

Image Window

Images are displayed for time points selected by pins and setpoints as well as the live image.

Access the control of the display settings by selecting the menu icon  in the upper right.



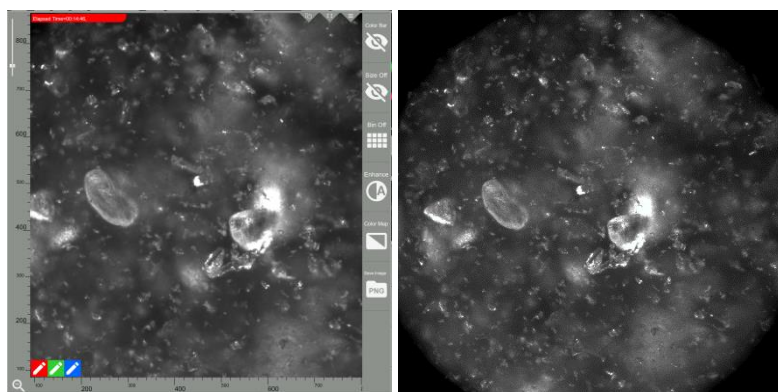


Save Image PNG



Clicking this button stores the image as a PNG graphics file which can be used for reports and analyzed by other software. A folder called “PNG Captures” is created inside the experiment folder, all PNG files are saved in it. The image is an 8 bit PNG with image tool enhancements applied only if enhancement is turned on. This is the full image (no zoom applied) and does not include axes or image measurement tools. Image name is the time stamp for when it was taken, formatted as YYYY-MM-DD_HH_MM_SS_MSEC for example 2019-05-20_06_40_15_661 is year 2019, month 5 (May), date 20th, hour 6 (24 hour clock), minutes 40, seconds 15, and milliseconds 661.

If the Save Image PNG button is clicked twice for the same image the prior saved image will automatically be overwritten.



Above: on the left is image as displayed in the Blaze software with zoom, on the right is the image without any zoom as saved in PNG.

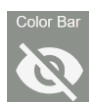
Color Map



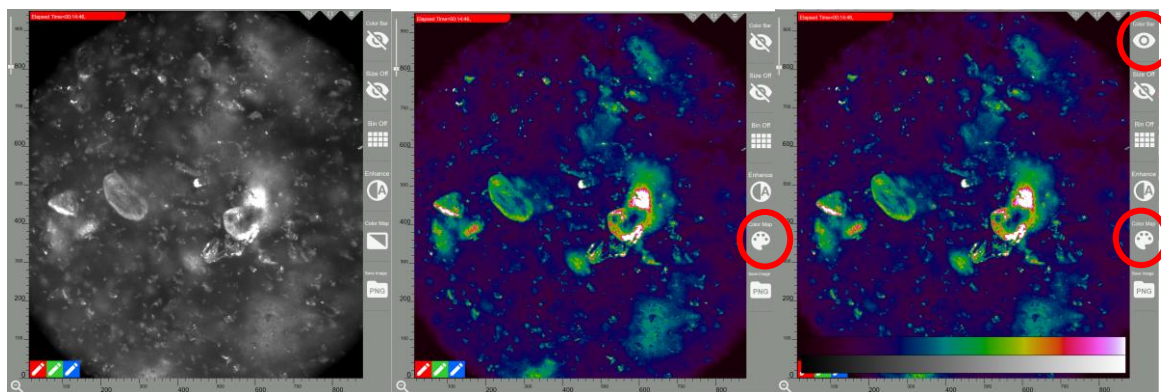
This button displays the image as either black and white or color. The button appears as  when displaying black and white (the default display). Click the button to display the image as color, the button also changes to color mode . Click again and it will change back to black and white .

Color mode comes closer to displaying the entire dynamic range of the image than black and white. In color mode the different colors correspond to different backscatter intensity, but it is not a single continuous gradient like black and white. For this reason, it is useful to display the color bar to provide an intensity scale when displaying in color.

Color Bar



This button displays the color bar on the image to provide an intensity scale. The button appears as  when not displaying the color bar (the default). Click on the button to display the color bar, the button will change to . The far-left color on the bar corresponds to the lowest intensity, the far-right color on the bar corresponds to the highest intensity. Note the color scale is not a single linear gradient in intensity like for black and white.



Above left: black and white image display

Above center: color image display

Above right: color image display with color bar

Enhancement



This button applies the image enhancement settings selected under Image Tools. The button appears as  when enhancement is on (the default). Click on the button to turn off enhancement and the button

will change to . Click it again and it will turn enhancement back on . See the image tools section of this manual for a detailed explanation of what enhancement is and how it works.

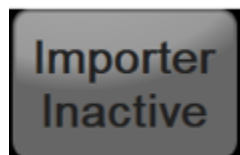
Sizing



This button is for use with the advanced image analysis package and has no effect when using the standard basic software.

Importer for Reading in OPC Data

To import OPC data available from Systag or MT or other automated lab reactors and PAT tools, please contact Blaze. If the Importer button on the toolbar is inactive, then no OPC data is being read in.



21 CFR Part 11

A special version of the Blaze software, ready for implementation into a 21 CFR Part 11 environment, is available. Please contact Blaze Metrics for further information.

Files generated by the 21 CFR Part 11 version recalled in the standard Blaze UI will be marked by '21 CFR Part 11' text atop the recall button:



These files cannot be corrupted by the standard Blaze software nor are all the 21 CFR Part 11 related features visible or accessible (specifically the audit trail). The 21 CFR Part 11 version must be used to for full compliance when reviewing these files.

Chapter 9 Operational Tips

This chapter describes typical best practices for operations.

Data Transfer and Backup

The Blaze can generate a large amount of data very quickly when so configured. Be sure there is enough hard disk space before starting an experiment, refer to the 'recommended measurement and image saving settings' section for approximate data set sizes. When transferring files do not separate the contents of the experiment folder, the files inside the folder are not named by experiment. Data transfer rates are entirely dependent upon network or external drive speeds. Using the correct external drive and port allows typical files to be transferred in about 1 minute, using the wrong (slow) drive and port can take up to 10 minutes.

External Drive Type

A high-speed SSD USB type C external drive, of speeds 550MB/s or higher, is recommended when using an external drive. These types of solid-state drives transfer data significantly faster than hard drives or drives using USB 3 connectors. New models are being introduced and prices are reasonable for sizes up to 2 TB, for example, the SanDisk Extreme Portable External SSD - USB-C, USB 3.1 is less than \$100 for the 500GB model.

Be sure the computers used have a USB C port as shown below.



Use of Mobile Cart



Caution Use a cart with soft inflatable tires, especially if moving the unit over rough, tile, or stone walkways. Vibrations caused by transporting over rough surfaces can cause internal components to loosen over time and affect operation. The lab model enclosure is not designed to withstand vibration beyond what would normally be expected on a laboratory bench.

Most users put the Blaze on a compact mobile cart with two shelves. Use a single power strip for all Blaze and Raman components to simplify power reconnection whenever the cart is moved. The monitor, keyboard, and mouse can go on the top shelf. If there is room put the main enclosure on the top shelf. If the probe can easily reach the reactor the main enclosure can be put on the bottom shelf.

Some carts have a place to loop the conduit and then a place to put the probe in a holster when moving the system. Others simply wrap the conduit around the top and then place the probe between the keyboard and monitor. Be sure to have a bend radius of 10" or more. The Raman components (if purchased) always go on the bottom shelf. Always bundle and contain wires and fiber optics to avoid accidents.

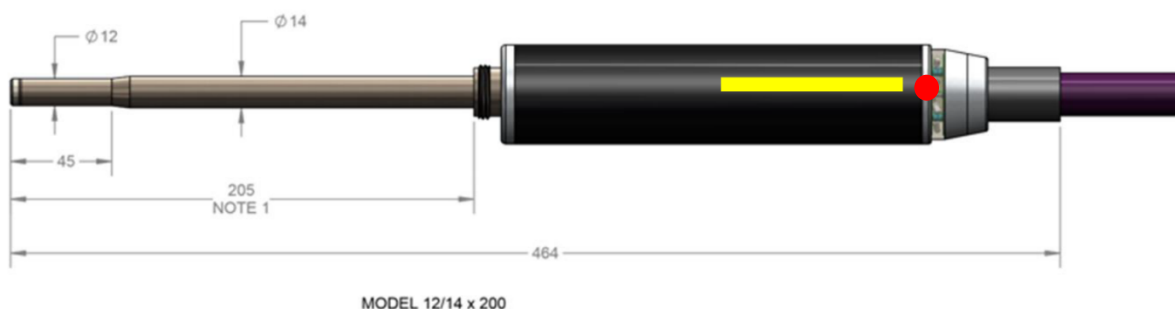
It is not recommended to lay the system on its side at this point. No long-term testing has been done in this orientation and it is possible some components are not suited for long term operation in this orientation.

The purge regulator (used when running near or below 10 degree C) can be mounted on the cart in a vertical position or on the side of the Blaze enclosure. A hose supplying dry oil free gas can be connected once the probe cart is in the desired location.

Probe Angle and Orientation in Reactor

In addition to the probe positioning relative to particle flow, the Blaze illumination should be directed downstream and toward the wall if possible. If the probe is pointed inwards instead of towards the wall, the Blaze laser light may occasionally bounce off the impeller giving a light background to some images, especially when at lower solids concentration.

The probe has a red dot which marks the top of the image. Use this dot to orient the probe and avoid reflection of the laser from the impeller. The red dot should be on the UPSTREAM side of the probe about 30 degrees toward the impeller shaft, hence directing the illumination toward the wall and away from the impeller blades. See probe installation section in Chapter 7 for a detailed illustration.



Probe in Solution Before Recording Data

The probe should be in the solution and running for a minute before recording data. This allows the auto laser to adjust fully to the background and capture the best possible images. To avoid saving data from the adjustment period press the record button after it has adjusted and select "discard prior + start recording".

Measuring in Small Vials

The 12/14 mm OD probe will easily fit in small vials including 10 and 20 ml scintillation vials. Use of plastic vials is not recommended because they often show elevated background light levels (they are not intended for optical use). Brown glass vials are the best choice. Clear glass or sapphire vials work as well but light scattering off their sides or from external objects may also create an elevated background light level. Sometimes clear glass may contain impurities which has background fluorescence or Raman signal. Run a blank sample to confirm there is no background signal if in doubt.

Magnetic stir bars should be avoided unless there is no other choice as is sometimes the case with small vials. In such cases a four-point magnetic stir bar (as shown below) is recommended due to its superior solid suspension properties.



Measuring in Flow Cells and Pipelines

For applications using a flow loop with a mill or other mechanism which result in entrained gas in the line, the probe should be oriented with the window facing upwards anywhere from 30 to 90 degrees relative to the horizontal plane. This minimizes the possibility of bubbles sticking to the probe window and their convoluting effect on the measurement. The Blaze system automatically maintains the image plane position despite any change in probe orientation, older non-Blaze tools will need to be used at the same orientation at which they are calibrated in order for the calibration to be valid.

Raman Spectra

Raman is a sensitive technique and as such can detect outside factors which could be mistaken for or obscure the signal of interest. Commonly encountered factors include sun light, room light, and certain optical components.

Sun light primarily elevates the background signal and will vary in intensity during the day and with exposure angle. Do not assume it is constant. The best way to prevent sunlight from interfering with the measurement is to shield the reaction vessel from the sun with aluminum foil or similar.

Room lights are typically fluorescent bulbs which have distinct emission spectra which will appear as distinct peaks in the Raman spectra, in addition to an elevated background. The best way to prevent interference is to shield the reaction vessel from the room light with aluminum foil or similar. If room light interference is suspected during the measurement, take spectra with and without the room lights on to assess the impact.

Blaze probes are made with diamond or sapphire windows depending upon the option chosen (sapphire is the default). Both diamond and sapphire are crystalline materials and exhibit Raman scattering. The optical design minimizes the amount of light collected from Raman scattering in the window, still some

is measured. Sapphire has peaks at 413, 375, and 641 cm^{-1} (in order of decreasing intensity). Diamond has a peak at 1332 cm^{-1} . In cases where Blaze 532 nm imaging is running, and backscattering from particles is very strong, there may be a small peak at 417 cm^{-1} of the 785 nm Raman spectrum. This peak is from the pump laser used to generate the 532 nm light used for imaging.

Room Light and Sunlight Effect on Blaze and Raman

The Blaze Microscopy operates at 532nm, very few other wavelengths will ever affect the Blaze sensor because of the optical filters used. It is possible in cases of strong sunlight; however, very unlikely unless the laboratory has a high amount of natural light. Weaker relatively constant sources of light, such as fluorescent lights, do not affect the Blaze sensor.

Raman operating at either 532 or 785nm allow wavelengths longer than 532 or 785 nm to reach the Raman spectrometer. These wavelengths contain the Raman signal. Unfortunately, both room lights as well as natural sunlight have these same wavelengths. It is therefore recommended to shield the vessel from outside light by wrapping in aluminum foil or Cinefoil (a type of blackened aluminum foil used in photography). If this is not practical, shutting off the fluorescent lights when acquiring Raman spectra can be sufficient depending upon the amount and variability of natural light in the laboratory. Comparison of Raman spectra with and without room lighting can be used to identify spectroscopic peaks from the room lighting.

FBRM and PVM Effect on Raman

Blaze has performed measurements when FBRM and PVM were installed in the same vessel as a Raman probe. The 785 nm Raman was impacted by both FBRM and PVM signals up to 650 and 1200 cm^{-1} respectively. This occurred even with significant solids present and the FBRM and PVM probes on the other side of the reactor. Anyone performing comparison studies must take this into account.

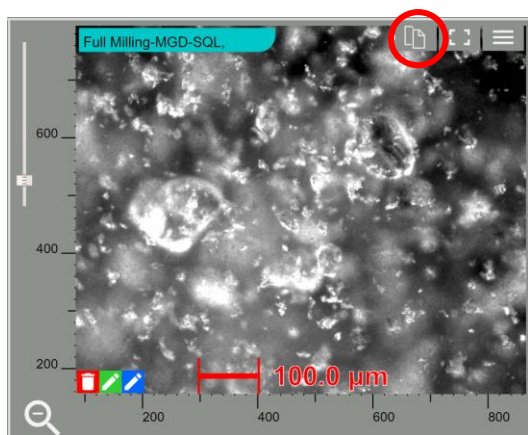
Chapter 10 Data Analysis and Reporting

This chapter describes approaches to data analysis and how to generate reports.

Exporting Displays to Reports

Any data or image as displayed in the Blaze software can be transferred into a separate document (i.e., Office 365, including Word, PowerPoint, OneNote and Excel) to generate a report. Display the data or image in the desired form (e.g., averaging, weighting, image enhancement, window size) and then press the clipboard icon  for the given display (clipboard button is upper left for the stats table and upper right for all other displays), the icon will flash red briefly.

Below: software display with clipboard icon circled



Go to the report document and paste (ctrl+v) to insert the selected display into Office 2016 or Office 365 programs (Word, PowerPoint, Excel, OneNote) or LibreOffice (free opensource software). Certain older programs will not allow pasting of this graphics format including Notepad, Notepad++, Office 2013 and earlier versions as well as OpenOffice and Paint. If using older programs use the method below.

The clipboard screenshots are also saved as PNG files on the computer. A folder called “PNG with scale capture” is created inside the experiment folder, all PNG files are saved in it. These files can be inserted or copied and pasted into any program accepting PNG files (including older versions of Office).

-  2021-05-18_14_26_05-Dist-a.png
-  2021-05-18_14_26_05-Events-a.png
-  2021-05-18_14_26_05-EventTrends-a.png
-  2021-05-18_14_26_05-ExpInfo-a.png
-  2021-05-18_14_26_05-Slices-a.png
-  2021-05-18_14_26_05-Stats-a.png
-  2021-05-18_14_26_05-Trends-a.png
-  2021-05-18_14_26_05-Trends-b.png
-  2021-05-18_14_26_06_966-Image-a.png
-  2021-05-18_14_26_30_503-Image-a.png
-  2021-05-18_14_26_34_201-Image-a.png
-  2021-05-18_14_51_05_207-Image-a.png

The name of the PNG file starts with a timestamp. For image display components, the time that the image was captured is used. For non-image display components, the experiment start time is used. The time is formatted as YYYY-MM-DD_HH_MM_SS_MSEC. For example, “2019-05-20_06_40_15_661” is year 2019, month 5 (May), date 20th, hour 6 (24 hour clock), minutes 40, seconds 15, and milliseconds 661. The milliseconds value is excluded from non-image capture files. A short description of the display component follows the time, and a letter suffix is added to make multiple captures of the same display component unique. For example, “2019-05-20_06_40_15-Trends-a.png”.

Note the pasted content and PNG file will contain the legend and menu if shown in the Blaze software (as well as image times and trend pins). Controls for the zoom, measure tools, and window enlargement are not part of the pasted content. Otherwise, the content will be as displayed on the screen, including the aspect ratio. Note: minimized images are not square displays whereas maximized images are.

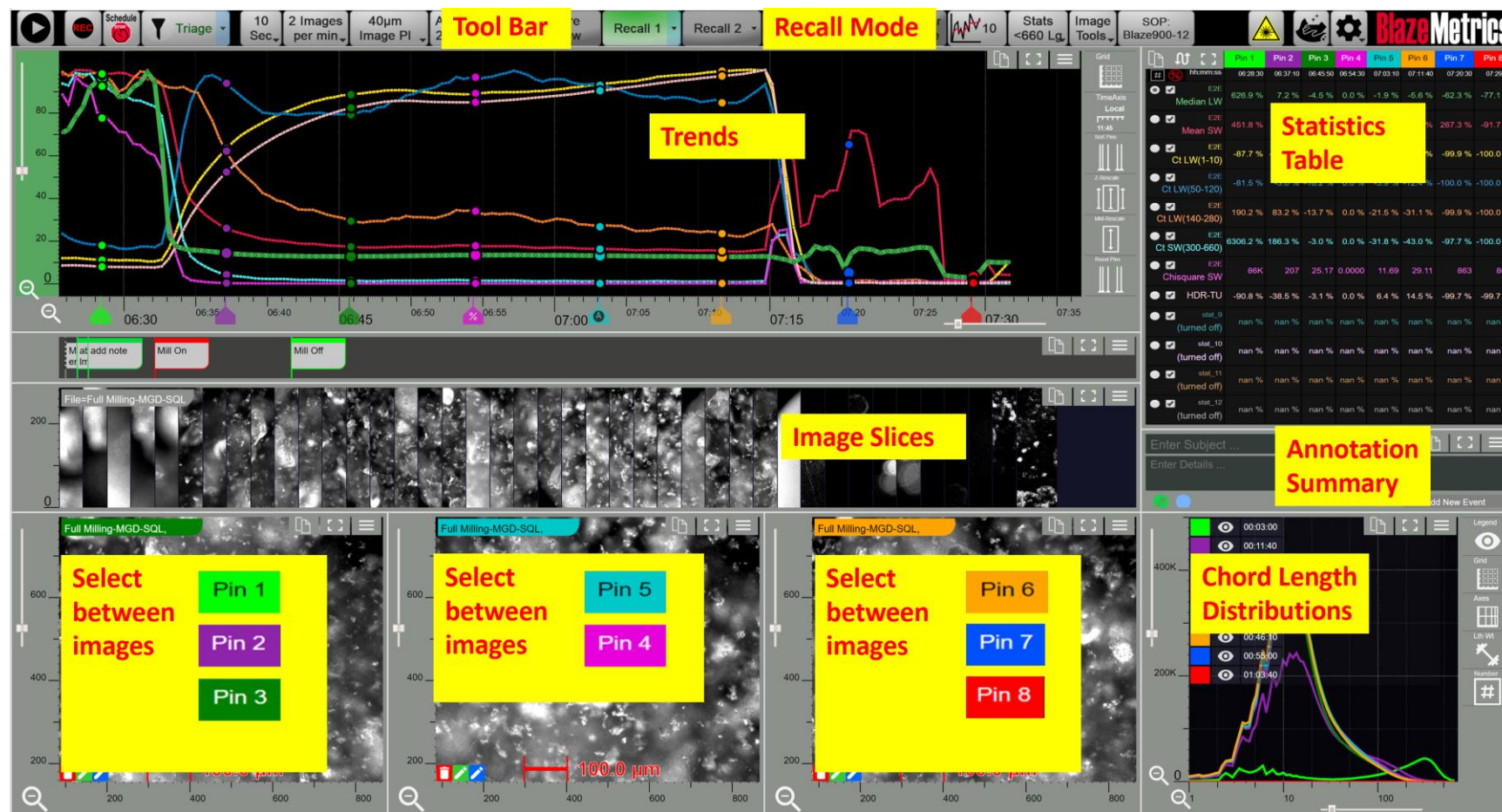
Alternative Method for Pasting into Reports

To capture a larger portion of the display (e.g., trends and stats table together) use the key combination ‘windows key ()+shift+s’. A plus sign will appear, click in one corner of the desired display and drag to the diagonally opposite corner (i.e., from upper left to lower right corner of display) and release the mouse button. Go to the report document and paste (ctrl+v) to insert the selected display. With this method everything seen on the screen will be copied including the zoom and measurement tools.

This method uses a different graphics format which is compatible with older versions of Office and other programs.

Recall 1

Recalling file 1 automatically brings up a display similar to what is shown below. This mode allows selection of 8 images, distributions, and statistical values corresponding to 8 different times during the experiment.



Pins

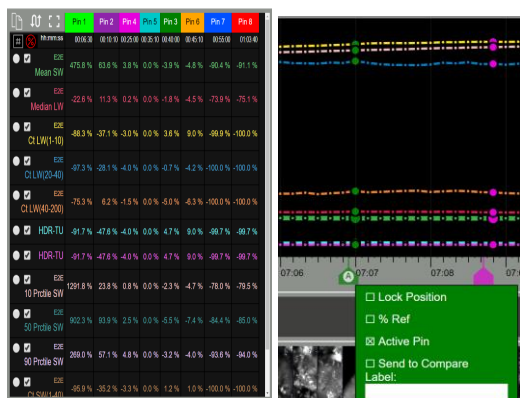
By default, eight evenly spaced time points are initially selected as pins in a recalled experiment. These 'pins' can be moved to key points in the experiment by dragging the triangle below the trend time axis. Note: The color of the pinned dots and full chord length distribution share the same color for easily identifying that specific time point. Additionally, the statistics table shows the specific data for each of these pins.

Pin and Dot Position

The pin marker is to the left of the dot, if multiple images were saved during the measurement the pin marker can be moved to select amongst those images without changing the position of the dot. If the pin marker is moved far enough, the dot will switch to the next measurement period.

Selecting An Individual Image

The active pin always defaults to pin 2. Right click on any pin and check the active box. The new active pin is marked with an "A". There can be only one active pin. A pin cannot be both the active and reference pin at the same time.



Now use the left or right arrow keys ($\leftarrow$, $\rightarrow$) on the keyboard to select an earlier or later image. One press of the arrow key moves one image. This allows selection of any individual saved image from the entire experiment. Note there may be multiple images saved during a measurement period. Images are saved independent of the measurements.

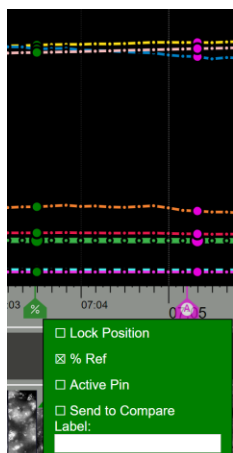
Scrolling Through All Selected Images

To “animate” the experiment using the selected images:

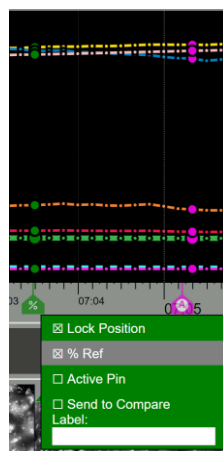
Make the earliest (furthest left) pin 1 the active pin. Press the down key $\downarrow$ on the keyboard, the far-left image will show the image for pin 2. Press again to show the image for pin 3 and so on. To go backwards use the up key $\uparrow$. Note: if this is done using a later pin (e.g., pin 4) as the starting point, the down key $\downarrow$ will cycle through pin 5,6,7,8,1,2,3 and then stop. Use the up key $\uparrow$ to return to pin 4.

Pins for Reference Distribution and Sample Compare

The reference pin always defaults to pin 1 and is unlocked. Right click on any pin and check the '% Ref' box. The new reference pin is marked with an "%". There can be only one reference pin per experiment, a pin cannot be both the active and reference pin at the same time. The live experiment, Recall 1, and Recall 2 each use their own reference pin for calculating the % values in the stats table. Lock the reference pin to avoid accidentally moving it during analysis.

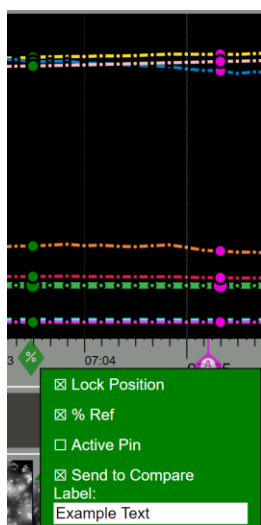


Check 'Lock Position' to fix % pin



Pins for Sample Compare

To compare data from different experiments (Live, Recall 1, Recall 2) move pin(s) to the desired time point(s) in that experiment. Right click on the pin, type in a unique name in the 'Label' field, and check 'Send to Compare'. When done up to twelve 'Send to Compare' pins can be viewed in Sample Compare, see Sample Compare section for further details. Compare pins have a diamond shape.



Quick Select of Pins from the Visual Trend

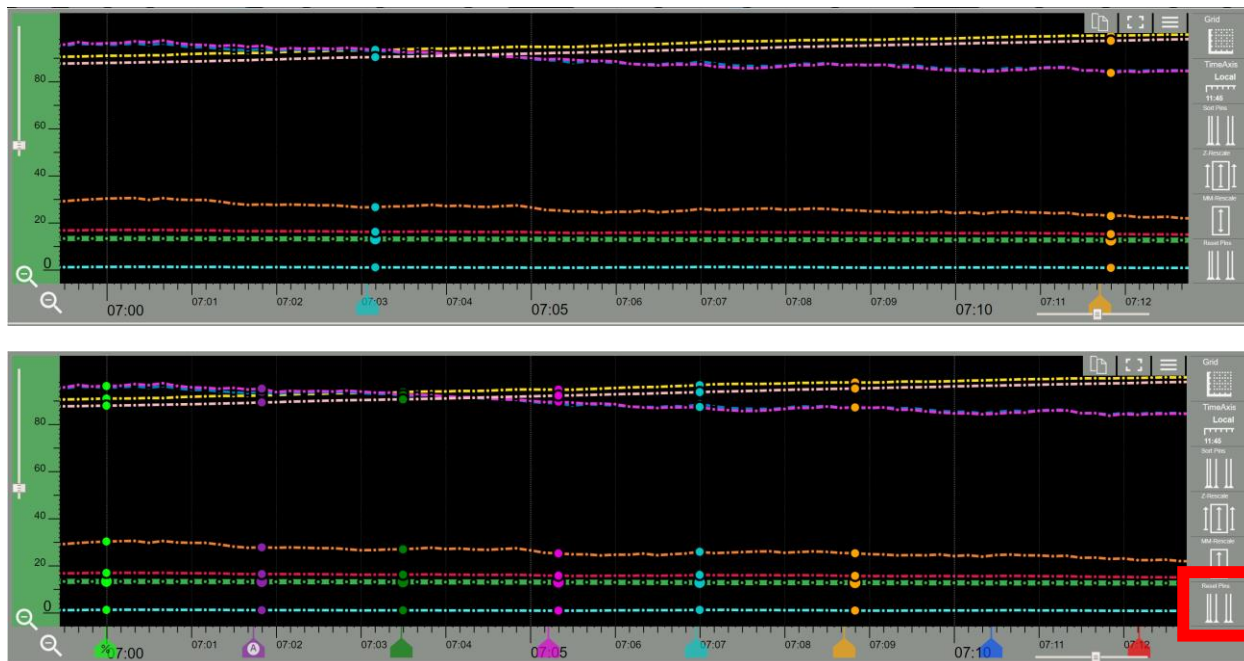
To quickly select up to two images from the visual trend:

Left click with the mouse in the visual trend to assign pin 3 (dark green) to the selected image slice.

Right click with the mouse in the visual trend to assign pin 7 (dark blue) to the selected image slice.

Automatic Pin Placement

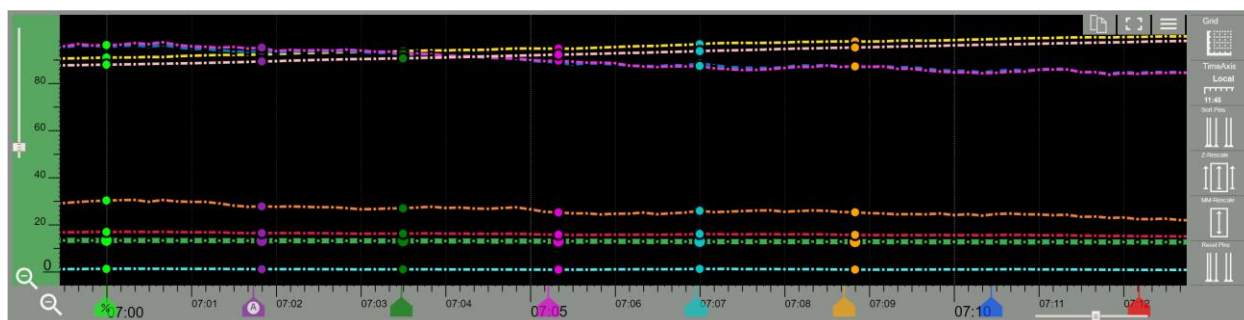
Pins can also be automatically spaced evenly across the displayed time range by clicking on the 'reset pins' button on the right side of the trend window.



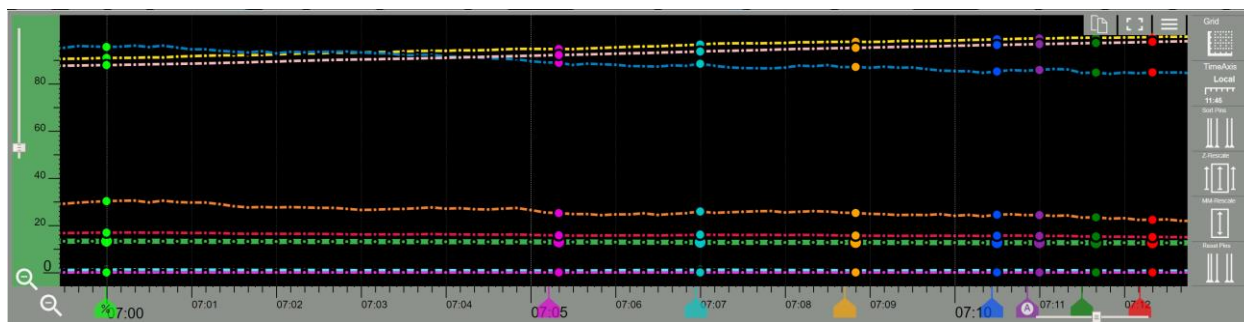
Automatic Sorting of Pins

Pins 1 thru 8 have a fixed sequence of colors which makes data presentation more consistent and easier to interpret. If the pins are moved out of order the pin number and color order can be set to the original sequence without manually moving pins, click on the 'sort pins' button on the right side of the trend window. Note: locked pins will not be sorted.

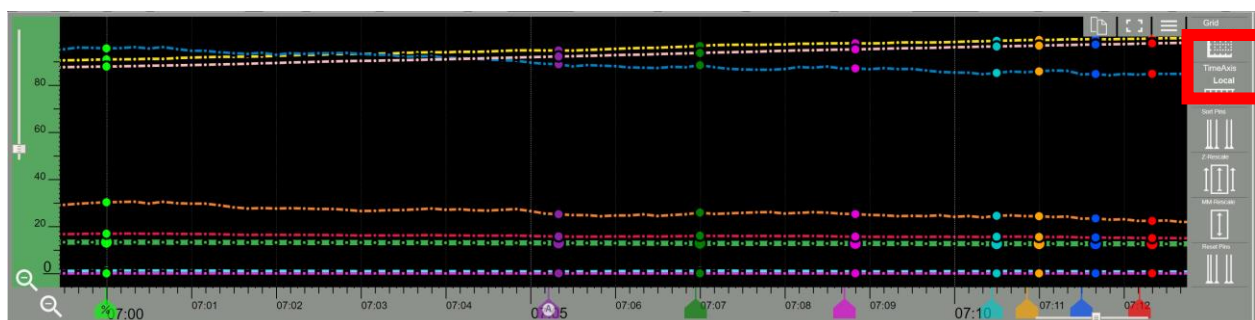
Pins in sequence 1 to 8



Pins 2 and 3 shifted to pins 7 and 8, note the change in color and number sequence

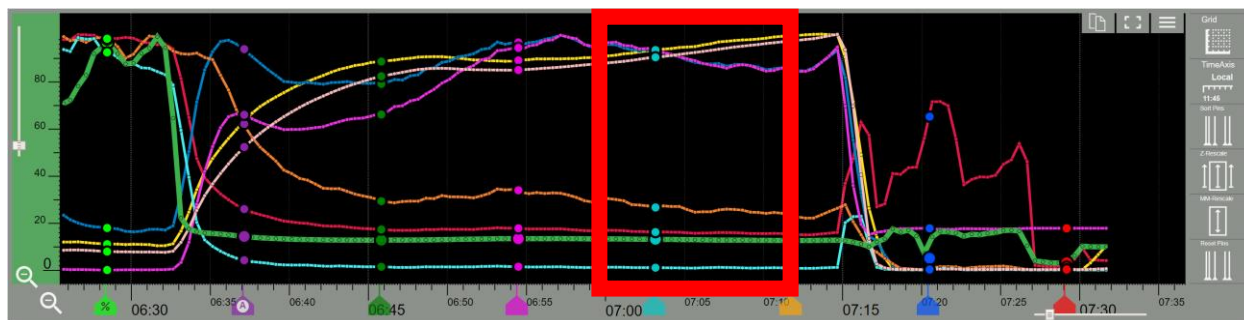


Pin sequence restored without moving the pins. Note the active status was carried to the new pin 2

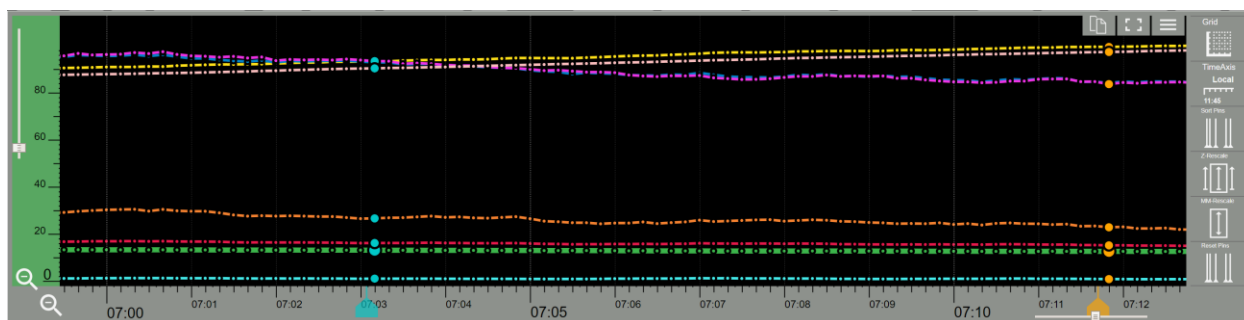


Y Scale of Trends

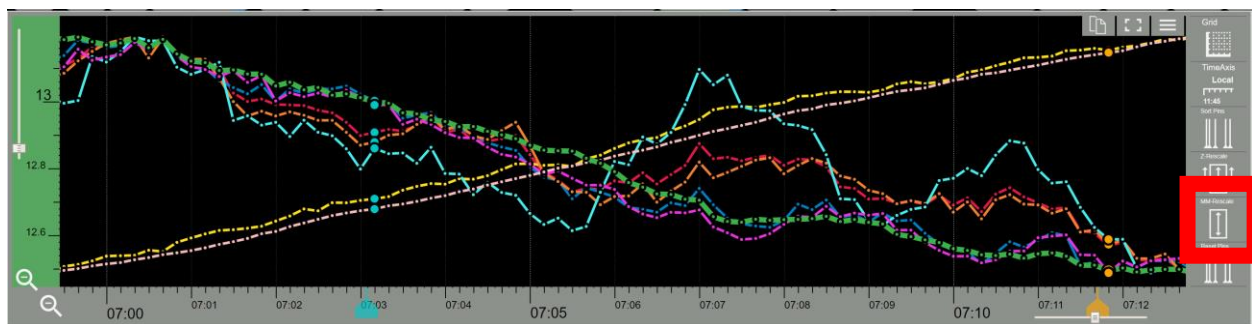
The Y axis of the trend is normalized for all trends except for the one which has Y axis scale selected in the stats table (round radio button). By default, a recalled file is shown full scale in time and in Y. After zooming in on the time axis click on MM-Rescale to auto scale the Y axis for the new time window



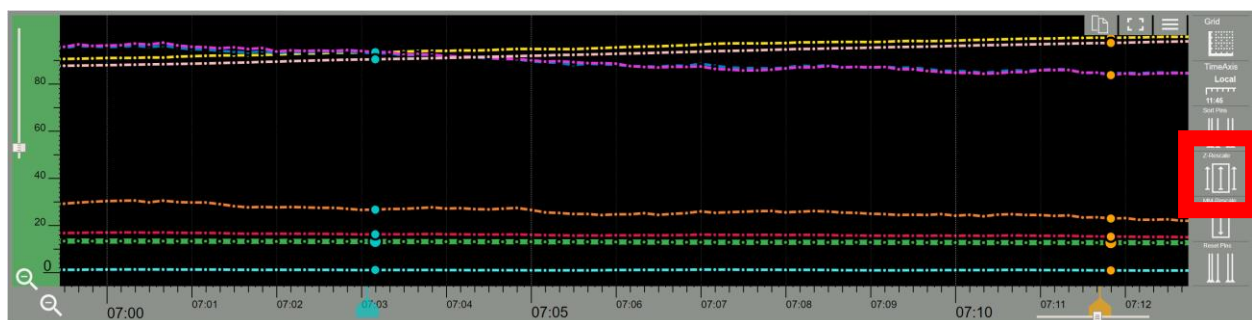
Zoom into the above area, it is hard to see the change in the trend



MM Rescale button scales Y axis for the minimum/maximum within the zoomed time frame



Z Rescale buttons scales Y axis for the global (i.e., whole experiment) minimum/maximum

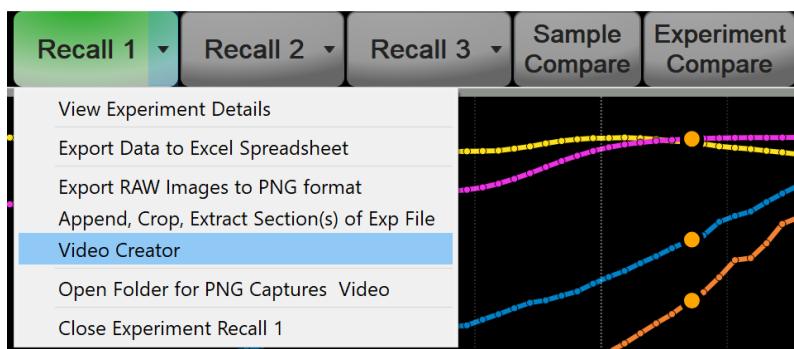


Recall 2

Recall file 2 and select Recall 2. This functions exactly as Recall 1 but on a second file.

Video Creator

This can be used to create a video from a recalled file. Recall the file and then select 'Video Creator' from the Recall 1 or 2 menu.



The video parameter control window appears

Number of Experiment Images Saved Per Min to Include: All images

Playback Speed: 2 Images per Second

Extract Start Pin 13-Aug-2019 07:35:30, elapsed: 0:00:00 <<< Start of experiment

Extract End Pin 13-Aug-2019 23:42:51, elapsed: 16:07:20 <<< End of experiment

OK Cancel

Select the number of images to be included in the video. The more images that are saved, the longer the video.

Number of Experiment Images Saved Per Min to Include: All images

Playback Speed:

Extract Start Pin 13-Aug-2019 07:35:30, elapsed: 0:00:00

Extract End Pin 13-Aug-2019 23:42:51, elapsed: 16:07:20

Every other image, 50%

Every 3rd image, 33%

Every 4th image, 25%

Every 5th image, 20%

Every 6th image, 16.7%

Every 7th image, 14.3%

Every 8th image, 12.5%

OK Cancel

Select the playback speed. The faster the speed, the less time any individual image is shown. The slower the speed, the longer it takes to view the whole video.

Number of Experiment Images Saved Per Min to Include: All images

Playback Speed:

Extract Start Pin 13-Aug-2019 07:35:30, elapsed: 0:00:00

Extract End Pin 13-Aug-2019 23:42:51, elapsed: 16:07:20

2 Images per Second

10 Images per Second

5 Images per Second

2 Images per Second

1 Image per Second

1 Image every 2 Seconds

OK Cancel

Pick the start and end point of the video. To select the whole experiment, use the start and end of experiment. Pin points can also be used as the start and end of the video.

Number of Experiment Images Saved Per Min to Include: All images

Playback Speed: 2 Images per Second

Extract Start Pin 13-Aug-2019 07:35:30, elapsed: 0:00:00 <<< Start of experiment

Extract End Pin 13-Aug-2019 07:35:30, elapsed: 0:00:00 <<< Start of experiment

- 13-Aug-2019 07:41:10, elapsed: 0:05:40
- 13-Aug-2019 08:09:10, elapsed: 0:33:40
- 13-Aug-2019 09:39:10, elapsed: 2:03:40
- 13-Aug-2019 14:29:40, elapsed: 6:54:10
- 13-Aug-2019 17:28:40, elapsed: 9:53:10
- 13-Aug-2019 20:18:40, elapsed: 12:43:10
- 13-Aug-2019 21:37:10, elapsed: 14:01:40
- 13-Aug-2019 23:37:10, elapsed: 16:01:40
- 13-Aug-2019 23:42:51, elapsed: 16:07:20 <<< End of experiment

Number of Experiment Images Saved Per Min to Include: All images

Playback Speed: 2 Images per Second

Extract Start Pin 13-Aug-2019 07:35:30, elapsed: 0:00:00 <<< Start of experiment

Extract End Pin 13-Aug-2019 23:42:51, elapsed: 16:07:20 <<< End of experiment

- 13-Aug-2019 07:35:30, elapsed: 0:00:00 <<< Start of experiment
- 13-Aug-2019 07:41:10, elapsed: 0:05:40
- 13-Aug-2019 08:09:10, elapsed: 0:33:40
- 13-Aug-2019 09:39:10, elapsed: 2:03:40
- 13-Aug-2019 14:29:40, elapsed: 6:54:10
- 13-Aug-2019 17:28:40, elapsed: 9:53:10
- 13-Aug-2019 20:18:40, elapsed: 12:43:10
- 13-Aug-2019 21:37:10, elapsed: 14:01:40
- 13-Aug-2019 23:37:10, elapsed: 16:01:40
- 13-Aug-2019 23:42:51, elapsed: 16:07:20 <<< End of experiment

Click ok , name the video, and click 'set name'

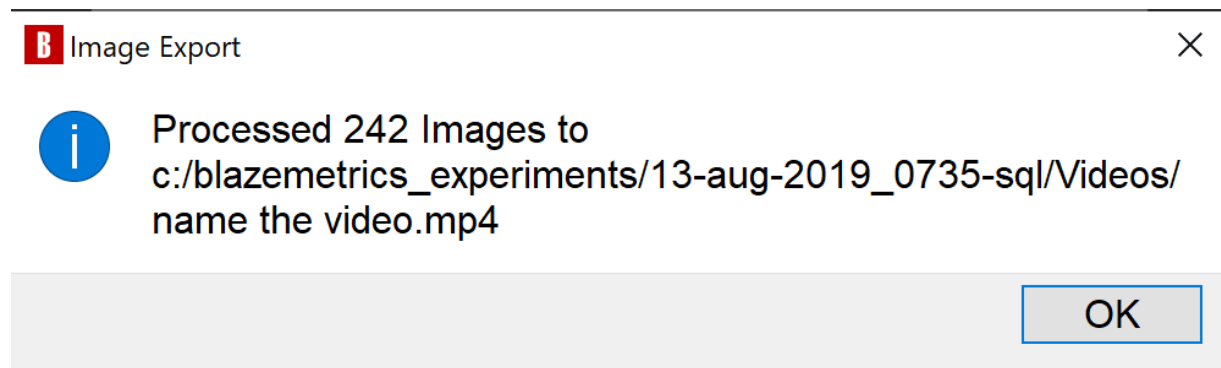
B Set Video File Name ? X

Video File will be written to:
c:/blazemetrics_experiments/13-aug-2019_0735-sql/Videos

name the video

Set Name Cancel VideoFile

A video subdirectory will be created under the experiment directory and the mp4 video file will be saved in it. This process can be repeated to create multiple unique videos from the same experiment. MP4 files can be read by most common video playing software.



Sample Compare

This view compares images, distributions, and statistics from user selected time points in Acquire Window (Live), Recall 1, and Recall 2. To make data appear in Sample Compare first select 'Send to Compare' for the desired pins in the trend. See Trend Window for further details. Then click on the 'Sample Compare' icon.



Note: the colors used under Sample Compare are different from original colors from the original pins. Assign a unique label to each pin to distinguish them more easily, e.g., R1P2 for Recall 1, Pin 2.

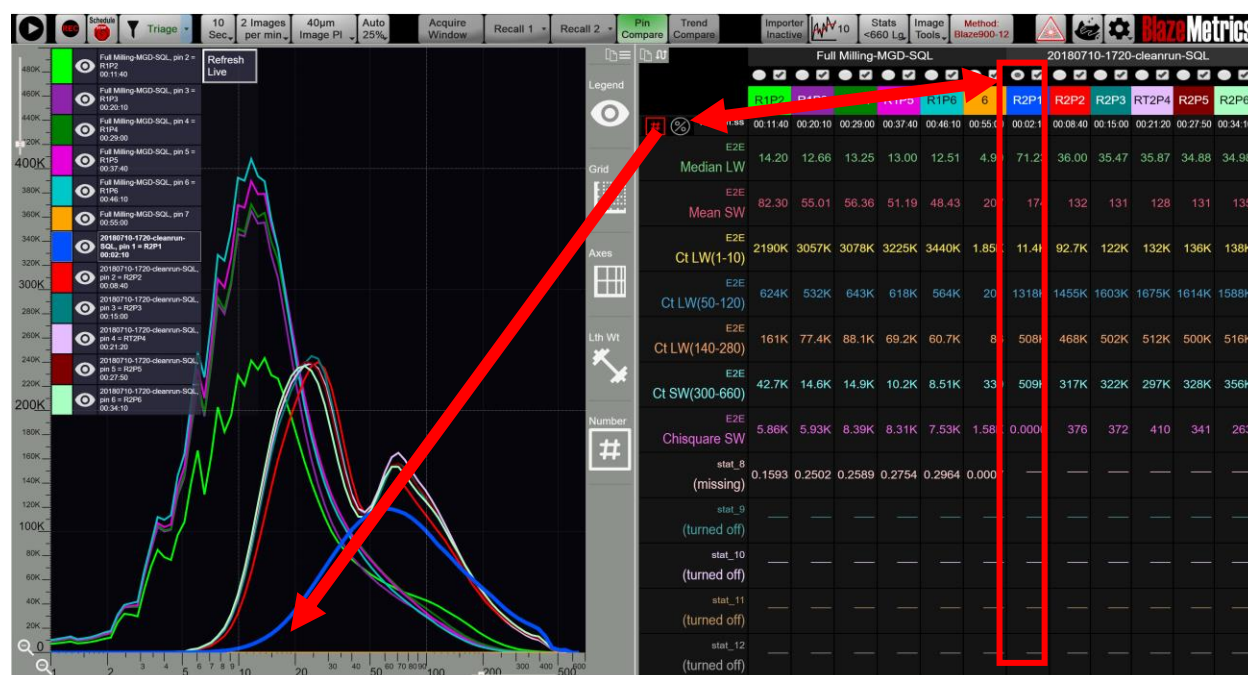
Note: Up to 12 pins can be compared, if more than 12 pins are selected for comparison the priority order is Acquire Window (live experiment), Recall 1, then Recall 2. This table shows some examples:

	Number of Selected Pins			Number of Shown Pins		
	Acquire	Recall 1	Recall 2	Acquire	Recall 1	Recall 2
Example 1	8	4	3	8	4	0
Example 2	3	4	8	3	4	5
Example 3	8	8	8	8	4	0

Note: for the live pin to be displayed data recording must be on.

Distributions are always displayed on the left. Control of the distributions is the same as elsewhere in the software. Times are always relative to the start of that experiment not between experiments.

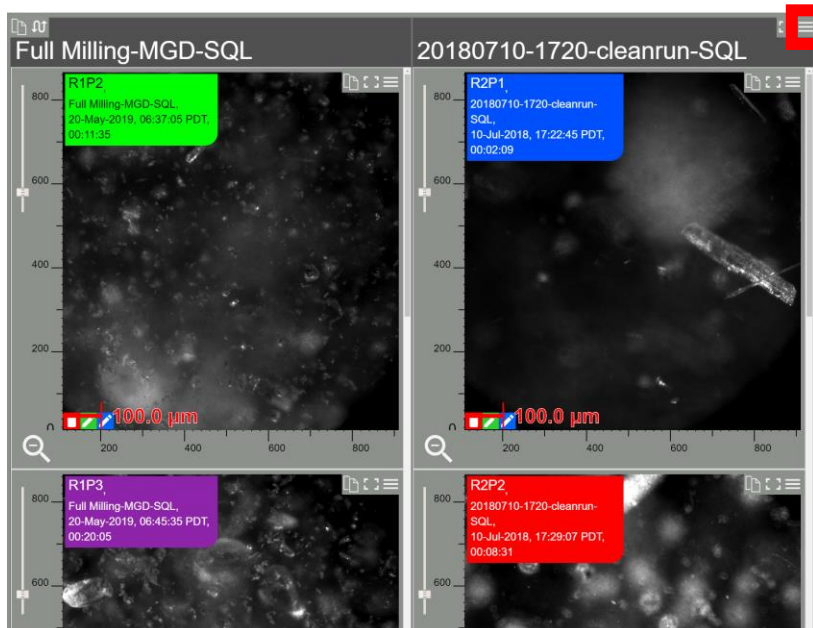
The display on the right starts with displaying the statistics table. Hover over the color to read the full label of the pin. Select the round radio button of a specific pin to make it the reference. The reference distribution is drawn in bold. Otherwise control of the statistics is the same as elsewhere in the software.



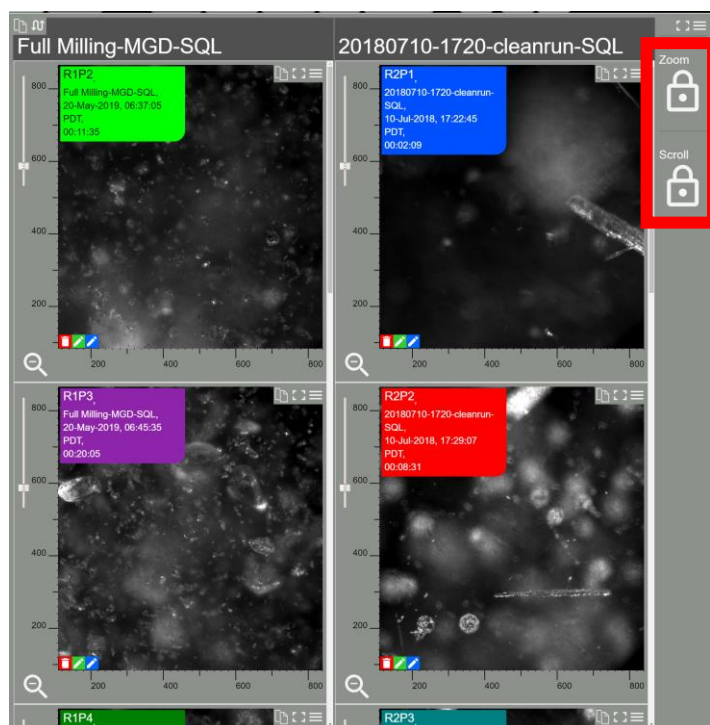
To view the corresponding images, click on the sideways S double arrow icon .

Pin Image		Trend Compare	Importer Inactive	Stats 10	Image Tools	Method: Blaze900-12	BlazeMetrics								
		Full Milling-MGD-SQL							20180710-1720-cleanrun-SQL						
		R1P2	R1P3	R1P4	R1P5	R1P6	6	R2P1	R2P2	R2P3	RT2P4	R2P5	R2P6		
#	%	hh:mm:ss	00:11:40	00:20:10	00:29:00	00:37:40	00:46:10	00:55:00	00:02:10	00:08:40	00:15:00	00:21:20	00:27:50	00:34:10	
E2E															
Median LW			14.20	12.66	13.25	13.00	12.51	4.99	71.23	36.00	35.47	35.87	34.88	34.98	
E2E															
Mean SW			82.30	55.01	56.36	51.19	48.43	207	174	132	131	128	131	135	
E2E															
Ct LW(1-10)			2190K	3057K	3078K	3225K	3440K	1.85K	11.4K	92.7K	122K	132K	136K	138K	
E2E															
Ct LW(50-120)			624K	532K	643K	618K	564K	201	1318K	1455K	1603K	1675K	1614K	1588K	
E2E															
Ct LW(140-280)			161K	77.4K	88.1K	69.2K	60.7K	86	508K	468K	502K	512K	500K	516K	
E2E															
Ct SW(300-660)			42.7K	14.6K	14.9K	10.2K	8.51K	339	509K	317K	322K	297K	328K	356K	
E2E															
Chisquare SW			5.86K	5.93K	8.39K	8.31K	7.53K	1.58K	0.0000	376	372	410	341	263	
stat_8															
(missing)			0.1593	0.2502	0.2589	0.2754	0.2964	0.0007	—	—	—	—	—	—	
stat_9															
(turned off)			—	—	—	—	—	—	—	—	—	—	—	—	
stat_10															
(turned off)			—	—	—	—	—	—	—	—	—	—	—	—	

The images from the acquire window are shown on the left, Recall 1 in the middle, Recall 2 on the right. The earliest images are on the top, the newest images on the bottom. By default, scrolling moves the images from all experiments together. Likewise zooming is applied to all images together. To enable independent scrolling and zooming click on the main right window menu control.



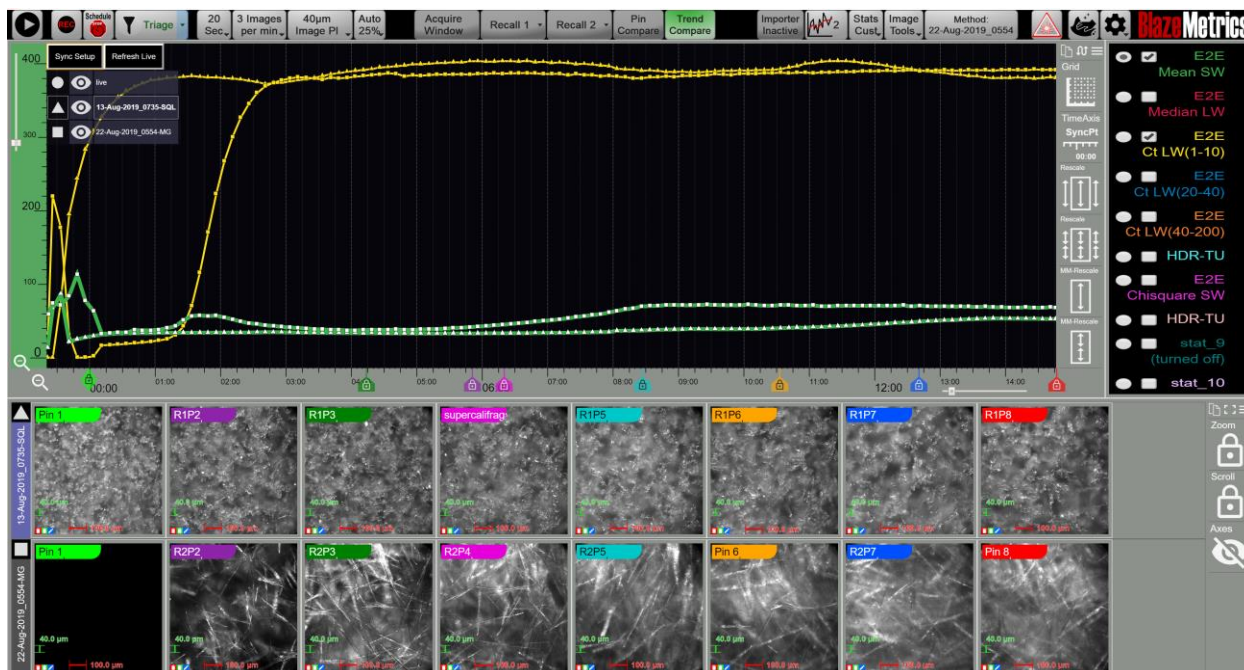
Unlock Zoom or Scroll to allow independent zooming or scrolling of the images.



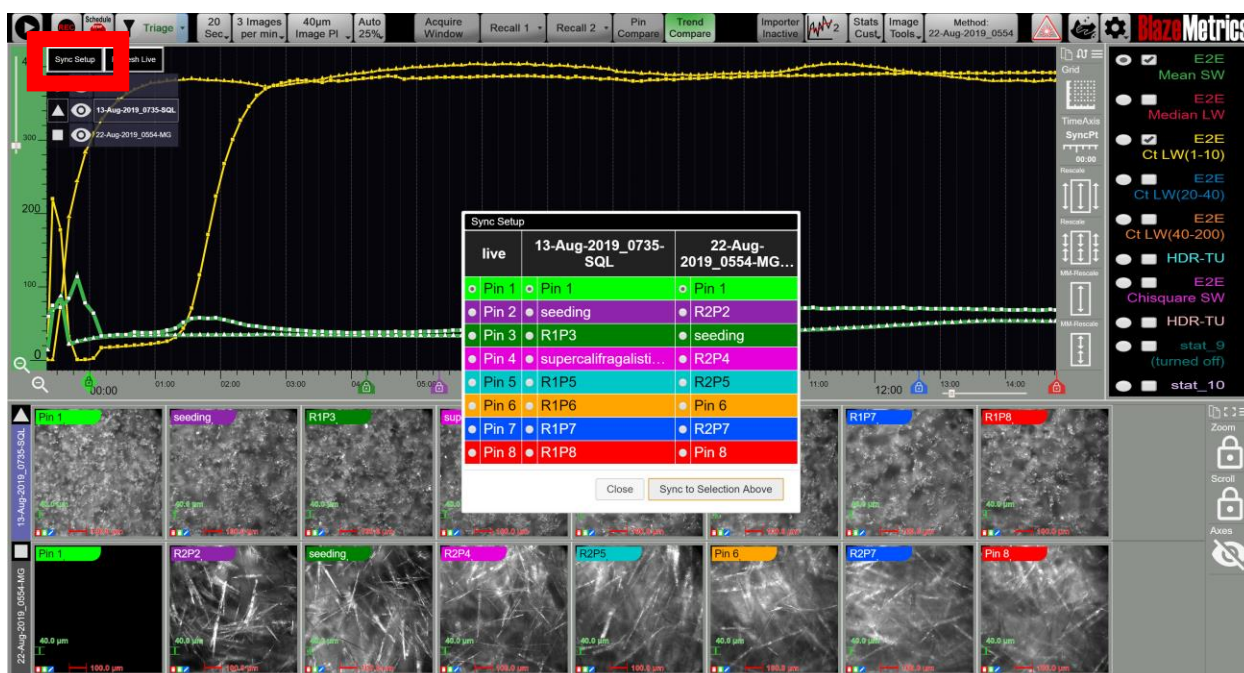
To view the corresponding experimental info, click the  icon again. Experimental info will only be displayed for data acquired with Blaze UI 148.02 or higher. An additional click on the  icon returns the right window to the statistics table.

Trend Compare

This view compares trends and images between Acquire Window (Live), Recall 1, and Recall 2. The trends can be aligned to any pin, images are based on the pins. To use Trend Compare load the desired file(s), move the pins to the desired time points, and click the 'Trend Compare' icon.

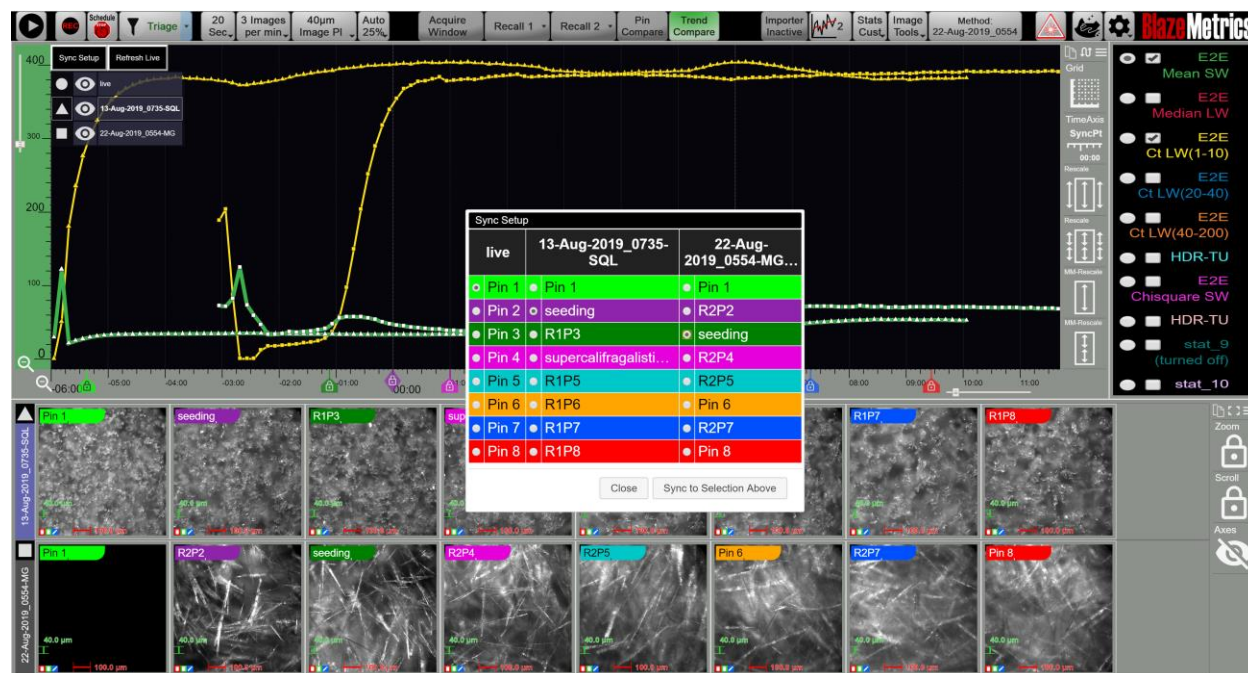


To align the trends click on 'Sync Setup' in the upper left of the trend display



Now select a pin for each trend as the synch point. For example, to synch (align) the seeding time between all trends pick the pin which corresponds to the seed point for each file. Now click "Synch to

Selection Above". The trends will automatically shift so that the select pins are all at the same relative time. When done click "Close".

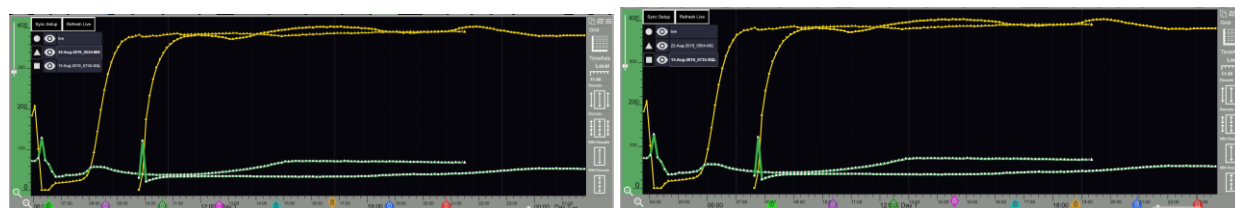


The synch point will always be the selected pin of the first available experiment (i.e. Live or Recall 1).

Trends of the same statistic are shown using the same color, markers are used to differentiate between the different experiments. A round marker is for the live (acquire window) data, a triangle marker is for recall 1 data, a square marker is for recall 2 data.

The trend display controls are analogous to elsewhere in the software. Trends can be displayed or hidden by checking or unchecking the square box to the right of the trend display. The Y axis of the trend values applies to the statistical trend with the selected round button, each such experimental trend line uses a white marker. All other static trends are shown as normalized values and use markers the same as the line color.

To show the pins for a specific experiment click on that experiment in the legend



The Y scale of the trends in Trend Compare has the same functions as the trend display for an individual function, in addition the trends can be offset relative to each other.

The Z-Rescale and MM-Rescale with multiple arrows offsets the trends relative to each other. Trends from the same statistic from different experiments are grouped together. The button selected stat is put on the true Y value scale, the others are offset positive or negative relative to it.

Z-Rescale rescales the Y axis using the minimum and maximum Y values over the entire experiment. MM-Rescale uses minimum and maximum Y values for the displayed time window only. This allows zooming into a period of time and amplifying the changes for just that time window.

The X axis of the trend has three choices.

- If 'SyncPt' is chosen, then the pin synch point time becomes the zero of the time axis (00:00). Time earlier than the synch point is negative, time later than the synch point is positive.
- If 'Local' is chosen, the time stamp of the data of the first available experiment (i.e., Live or Recall 1) is used. The other experiments are shifted based on the synch point chosen.
- If 'Elapsed' is chosen, the first data point of the first available experiment (i.e., Live or Recall 1) becomes the zero of the time axis (00:00). Time earlier than the zero is negative, time later than the zero is positive.

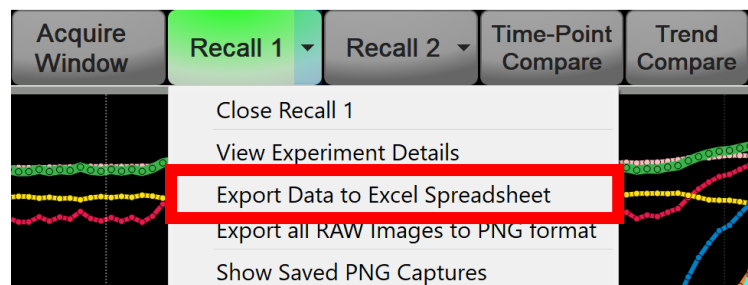
The images in trend compare are automatically displayed for the pin locations for the Acquire Window, Recall 1 and Recall 2 data. Click on the  icon to increase or decrease the space for image display. Images from one, two or all three experiments can be shown. The space for the trend decreases as more images are displayed.

Images scroll in the horizontal direction. If the scroll button is unlocked each row of images can be scrolled independently.

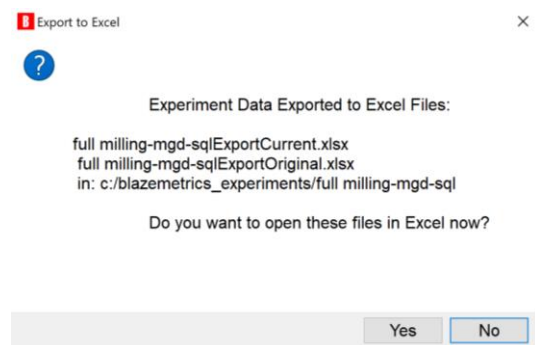
If the zoom button is locked the same level of zoom is applied to all images. Also panning one image will pan all images when the zoom button is locked. If the zoom button is unlocked, then each image can be zoomed and panned individually.

Export Data to Excel Spreadsheet

Trends and distributions can be exported directly to an Excel file from within the Blaze UI or Blaze Office software. First apply any data processing (averaging, channel grouping, statistics. Then click on the pulldown arrow on Recall 1 and select 'Export Data to Excel Spreadsheet'.



Export time will depend upon the file size. When completed, a message will appear asking if the files should be opened. Note: Excel must be on the computer in order to open the file.

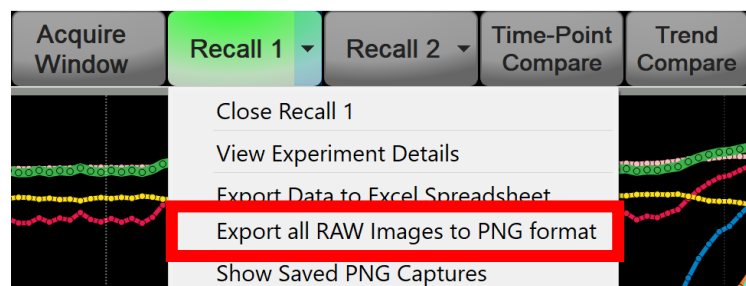


The data is exported both with the processing at the time the data was taken as well as the processing applied when most recently opened. Processing includes statistics, averaging and channel grouping.

The data files are saved as *FilenameExportCurrent.xlsx* and *FilenameExportOriginal.xlsx* within the directory for that experiment, i.e., under the path C:\BlazeMetrics_Experiments\Filename\ . The xlsx format is used by Excel 2007, 2010, 2013, 2016, 2019, Excel (Office) 365. If using a version of Excel prior to 2007 the file will not open. Using Excel 2007 or later it can be saved as a backward compatible *.xls format file for use with Excel 2003 and earlier.

Export all RAW Images to PNG format

This function exports all the images from the recalled file as PNG files. There is no enhancement (image tools) applied so the image will likely be darker or brighter than it appears in the Blaze UI. The PNGs are typically saved in C:\BlazeMetrics_Experiments\FileName\rawPNGImages



Images are named YYYY-MM-DD-HH-MM-SSXXX where XXX is milliseconds.

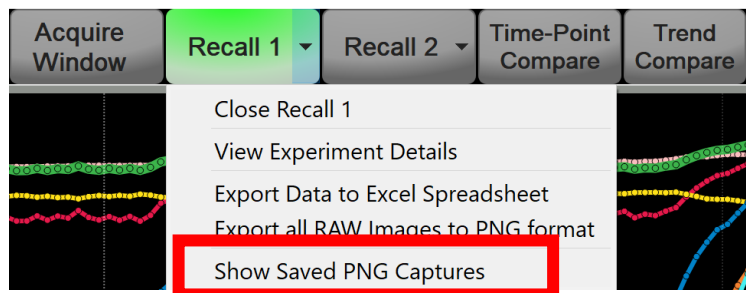
Windows (C:) > BlazeMetrics_Experiments > 29-Sep-2020_13-SCB-CFR21p11 > rawPNGImages

Name	Date	Type	Size	Tags
2020-09-29_12-04-52946_RawImage.png	3/17/2021 1:51 PM	PNG File	3,776 KB	
2020-09-29_12-05-19876_RawImage.png	3/17/2021 1:51 PM	PNG File	3,831 KB	
2020-09-29_12-05-49904_RawImage.png	3/17/2021 1:51 PM	PNG File	3,840 KB	

Please contact Blaze Metrics for further details on how to work with these PNG images.

Show Saved PNG Captures

This opens up the directory where the clipboard captures of images, distributions, trends, statistics, annotations, etc. of an experiment are automatically stored, e.g., the contents of C:\blazemetrics_experiments\FileName\PNG with scale captures



Exporting Blaze Trends to iControl™

Export the Blaze data to Excel selecting the export option from the file open and export button. Open the resulting Excel file, select and copy the time and desired trend data (example below):

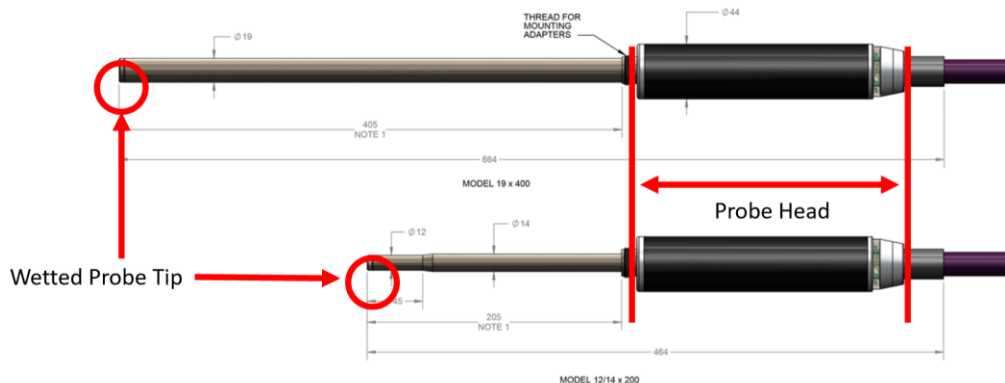
	A	B	C	D
	Elapsed Seconds	Local Time	Trend#1 (mean)	Trend#2 (median)
10				
11	0	4:43:34	48.5807	19.8959
12	30	4:44:04	40.2485	18.7516
13	60	4:44:34	37.0911	17.9291
14	90	4:45:04	35.65	17.5312
15	120	4:45:34		
16	150	4:46:04		
17	180	4:46:34	34.1449	17.0054
18	210	4:47:04		
19	240	4:47:34		
20	270	4:48:04		
21	300	4:48:34		
22	330	4:49:04		
23	360	4:49:34		
24	390	4:50:04		
25	420	4:50:34		

Now go to iControl™ (trademark of Mettler-Toledo), right click in the trend window and select paste from clipboard. Only one trend at a time can be imported. See the section “Importing an External Trend into the Trend Viewer” in the iControl™ manual for further details.

Appendix A Purge Accessories

Gas Supply and Temperature Limits

Temperature	Situation	Comments
Probe Tip < +5 °C	Condensation can occur inside probe window when in cold solutions	Available option: N ₂ purge to remove condensation at the window. Expands range to -5 °C.
Probe Head > 30 °C	Probe head approaches process temperatures when inside dip pipe mounting	Available option: N ₂ purge of probe head section for dip pipe installation. Allows to +62 °C in operation, up to +130 °C when non-operational.



Condensation Prevention Kit for Probe Window

The Purge Regulator is designed to supply low pressure clean dry nitrogen (N₂) to the Blaze Metrics process microscope, for the purpose of preventing condensation on the inside of the probe window at low temperature. The kit contains a low-pressure regulator and a variable area flowmeter (rotameter).

Mounting

The flow meter must be oriented vertically in order to operate properly. The Purge Regulator may be set upright in a bench surface, or it can be attached to a smooth vertical surface using self-adhesive “hook and loop” fasteners.

Connections

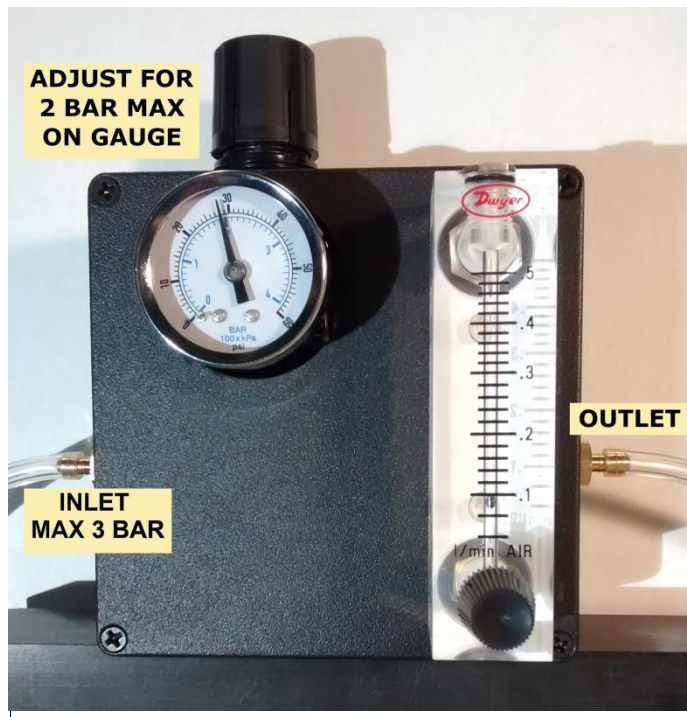
A nitrogen supply is connected to the inlet. Maximum pressure at the inlet is 45 psi (3 bar). **The nitrogen must be clean and dry to avoid introducing moisture, oil, particulates or other contaminants into the probe. Always purge out the line to remove dust particles before connecting to the Blaze. Damage caused by contaminated gas is not covered by warranty!**

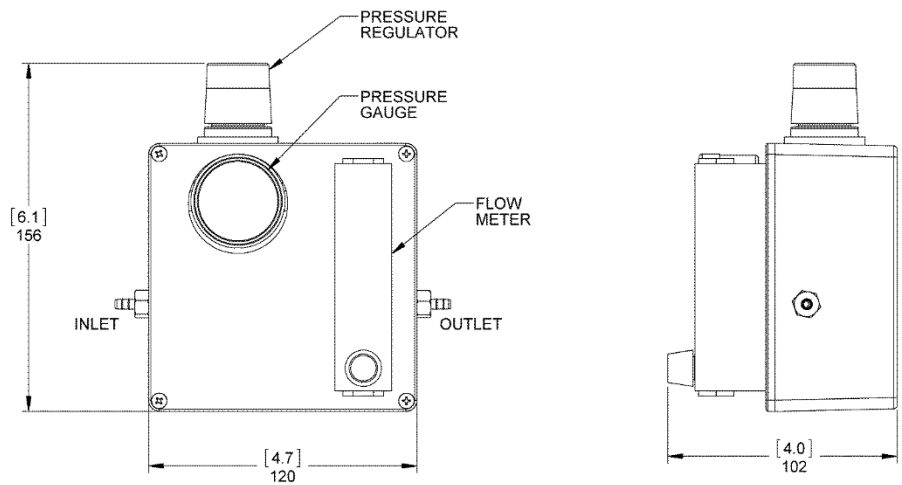
The Inlet and Outlet fittings will accept 4mm ID tubing with a clamp to secure the hose.

A soft 3mm ID tube (Tygon R-3603 or similar) can be stretched onto the fittings and will hold the rated pressure of the tube without using a clamp.

Instructions

1. Connect the Inlet to a dry N₂ supply.
2. Connect the outlet line to the regulator and flow gas thru to remove any dust particles.
3. Place a clean dry white KimWipe™ tissue at the end of the outlet tubing. Allow nitrogen to flow onto the tissue. Inspect the tissue for any signs of dirt, particles, oil and/or moisture. Do not proceed to the next step if any signs of contamination are found on the tissue.
4. Connect the outlet to the purge fitting on the back panel of the Blaze Metrics unit (for Lab style probes; see separate section for Pilot style probes). Note: the back panel connection has a small tube inside of the larger pipe barb fitting, it is supposed to be there. It is not an obstruction – do not try to remove it.
5. Adjust the pressure regulator until the gauge reads 2 bar (29 psi).
6. Open and turn the rotameter valve counterclockwise and verify gas flow by the float moving up from the bottom. The maximum flow will usually be under 0.2 LPM. Note in the image, the float is just below the 0.1 LPM mark.





NOTES:

1. INLET/OUTLET BARBED HOSE FITTINGS COMPATIBLE WITH 1/8" (3MM) ID SOFT TUBING (EXAMPLE TYGON R-3603).
2. TUBING 4mm ID MAY BE USED WITH CLAMPS.

UNLESS OTHERWISE SPECIFIED: INTERPRET GEOMETRIC SYMBOLS AND TOLERANCES PER: ASME Y14.5 1994. DIMENSIONS ARE IN MILLIMETERS. TOLERANCE ± 0.1 ANGLES $\pm 1.0^\circ$ BREAK EDGES 0.2 MAX — INTERIOR CORNER RADIUS 0.2 MAX SURFACE ROUGHNESS: ISO GRADE N6-N7 (Ra 0.8 - 1.6 MICROMETER)	THE INFORMATION ON THIS DOCUMENT SHALL NOT BE REPRODUCED, DISCLOSED, OR USED TO MANUFACTURE OR PURCHASE PARTS WITHOUT WRITTEN APPROVAL FROM BLAZE METRICS	980101	Purge Regulator Assembly	REV
				A
				980101 Purge Regulator

Probe Head Cooling Kit

This kit uses a dry gas to purge of non-wetted back section of the probe for cooling of the sensor and other components when installed in a Dip Pipe or other unusually hot environment. This enables operation of the non-wetted backend of the probe up to 62°C [Note: future production versions will enable higher operational temperatures], 131°C non-operational (cleaning) utilizing the Blaze Dip Pipe installation method. Note: not ATEX.

This cooling purge option requires clean dry air or nitrogen meeting ANSI/ISA S7.0.01-1996 Quality Standard for Instrument Air which requires:

The pressure dew point as measured at the dryer outlet shall be at least 10°C (18°F) below the minimum temperature to which any part of the instrument air system is exposed. The pressure dew point shall not exceed 4°C (39°F) at line pressure.

A maximum 40 micrometer particle size in the instrument air system is acceptable for the majority of pneumatic devices. **Pneumatic devices that require instrument air with less than 40 micrometer particle sizes shall have additional filtration to meet the particulate size limit for the device.** Subsequent to any maintenance or modification of the air system, maximum particle size in the instrument air system should be verified to be less than 40 micrometers.

The lubricant content should be as close to zero as possible, and under no circumstances shall it exceed one (1) ppm w/w or v/v. Any lubricant in the compressed air system shall be evaluated for compatibility with end-use pneumatic devices. For example, the use of automatic oilers is strongly discouraged.

Use a 6 mm OD tubing to bring dry gas to the purge connection. Gas must be either clean dry air meeting ANSI/ISA S7.0.01-1996 or clean dry nitrogen at a pressure of 14psi (1 bar).

Purge Connections for Blaze Pilot Probes.

The purge gas inlet connections for Blaze Pilot style probes are made at the probe head. The gas type, pressure, and flow requirements are the same as for the lab style probes.

The fittings at the back of the Blaze Pilot probe housing serve two purposes. They are labeled:

EXHAUST ◀
WINDOW ▶
COOL ▶

The WINDOW connection is a 2mm tube fitting, connected to the Purge Regulator (included). This feature is used if the process temperature causes condensation inside of the window.

The COOL fitting accepts a 6mm tube. The air flowing through this port removes heat from the image sensor in the housing.



The EXHAUST fitting is left open if either the WINDOW or COOL features are used. It is recommended that the exhaust be protected against water/solvent ingress if needed. This can be accomplished with a length of tubing, an exhaust filter, or both.



The final exhaust point should be well ventilated, have capacity to capture chemicals safely and be free of ignition sources in the event damage to the probe occurs which could result in liquid and/or gases from the process travelling through the exhaust line.



If nitrogen is used for probe head cooling it can build up at the exhaust point. Without adequate ventilation oxygen levels in the room will be reduced, in small rooms this could lead to asphyxiation. Always ensure adequate ventilation at the probe exhaust point when using nitrogen for probe head cooling.

Note all of these ports are to remain plugged unless they are in use.

Using the Probe Head Cooling (COOL)

Connect a 6mm tube to the COOL fitting. Maximum pressure at this port is 14psi (1 bar). Only clean instrument air or dry nitrogen gas is allowed.

Remove the plug from the EXHAUST fitting. Protect the port as noted above.

Leave the WINDOW port plugged.

Using the Condensation Prevention (WINDOW)

Included with the Purge Regulator is a flexible tube, with a section reduced to 2mm diameter. First blow out the gas line with the dry gas source (nitrogen) to remove any dust particles in the line. Then connect the 2mm tube into the WINDOW fitting and the large end to the OUTLET of the Purge Regulator. Adjust the pressure to 14 psi (1 bar) and adjust the flow for at least 0.1 l/m. If required, increase the pressure to achieve 0.1 l/m flow.

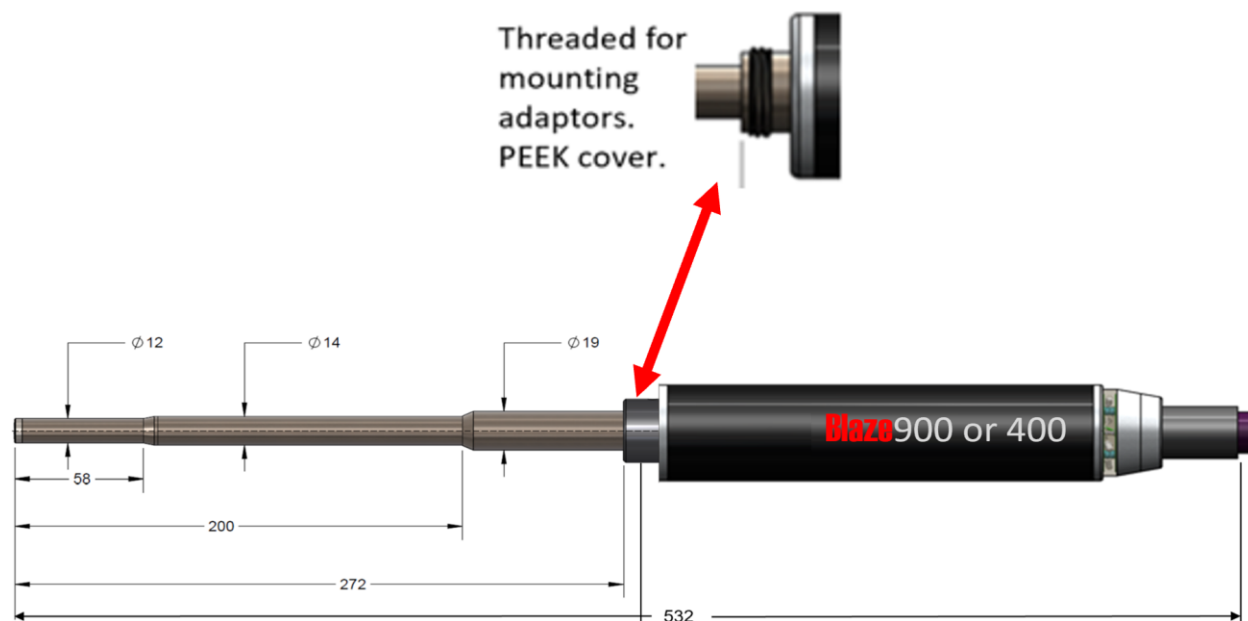
Appendix B Probe Mounting Options

Glass Reactor Adapters

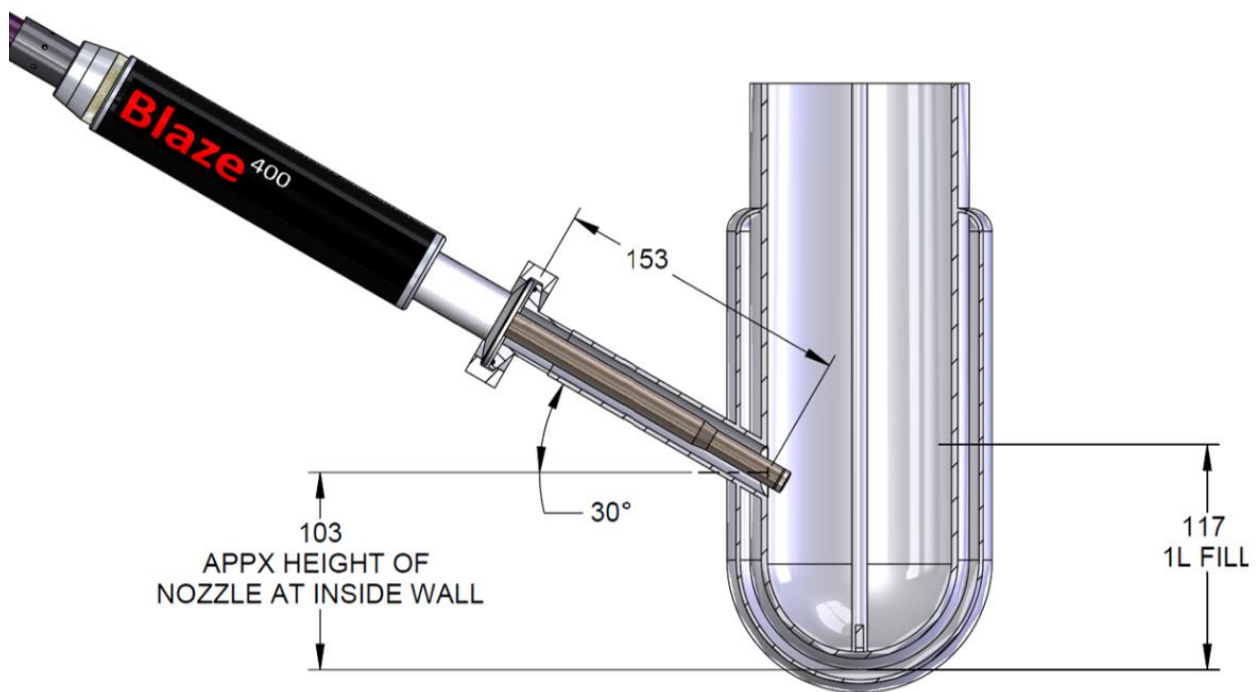
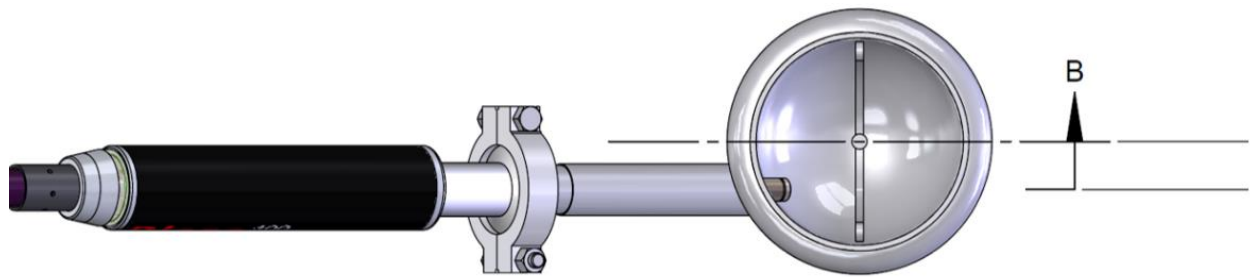
For laboratory scale batch reactors, the Blaze probes will fit into adapters designed for 14 and 19 mm OD probes used on common automated lab reactors including those provided by ChemGlass, MT, Syrris and Systag. If the lab reactor lid does not have the correct port size, then a glass reinforced Teflon reactor lid from Cowie Technology is an effective economical choice. 19/22 and 24/40 are suitable for the 12/14/19 x 276 mm and 12/14 x 200 mm probe, 24/40 and 29/42 are suitable for the 12/19 and 19 x 454 mm probe.

Threads for Flexible Mounting of Adapters

There are threads underneath the black PEEK cover at the junction of the probe tip and probe head. These threads have a pitch of M24 x 2.0 6g and can be used to attach the dip pipe, tri-clamp and any other type of adapter with compatible threads. All Blaze probe models, both Lab and Pilot, have these threads.



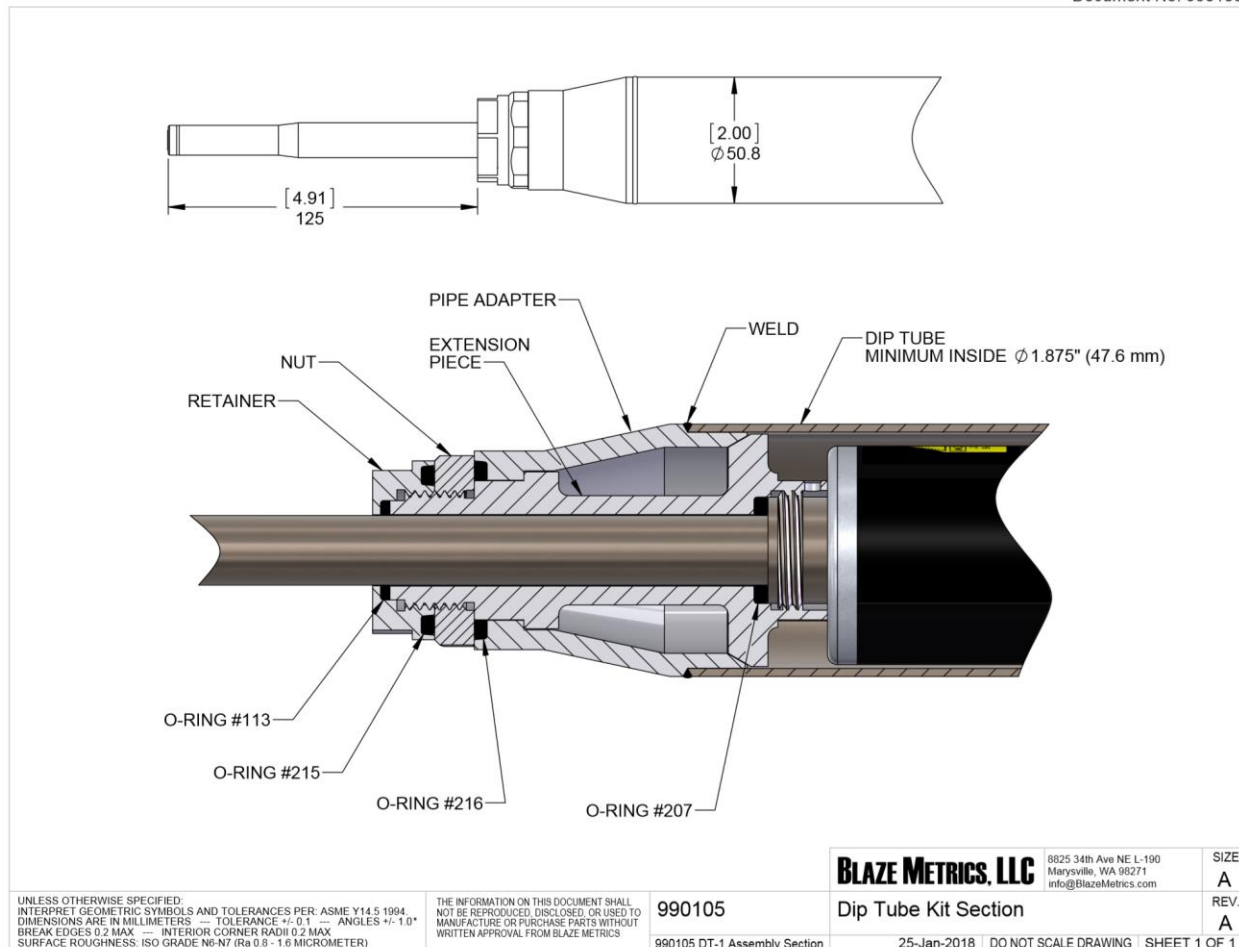
An example of attaching a tri-clamp adapter to these threads to mount into a reactor side port:



Dip Pipe Mounting Adapter

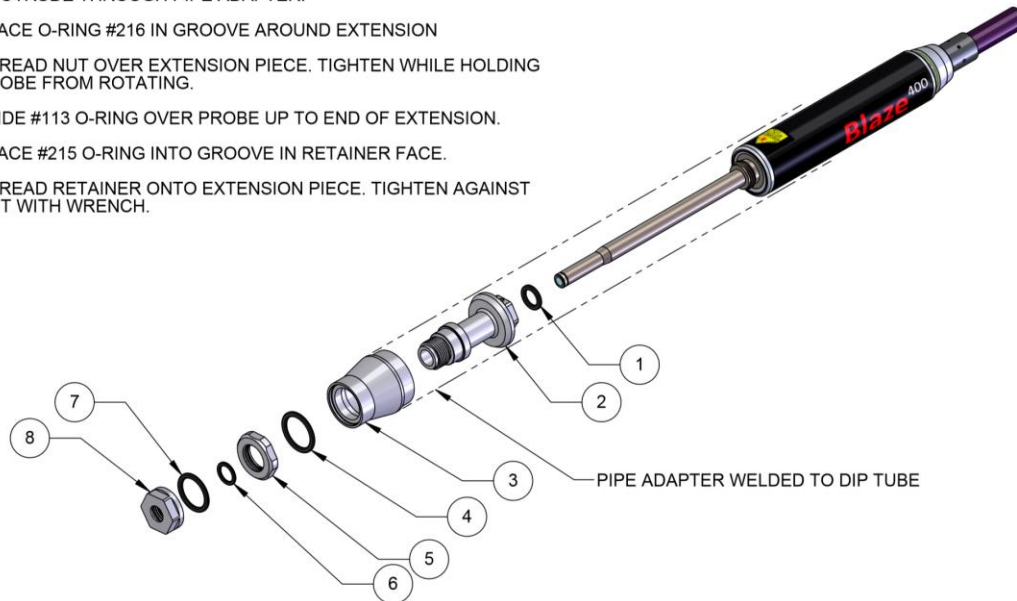
For larger scale reactors there is a dip pipe mounting option, the drawing for the 12/14 x 200 probe is shown below. Option for the 12/14/19 x 276 mm and 19 x 454 probe are available and use the same general design:

Document No: 990105



ORDER OF ASSEMBLY

1. SLIDE #207 O-RING OVER PROBE TUBE UP TO SHOULDER
2. THREAD EXTENSION PIECE TIGHT TO PROBE. INSTALL SET SCREW TO LOCK.
3. SLIDE PROBE THROUGH TUBE UNTIL EXTENSION THREADS PROTRUDE THROUGH PIPE ADAPTER.
4. PLACE O-RING #216 IN GROOVE AROUND EXTENSION
5. THREAD NUT OVER EXTENSION PIECE. TIGHTEN WHILE HOLDING PROBE FROM ROTATING.
6. SLIDE #113 O-RING OVER PROBE UP TO END OF EXTENSION.
7. PLACE #215 O-RING INTO GROOVE IN RETAINER FACE.
8. THREAD RETAINER ONTO EXTENSION PIECE. TIGHTEN AGAINST NUT WITH WRENCH.



UNLESS OTHERWISE SPECIFIED:
 INTERPRET GEOMETRIC SYMBOLS AND TOLERANCES PER: ASME Y14.5 1994.
 DIMENSIONS ARE IN MILLIMETERS — TOLERANCE ± 0.1 — ANGLES $\pm 1.0^\circ$
 BREAK EDGES 0.2 MAX — INTERIOR CORNER RADII 0.2 MAX
 SURFACE ROUGHNESS: ISO GRADE N6-N7 (Ra 0.8 - 1.6 MICROMETER)

THE INFORMATION ON THIS DOCUMENT SHALL
 NOT BE REPRODUCED, DISCLOSED, OR USED TO
 MANUFACTURE OR PURCHASE PARTS WITHOUT
 WRITTEN APPROVAL FROM BLAZE METRICS.

990104

990104 DT-1 Assembly

BLAZE METRICS, LLC
 8825 34th Ave NE L-190
 Marysville, WA 98271
 info@BlazeMetrics.com

Dip Tube Kit Order of Assembly

SIZE

A

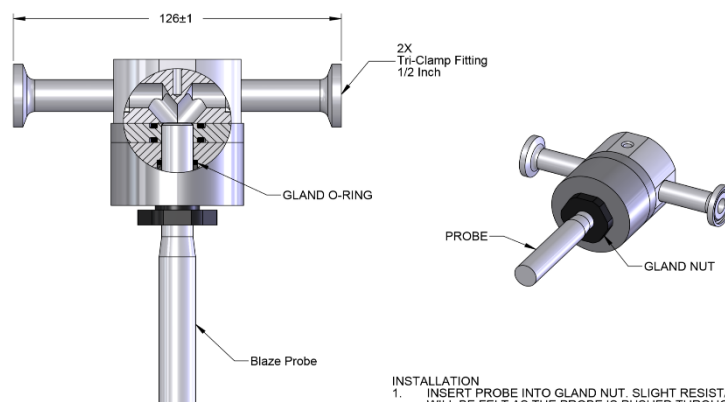
REV.

A

25-Jan-2018 DO NOT SCALE DRAWING SHEET 1 OF 1

Y-Flow Fitting

For continuous flow processes Blaze has developed a flow cell for use with all Blaze probes. The probe is held by a compression fitting and does not require use of the flexible mounting threads. The standard fitting has a 9mm ID line using $\frac{1}{2}$ " Tri-Clamp connections to match common lab equipment e.g., outlet of IKA magic LAB. Different size barb fitting connections are also available as well as other designs down to 3mm ID and up to about 12mm ID. Below 3mm ID Blaze has a low volume cell with push fittings for 1.1mm ID tubing. Other line diameters and connections are available, just ask Blaze!



- INSTALLATION
1. INSERT PROBE INTO GLAND NUT. SLIGHT RESISTANCE WILL BE FELT AS THE PROBE IS PUSHED THROUGH THE GLAND O-RING.
 2. SLIDE THE PROBE FORWARD UNTIL IT STOPS.
 3. TIGHTEN THE GLAND NUT.

UNLESS OTHERWISE SPECIFIED, INTERPRET GEOMETRIC SYMBOLS AND TOLERANCES PER ASME Y14.5-1994. DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED. BREAK EDGES 3.2 MAX. INTERFERE CORNER RADIUS 3.2 MAX. SURFACE ROUGHNESS: ISO GRADE N6.3 (Ra 0.8 - 1.6 MICROMETER)

THE INFORMATION ON THIS DOCUMENT SHALL NOT BE REPRODUCED, DISCLOSED, OR USED TO MANUFACTURE OR FURNISH PARTS WITHOUT WRITTEN APPROVAL FROM BLAZE METRICS

100129
100129 FC3 Stainless Tri-Clamp

BLAZE METRICS, LLC
8822 34th Ave NE L-190
Marysville, WA 98271
info@blazemetrics.com

SIZE
A
REV
A

Flow Cell FC3, Stainless w/Tri-Clamp

20-Feb-2018 DO NOT SCALE DRAWING SHEET 1 OF 1

To install: put the gland nut over the probe and insert the probe into the flow cell body until it stops moving forward. There will be resistance when the probe is pushed through the gland O-ring. Orient the probe as needed and tighten the gland nut by tightening clockwise into the flow cell body. When properly assembled the back of the fully tightened nut will be 38 mm from the probe window.



Do not rotate the probe once it is installed in a flow cell, either deliberately or by conduit movement. Rotation may loosen the probe window causing changes in the image plane or possible solution leakage into the probe.

Loosen the nut before removing the probe to prevent damage to the gland O-ring. The gland O-ring should be inspected on a regular basis and replaced as needed. Mechanical wear on the O-ring is accelerated if the nut is not loosened before removal and re-insertion. Swelling or partial dissolution of the O-ring is likely from incompatibility with the solvent. O-ring replacement information is as follows:

Gland O-Ring Size: AS568-014
Material: perfluoroelastomer
Cross Section: 0.070" or (1/16")
Inner Diameter: 0.489" or (1/2")

Blaze uses perfluoroelastomer (a generic version of Kalrez™) as the standard O-ring material in the flow cells. No chemical attack has been observed although some users have reported some swelling. But the main cause of O-ring damage is not loosening the compression fitting before pulling out the probe. If this is done enough times it starts to shred the O-ring, and this will happen to any type of O-ring material. So, the key is to loosen the compression fitting first. Note: there are two other O-rings, static fittings, in this assembly as well. If the slurry is not leaking out the sides of the flow cell, then it is not likely a chemical attack, though for a static situation it could take longer.

Source of standard perfluoroelastomer (as shipped) is:

https://www.theoringstore.com/index.php?main_page=product_info&cPath=367_475_1309_1310&products_id=26933

They are usually in stock and can be purchased with a credit card or PayPal. Free shipping.

Kalrez brand perfluoroelastomer can be purchased online from McMaster-Carr:

Kalrez Compound 4079: <https://www.mcmaster.com/9568k19>

Kalrez Compound 7075: <https://www.mcmaster.com/1280n23>

The flow cell shown in the drawing uses ½" triclamp fittings, other styles are available. Please contact Blaze Metrics to discuss which style is appropriate for your application.

The pumping rate must be matched to line and flow cell. An incorrect pumping rate can cause back pressure or lead to gas bubble formation which in turn can affect the measurement.

Radial Flow Cell

Usage Notes

Follow the directions and flow direction as described, improper usage can cause leaks and possible forceful separation of the probe and flow cell due to excessive pressure.

Cell is designed for low pressure use below 2 bar. Leakage or sudden separation of probe from the cell can occur at higher pressures. The probe is held in place by the friction of an O-ring and can be worked loose under higher pressures.

Each time the probe tip is removed the probe O-ring can be damaged. Inspect before each use and replace if any signs of damage are seen. If possible, apply a process compatible lubricant to the O-ring to make assembly easier and reduce O-ring damage.

Inlet nozzle O-ring is ASTM size -010 and made of Viton.

Probe fitting O-ring is ASTM size -014 and made of Viton.

Assembly (refer to drawing and pictures at end of instructions)

1. Put probe fitting (A) over probe with thread side towards the probe window.
2. Slide probe O-ring (B) over the probe to a few mm beyond the window taking care not to roll the O-ring.
3. Insert probe tip into flow cell (C), rotate the probe so red dot on probe head is opposite the outlet of the flow cell. Push probe in firmly against the internal edge.
4. Slowly tighten the probe fitting taking care to keep the probe flush with the internal edge and seat the O-ring well. A wrench can be used to tighten as needed.
5. Insert outlet tube fitting (D) into flow cell and finger tighten fully.
6. Attach nozzle O-ring (E) to nozzle fitting (F) and insert into flow cell. Turn nozzle fitting clockwise until fully finger tight. Now turn counterclockwise to set the flow gap:
 - **No more than ¼ turn is recommended**, this creates a gap of ~225 microns.
 - Optimal gap depends upon maximum particle size, particle size distribution, and flow rate.
 - The larger the particles and the higher the flow rate, the larger the gap should be.
 - The smaller the particles and the slower the flow rate, the smaller the gap should be.
 - Too small of a gap restricts flow and causes excessive back pressure and leakage.
 - Too large of a gap and particles will be too far from the window.
 - **If the gap is large the nozzle fitting will be loose, and the cell may leak.**
7. Insert inlet tube fitting (G) into nozzle fitting and finger tighten fully.

Note: if adjusting gap after flow cell is fully assembled unscrew the inlet tubing first, adjust the gap, then retighten the inlet tubing. This prevents 'twist' from being introduced into the tubing.

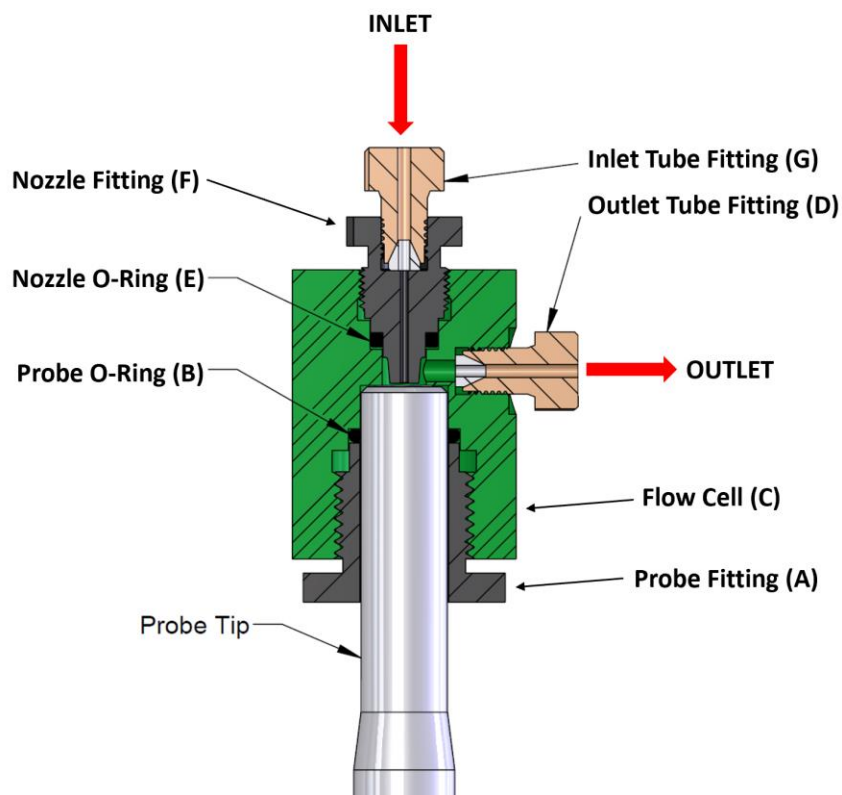
Note: the probe-flow cell assembly can be operated in any orientation if the flow lines are full and free of trapped air or gas.

Note: the outlet tube fitting (D) is for 1/8" tubing. Replacement outlet fittings can be purchased from the original manufacturer IDEX by ordering part number XP-335X from this web page:

<https://www.idex-hs.com/store/fluidics/fluidic-connections/fittings/flat-bottom-fittings/flangeless-fittings.html>

Note: the inlet tube fitting (D) is for 1/16" tubing. Replacement outlet fittings can be purchased from the original manufacturer IDEX by ordering part number XP-218BLKX from this web page:

<https://www.idex-hs.com/store/fluidics/fluidic-connections/fittings/flat-bottom-fittings/flangeless-fittings.html>



The following parts are available from IDEX for use with metric tubing. These use 1/4-28 thread with a flat bottom which fits into the flow cell body (part C).

[P-363R Flangeless Ferrule M6 or 1/4-28 Flat-Bottom, 2.0mm Tefzel™ \(ETFE\) - Red](#)

[P-353 Flangeless Ferrule M6 or 1/4-28 Flat-Bottom, 2.5mm Tefzel™ \(ETFE\)](#)

[P-342 Flangeless Ferrule Tefzel™ \(ETFE\), 1/4-28 or M6 Flat- Bottom, for 1.8mm OD Green - Single](#)

[P-343 Flangeless Ferrule Tefzel™ \(ETFE\), 1/4-28 or M6 Flat- Bottom, for 3mm OD Orange -Single](#)

[P-366 Super Flangeless™ Ferrule PEEK, 1/4-28 Flat-Bottom, for 2.5mm OD Natural - Single](#)

[P-355 Super Flangeless™ Ferrule, PCTFE, 1/4-28 or M6 Flat-Bottom, for 1.8mm OD -Green](#)

[P-352 Super Flangeless™ Ferrule, PEEK, M6 or 1/4-28 Flat-Bottom, for 1/8"OD Black - Single](#)

For 1.8mm tubing use P-342 ferrule with XP-335 nut (XP-218 nut is too small on inside)

For 3mm tubing use P-343 ferrule with XP-335 nut

XP-218 is still available as individual pieces, the nut is PEEK vs Tefzel in the alternative kit.

8. Face the probe window up and tilt slightly to the side, an angle of 30-45 degrees from vertical is ideal. Tilt so the outlet flow is facing up to allow any air bubbles to escape easily.
9. Rotate the probe so the red dot marking on the probe head is on the opposite side of the outlet.
10. Verify the probe is properly supported and conduit bend radius is not less than 10" (25 cm).

11. Note the flow cell can separate from the probe if pressure builds from blockage of the outlet or direct application of high pressure.



Appendix C Window Replacement Procedure

Equipment and Parts

700195 Window (part number differs by window type)

600131 O-Ring

700231 Window wrench (shown below)



Silicone Grease (or other lubricant)

Plastic or Wood Pick

Instructions

Remove the Window



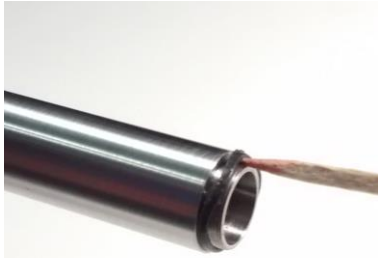
1. Place the window wrench over the window assembly.
2. *Gently* hold the handles while turning the window wrench counterclockwise to remove the window assembly. Squeezing too hard can crack the window.

Assess the O-Ring



1. If the O-ring sticks in the window shell during removal, it will typically be damaged during removal. A damaged O-ring will look abraded, rough, or frayed as shown in this picture. A damaged O-ring must be replaced.
2. If the O-ring stays in the groove when the window is removed, it should be okay to reuse. No need to remove it, just apply grease to the outside of the O-ring before replacing the window.

To Remove the O-Ring (if needed)

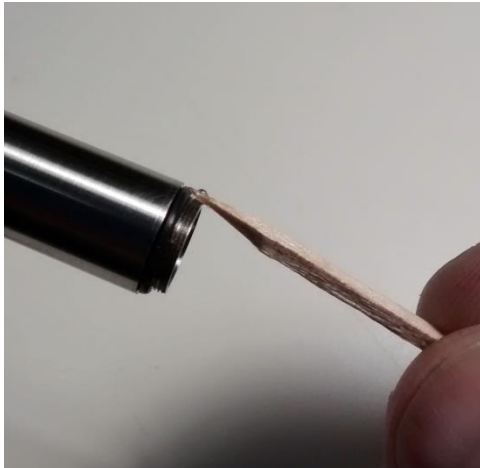


3. Use a pick (plastic or wood) to lift the O-ring out of the groove.
4. Roll the O-ring over the threads to remove.

To Install a New O-Ring (if needed)

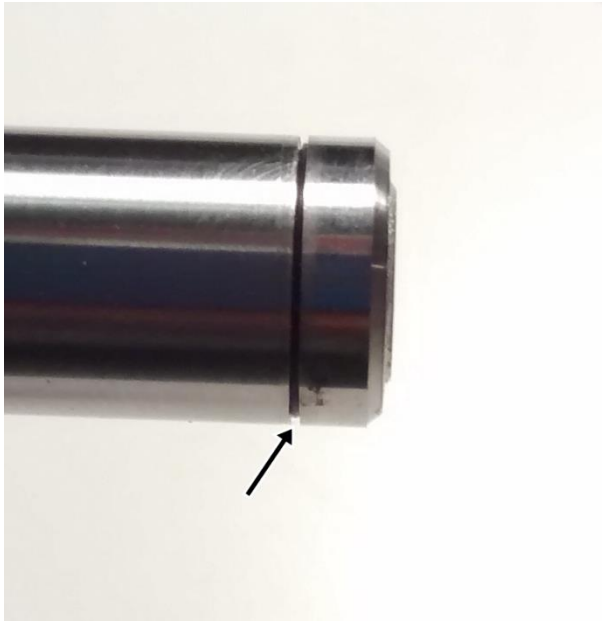


1. Lightly coat the O-ring with silicone grease or other suitable lubricant.
2. Stretch the O-ring over the threads and gently roll it into the groove.



Install the window

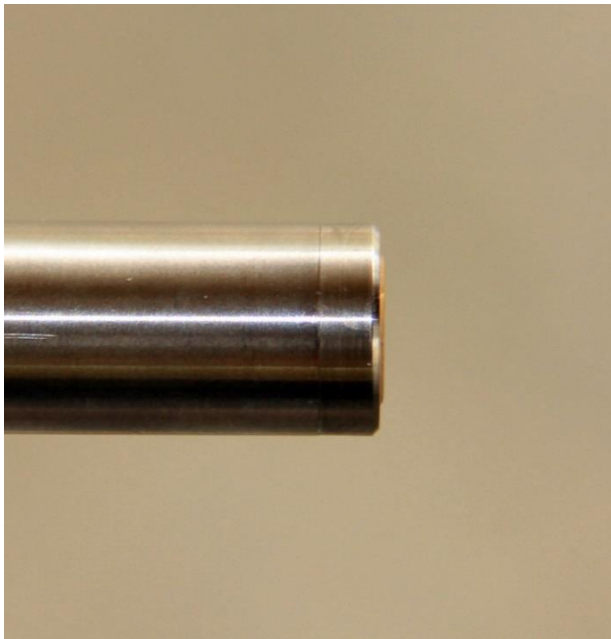
1. Make sure the threads are clean.
2. Apply a small amount of silicone grease (such as Molykote or other suitable lubricant which is chemically compatible with the process chemicals and temperature) to the threads. If reusing O-ring apply silicone grease to the outside of the O-ring.
3. Make sure the window is clean.
4. Using fingers (not the wrench) *slowly* screw the window assembly onto the probe tip turning clockwise.



Tighten the Window Assembly

1. When the window contacts the O-ring, make sure the O-ring is squeezing into the shell by observing the gap between the window shell and the probe tip (arrow at left). The O-ring should not be pinched between these surfaces. If the O-ring is protruding into the gap, stop, unthread the window, inspect O-ring for damage, and try again.
2. *Gently* hold the window wrench and *slowly* keep turning the window clockwise until the shell is snug against the probe. Squeezing too hard can crack the window.
3. The resistance will be high. There should be no gap between the window shell and the probe tip when fully tightened. If a fingernail can fit into the gap, then it is not fully tightened.

Check gap between probe tip and window shell to verify that O-ring is not pinched.



Window shell has been fully tightened onto the probe tip; no gap is present.

After the replacement is complete perform the Window Reference Procedure described in this manual.

Appendix D FAQs and Troubleshooting

Support Contact Information

To contact Blaze Metrics email or call

info@BlazeMetrics.com

USA (206) 338-5220

Is vibration ok for the probe and optics? What about ultrasonics?

The optics will have no issue with the vibration. The rest of the probe is 'hardened' against vibration. Every reactor system where the Blaze is installed has some level of vibration and no issues have been seen in reactor systems. Based on past experience with ultrasonic devices in reactors in a few cases a 'harmonic' of the system will unscrew some part of the probe. Observe or video the probe the first time it is installed with an ultrasonic device or in an extreme vibration environment to check if harmonics are present.

Log files for diagnostics

Blaze Metrics may request software log files for diagnostics purposes. A new log file is created each day. If the software was installed under default locations, these files are stored under the following locations:

For Blaze UI for instrument operation the files are under

C:\BlazeMetrics\log

For Blaze Metrics Office for off-line data analysis the files are under

C:\Users\USERNAME\AppData\Local\BlazeMetricsOffice\log

Where USERNAME is the user account name

Log files are kept for 35 days and are automatically purged by the software at start up if older than 35 days.

Image and Measurement Show Different Time Stamps from Each Other

This occurs because of how the data is captured. Measurements are taken at fixed intervals separated by the measurement duration and reported to the second. Images are taken throughout the measurement period and each image uses its exact time (to the millisecond) as a unique identifier. Because images are saved based on their triage ranking, there is no guarantee they are at the same time intervals as the measurements. There is no fixed time offset between the image time stamp and the measurement time stamp.

Different Images Show the Same Time Stamp

This occurs because of how the time stamp is displayed. Images are taken throughout the measurement period and each image uses its exact time (to the millisecond) as a unique identifier. Because images are saved based on their triage ranking there may be more than one image at the "same" time stamp (which

is given only to the second) though they were taken some milliseconds apart. Use of the default triage image spacing minimizes how often this happens.

Image not changing

Verify probe tip is immersed in solution not in air.

Verify mixer is turned on and suspending particles at the level of the probe tip.

Verify live image window is in play mode and image acquisition is on i.e., press the play icon .

If triage is on, then turn it off. If the image is now changing, the triage parameters were set too tightly.

If above steps do not resolve the problem, remove probe and place Kim-Wipe or other tissue on probe tip and check image when moving tissue.

Laser won't turn on

Verify key is turned to on position. If laser was turned off using the key it also needs to be turned on again in the software (this is for safety). Press the yellow triangle laser button once, it should go gray, press it again, it should go yellow, and laser will be on.

Image is black or nearly black

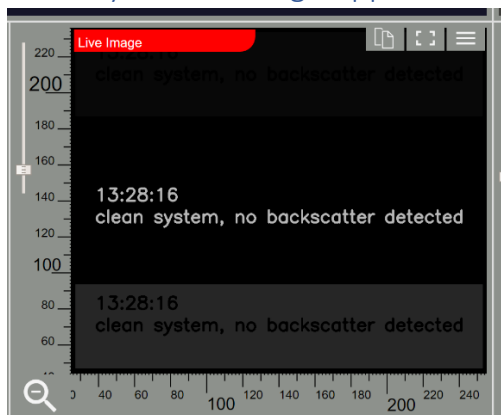
Verify laser is enabled and set to auto-laser.

Verify laser key is turned ON

Verify enhancement is turned on in live image window.

If above steps do not resolve the problem, remove probe and place Kimwipe or other tissue on probe tip and check image.

Clean System Message Appears During Measurement



If the clean system message appears during a measurement, the most likely reasons are:

- There are no particles to measure
- The laser was turned off

Check the probe is fully immersed in solution. For solutions with extremely low or no particle count the clean system message will appear if the window is clean. The message updates 3 times a minute and will go away once particles are detected again. If in doubt, remove the probe and place in a slurry or place the blue tape or a Kimwipe tissue on the probe window. The message should clear in less than a minute.

Note: the clean system message may vary from the example if non-default image tool settings are applied, it may appear as all white or all black for the most extreme settings.

Verify laser key is turned ON. Verify the laser power is set to auto and the laser control button is set to



If the clean system message continues after taking the above steps, please contact Blaze.

Image contains spots that don't move

First confirm that other images in same sequence show other particles moving/changing while certain spots remain fixed. If not see other FAQs.

If confirmed, then try cleaning window with Kimwipe and appropriate solvent.

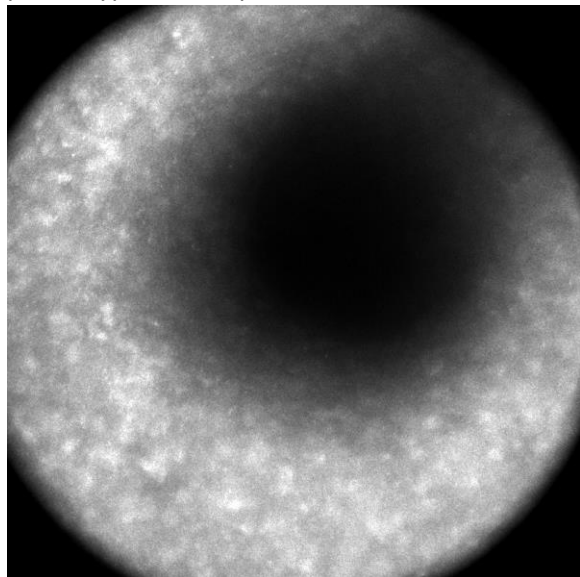
If using purge, verify gas is clean dry and oil-free. Often in-house air systems contain oil (this is why nitrogen cylinders are recommended). Oil droplets or other contaminants can adhere to the inside of the window and create persistent spots in the image. If purge gas was determined to have oil or other contaminants, contact Blaze for additional support.

If spots have the same intensity from image to image and don't respond to changes in image tools – clean the computer monitor!

If spots persist after trying these things, contact Blaze for additional support. Blaze can ship a user replaceable window as required.

Image contains large dark areas

Water can condense inside the probe window if process temperatures are low, and the condensation prevention dry nitrogen line is not connected and turned on. Typically, this occurs when the process temperature is in the 5 to 10 C range but can occur anytime the inside of the probe reaches the dew point. Typical example of condensation:



If condensation occurs connect and flow dry nitrogen through the condensation prevention kit. Warm the probe to make the probe dry out faster. To prevent condensation in the future, always start flowing dry nitrogen well before potential condensation temperatures are reached.

Image contains unexpected particles

The Blaze, with its high resolution, high image capture rate and triage capabilities will capture infrequent and hard to see particles missed by other techniques. These include foreign matter such as fibers and insoluble material as well as liquid droplets and air bubbles.

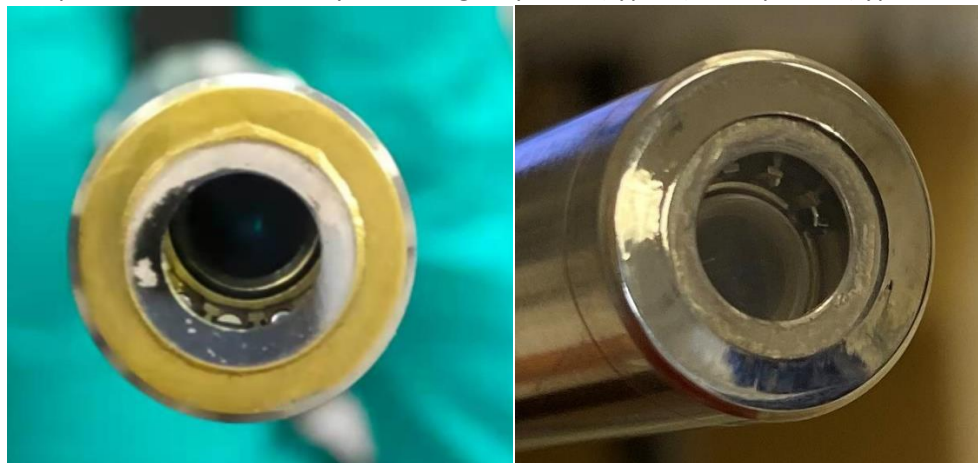
The Blaze often observes droplets in systems where droplets are not expected. Often trace liquids or cleaning residues can form droplets, e.g., trace water in organic solvent. Also, miscible liquids do not immediately dissolve in the solvent and droplets may be observed until the two liquids fully mix.

Droplets showing strong contrast with the dispersed phase are often air bubbles. These can occur due to air entrainment by the mixer, mixing induced cavitation, or liquid addition entraining air when addition occurs above the surface. Air bubbles are typically circular and shiny with 3 bright dots mirrored by a set of 3 smaller dots on the opposite side (these are from the laser illumination).

Finally test different image plane positions to see if static particles are a function of the image plane position. Perform the window reference if the reference plane requires adjustment or clean the probe window as necessary.

Probe Window Appearance and Damage

The probe window assembly is either gold plated (type A) or unplated (type B or C):



Type A- gold plated window assembly

Type B- unplated window assembly

If working with very abrasive slurries the gold plating of type A may wear off over time to reveal the nickel layer beneath it. Contact Blaze for other window options. For some applications a protective inert metal oxide layer is used. Please contact Blaze to verify the exact materials used in your configuration. The sapphire window is attached to the metal window assembly by a braze along the outside edge, this is not visible when looking at the window. When looking straight at the window the shelf below the window is visible, the metal of the shelf or a white material (residue from the manufacturing process)

will be visible. The white material is fused during the manufacturing process and will not move. None of this material is in contact with the process. The Blaze measurement area is in the central part of the window and will not be affected by anything on the shelf.

The following are abnormal and cause for concern:

- particles on the central interior of the window
- damage between the sapphire window and metal window assembly
- signs of excessive wear, rubbing, or scratching on the window assembly (or anywhere on the probe)
- dark or corroded color around the edge of the window (chemical corrosion)

The most common causes of damage are:

- Dropping of the probe
- Hitting the window assembly with the impeller
- Wear on the probe by the impeller shaft rubbing against it

These can all be avoided by careful handling and a manual check before starting the experiment to verify the probe and impeller assembly are not in contact .

Though rare, the window assembly can be damaged by chemical corrosion. Combinations of halogens and halides, multiple strong acids, or strong acid with ferric chloride when used with elevated temperatures are possible causes of corrosion. If signs of corrosion are seen contact Blaze to discuss alternative window assembly materials. If corrosion is allowed to continue the window assembly may leak and cause damage to the internal parts of the probe.

If the probe window assembly is damaged it can be replaced by the end user using the replacement window kit available from Blaze. The kit includes a special tool for replacing the window. Blaze recommends keeping a spare window and tool on hand to minimize potential downtime for critical projects.

Can't Find Image Plane Focus

If the image plane position is way off, then it's hard to tell if the image plane is set too far inside or too far out from the window. Be sure the blue tape is firmly on the window and then compare to these example images in the Window Reference section to determine the approximate image plane position. Be sure software is in Clean mode or the triage has been turned off manually, so the current image is displayed.

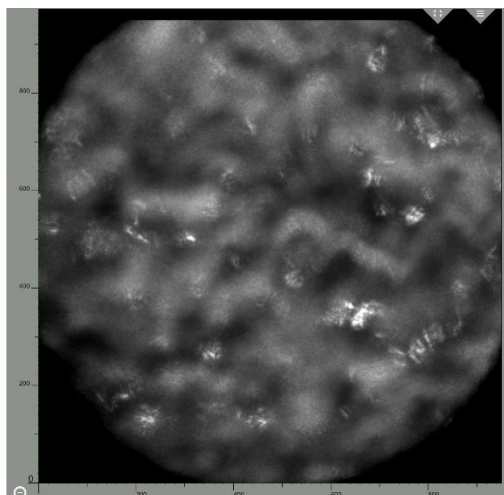


Image plane is 34 μm inside the window

Image Plane Not Moving

If it has been determined that the image plane is not moving, try the following procedure to free up motion. The procedure assumes the image plane is stuck at the maximum position out from the window, change the motion directions if stuck at maximum position in from the window.

1. Go to the zero point settings, read and record absolute probe position
2. Select direction 'into the window'
3. Remove probe from reactor and hold with window facing straight up into the air, allow the conduit to dangle down
4. Press large step and then read position, if it less than recorded value then it has unstuck.
5. If it does not unstick repeat step 4 and tap the black portion of the probe with your hand in an upward motion. Tap means using your palm or knuckles with a swing of a few centimeters (gently, it should not hurt). The upward tap while the image plane is trying to move downwards should help it unstick.

Slow updating of live image

Shut off any non-Blaze programs running on the computer. For anti-virus software, check for compatibility. Some programs like Bitdefender tend to slow the system down significantly.

Check if Blaze GUI is assigned to the GPU as described under the Computer Configuration section of this manual.

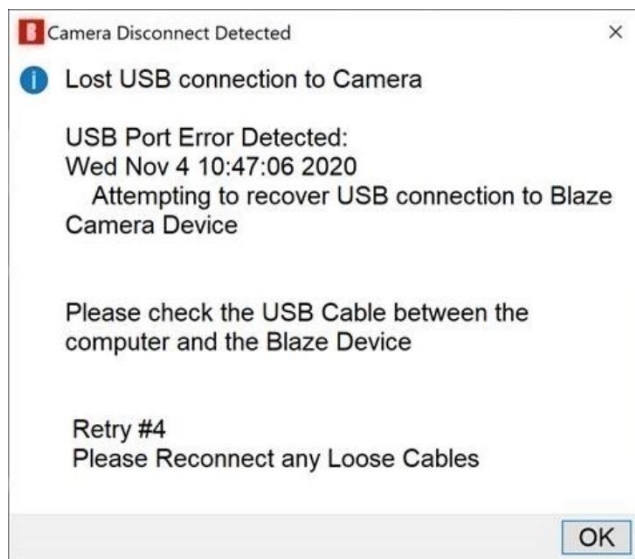
Turn off enhancement on Visual Trend. Increase save measurements period. Decrease value of imaging frames per minute to a lower value (1000-2000). Decrease frequency and amount of saving.

Not connected to camera

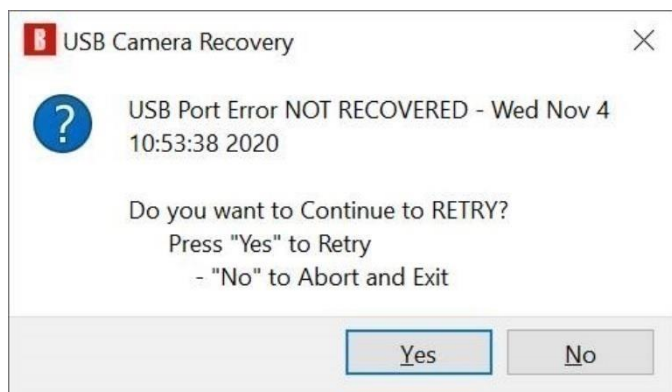
Check that the USB 3.1 cable is connected to the Main Enclosure and the Computer. On the computer end, the USB port must be a USB C port or USB A port marked with the SS symbol . A USB 2 port will not work.

Check that the cable used is what was provided with Blaze (the brand Cable Matters, see <https://www.amazon.com/gp/product/B00821FDI8>). Not all cables labelled as USB 3 perform the same way, for example, Blaze testing has shown the Amazon Basic series of USB 3 cables will not work reliably.

If the USB cable is disconnected the Blaze UI will automatically try to reconnect and if no connection is established after about 3 minutes it will display this message:



Then the Blaze UI will continue to try for about another 5 minutes and this message will appear:



Click "Yes" to retry, the message will reappear if it cannot connect.

Click "No" and the experiment will be saved automatically. Alternatively, stop the recording at any time during a connection error and the experiment will be saved.

In general, if the USB cable is disconnected for a brief period the experiment can continue. If the software does not reconnect after several minutes leave the software running and turn the power to the Blaze off and then on again. The software will reconnect and resume the measurement.

Blaze UI not working after uninstalling Pylon RunTime

If Pylon Runtime 5.0 was uninstalled after updating a computer to Blaze UI 148.03 or higher then communication to the camera sensor on the Blaze unit will not work correctly. Reinstall Blaze UI 148.03 or higher which will automatically reinstall the necessary software for camera communications.

Not connected to laser or No focus device detected

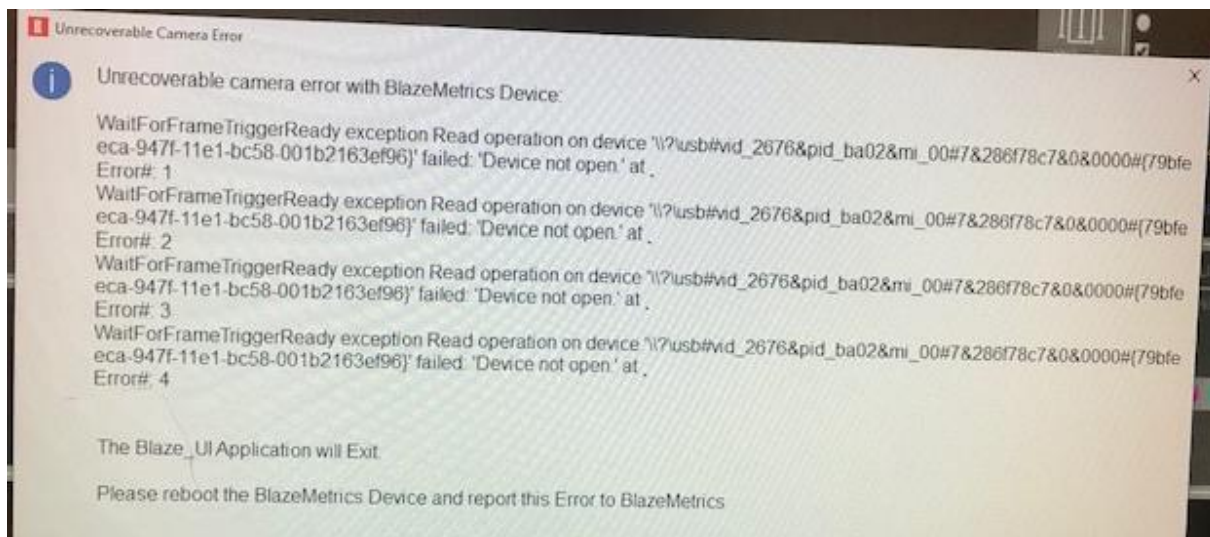
Change com ports. Recommend using the same USB port each time and not to plug new USB devices into the computer. Driver installation will cause com ports to be reassigned.

Under Settings, 'Device Info', verify the imaging laser has been detected. If the Com Port is not found, check under Windows Device Manager the correct Com Ports and make sure they match what is set in 'Device Info'.

Under Settings, 'Device Info', verify the camera and image plane adjustment have been detected. Click on 'Reconnect'. If the camera has not been detected, power off the unit, close the software, restart the unit, restart the software. If the Image Plane Adjustment Com Port is not found, check under Windows Device Manager the correct Com Ports and make sure they match what is set in Diagnostics 1.

Unrecoverable camera error message

If the message below appears, disconnect the USB cable from the computer and main enclosure, inspect for damage, exit the software, reconnect the USB cable, and restart the software. See the 'Not connected to camera' in the FAQ section.



Connected but software not working

Check USB pins for damage on both cables and ports. Replace any damaged cables with factory equivalent cables—a random USB cable will most likely not be rated for the high data transfer rates required for Blaze operation.

Communication errors and loss in laser intensity

Check that the USB 3.1 cable is connected to the Main Enclosure and the Computer. On the computer end, the USB port must be marked with the SS symbol . A USB 2 port will not work.

Check that the cable used is what was provided with Blaze (the brand Cable Matters, see <https://www.amazon.com/gp/product/B00821FDI8>). Not all cables labelled as USB 3 perform the same way, for example Blaze testing has shown the Amazon Basic series of USB 3 cables will not work reliably.

Check pins on cable for damage, try different USB 3 port on computer. Replace cable.

Communication errors and/or slow software response

Check the USB cable is plugged directly into the USB C or USB 3.1 port of the Blaze computer and not through a USB hub. USB hub will slow the data transfer rate. Check the USB cable used is the original factory supplied cable or equivalent. Common USB cables are not rated for the high data transfer rates required for Blaze operation.

Communication errors after connecting Bluetooth headset

Bluetooth headsets on Windows 10 will use the Com 3 or Com 4 port and interfere with Blaze operation. Under device manager, port, click on the Bluetooth port used for the headset. Under port settings, advanced, the port number can be changed (Com 10 or higher recommended).

Software stopped running when unattended

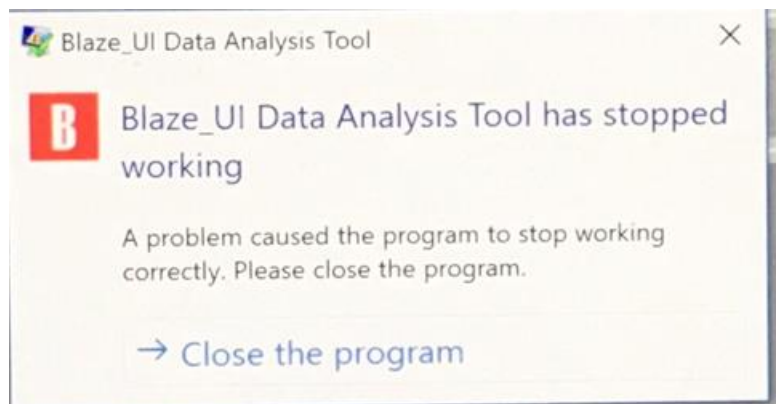
The most common cause of this is a Windows update and subsequent computer restart. Windows updates settings should defer feature and quality updates so that the Windows update can be performed manually when no experiment is running. Note that Windows updates cannot (and should not) be deferred indefinitely. Check with corporate IT if group policies are applied to the Blaze computer's Windows update settings.

The other cause of this is a power management scheme either shutting down USB ports or the computer after a period of "inactivity". Often laptops are subject to power management schemes which shut down USB ports after 1-2 hours even if software is using the port to communicate with an external device. Refer to Appendix H, Optimizing Computer Performance, for Blaze compatible power management settings. Contact Blaze for a power management scheme file that can set all of these values at once. Check with corporate IT if group policies are applied to the Blaze computer's power management settings.

Note: It may be necessary to have the Blaze computer in a separate group so that general corporate group policies intended for office computer are not applied. Most corporate IT is aware that instrument computers have different requirements and have special group policies for them to avoid these types of problems.

Software crashes after pressing play button

If a message similar to this is seen



Check under the 'Settings' menu, 'Change Blaze Experiment Files Location' command if the experiment file saving directory is set to C:\BlazeMetrics\SOP_Folder_Defaults or C:\BlazeMetrics\SOP_Folder_Projects. If so, change to C:\BlazeMetrics_Experiments or other location.

Exported images look different (darker or lighter) than in Blaze software

Apply visual enhancement in the viewing software (e.g., ImageJ). Blaze software automatically turns on visual enhancement (as described in 'Image Tools') to optimize the display for the gray scale range of typical computer displays.

Image File Name, Epoch Time, and Date Time

In older versions of the Blaze software individual images were automatically named with an epoch time stamp which is the number of milliseconds since Jan 1, 1970 so that each exported image has a unique name. To convert this name to a more easily understood date and time stamp a formula can be used or the name can be entered into the website <https://www.epochconverter.com/> for easy conversion. Note: epoch time is based on the GMT time zone so any conversion formula should take the local time zone into account.

Exported Raw PNG image files with the current release are named with date and time stamp to the millisecond so each image file name is unique.

Reading the SQLite database files used to store Blaze data

The Blaze data are stored in SQL format (Sequel Lite, SQLite). There are multiple databases for each experiment. A free database browser is available at <https://sqlitebrowser.org/>. SQLite queries can be used to read and request data from the databases.

This table explains which data are in which database:

File Name	Contents
BlazeExperimentData.db	Chord length distribution, instrument settings, instruments events, user annotations.
BlazeImage_Full.db	All saved images in original size
BlazeImage_Slice.db	Slices of individual images used for the visual trend, these are derived from full images.
DerivedData.db	Statistical trend data from last time the experiment was recalled.
OriginalStatistics.db	Statistical trend data trended at the original time of the experiment.
imported_experiment_data.db	Data captured from external sources under Imported Data (OPC Recorder) such as lab reactor readings and Raman trends.

File names which include P11 such a BlazeExperimentDataP11.db are from experiments which comply with 21 CFR Part 11. Any modification of a P11 file will render the data invalid for 21 CFR Part 11.

File transfer and data backup is slow

File transfer speed will be controlled by the network speed or choice of drive and interface for local storage. Network speed is determined by local IT infrastructure. If using local storage Blaze recommends using drives which support transfer rates of 500 Megabits/sec or greater. Be sure to check external reviews to verify the claimed transfer rates are achieved in practice, some drive specifications are based on the theoretical maximum of the interface used, not the actual speed of the disk.

Interface Speed	Transfer Time of 10 Gigabyte file	Examples
100 Megabits/sec	13 minutes 20 seconds	Fast Ethernet
120 Mb/sec	11 minutes 7 seconds	Standard HDD over USB 3 [1]
440 Mb/sec	3 minutes 2 seconds	Fastest HDD over USB 3 [2]
550 Mb/sec	2 minutes 25 seconds	SSD drive over USB C [3]
1000 Mb/sec	1 minute 20 seconds	Gigabit Ethernet, fastest SSD [4]

[1] examples include Western Digital My Book HDD (hard disk drive)

[2] examples include G-Technology G-Raid with Thunderbolt 3 HDD

[3] examples include SanDisk Extreme Portable SSD, Samsung T5 SSD, Western Digital My Passport SSD (solid state drive)

[4] examples include SanDisk Extreme Pro Portable SSD (USB C), **SanDisk 1TB Extreme Portable SSD** (next generation), Crucial X8 Portable SSD (requires USB 3.1 Gen 2 for maximum speed)

Measurements from experiments taken prior to the 2020 A release consist of a large number of individual files (esp. images and chord length distributions) which are stored in a single directory. Transferring or backing up these directories is slowed by the number of files involved. The new data format of the 2020 A release reduces the number of files which greatly speeds file transfer.

These files can be migrated to the new data format without the loss of any data. After migration, transfer will be at least twice as fast as the old format.

Sharing Files Outside the Network

Minimizing file size simplifies share. The first step is to crop the experimental file to the relevant portions.

Then use Windows Explorer and right click on the directory with all of the Blaze data of the cropped experiment, then select send to, then select compressed (zipped) folder. Then all of the Blaze data will be zipped into a single file for easier sharing.

IT/Network Questions

Q: Are there any issues with adding the PC to a domain?

A: There are no issues with adding the PC to a domain. The name of the PC Domain (if any) is recorded in the “Experiment” file for each data-collection run.

Q: Are any anti-virus exclusions required?

A: None are required however for performance improvement at high data acquisition rates the “EXPERIMENTS” folder & its sub-folders can be excluded from real-time scanning. The default location of “EXPERIMENTS” folder:

%userprofile%\documents\Experiments \

of the user account running the software the first time on that PC.

Q: What is the data location for backup?

A: All data collected is stored under the “EXPERIMENTS” folder as described above.

User editable Application configuration data is stored under \etc\BlazeMetrics\... on the same drive as the Blaze Metrics software is installed (usually the C drive)

Q: Can local accounts be disabled after setup?

A: Yes

Q: Is renaming the computer allowed?

A: There are no issues with renaming the computer. The name of the computer is recorded in the “Experiment” file for each data-collection run.

Q: Can the Blaze computer run standalone – not connected to the network?

A: Yes, except for the OPC Connectivity there is no network requirement for the Blaze_UI or Blaze_Office software.

Q: Does the Blaze_UI do any automatic downloads or upload of data to the network?

A: No, there is no automatic data upload or download and no automatic updating of software.

Q: Can software be run on an individual Active Directory (AD) account?

A: Yes, the software can be run from any user account with the following privileges:

- i. Read + Execute privilege to the folder tree and contents where Blaze Metrics software is installed (C:\BlazeMetrics\...)
- ii. Read + Write + Update privilege to the “EXPERIMENTS” Folder and contents.
- iii. Read + Write + Update privilege to the folder “\etc” Folder and contents.
- iv. Access to USB devices

Comparing Blaze Results to Older Technologies Including FBRM®

Typically, the Blaze will trend in a similar fashion to FBRM® (registered trademark of Mettler Toledo). Since the FBRM® is reporting a scan derived chord length distribution it will differ in the following ways:

1. FBRM®’s circular scan goes with and against the flow of particles thus always over-sizing and under-sizing and providing a broader distribution. Blaze doesn’t use scanning and has no broadening.
2. FBRM® readings are a function of particle speed. The ratio of particle speed to the fixed scan speed of FBRM® determines the degree of over and under-sizing. Average particle speed typically changes during a process because of things such as increased solids loading (crystallization), same solids loading with smaller particles (milling), solution viscosity changes with temperature (cooling), and these measurement artifacts will convolute the measurement of the particle system under investigation, sometimes significantly, sometimes not. Several processes reporting size changes during cooling with the FBRM® were reinvestigated with the Blaze—and Blaze chord length data and images showed that no changes occurred. Blaze, with an effective ~10ns image acquisition, is not impacted by particle speed changes within the resolution of the instrument.
3. FBRM® has a significantly narrower dynamic range which is a critical deficiency in some key applications:
 - a. When particles change from opaque to translucent e.g., after seed addition when a milled seed surface heals to form a smooth surface. In many cases this effect is significant enough that FBRM® counts go to zero (attributed to non-existent ‘seed dissolution’) while large clear well-formed crystals are visible in Blaze Microscopy and trends.

- b. In crystallization space, the extended dynamic range of the Blaze is also particularly significant when comparing different solvent systems. Solvents differ in refractive index, causing FBRM® chords to be measured differently in different solvents. Although Blaze does not eliminate this impact, it is significantly reduced. Note refractive index changes during a crystallization, due to changes in solvent temperature, concentration, or composition as crystallization progresses. This results in artifacts that can be quite significant with FBRM® and are significantly reduced with Blaze.
4. Blaze has true resolution well below 10 µm. The FBRM® beam spot is comparable to particle size for systems below 10 µm, furthermore the beam spot size varies by model and from unit to unit. The measured chord is a convolution of beam spot and particle size.
5. On a related note, FBRM® often fails to measure agglomerates in systems of fine particles or needles. One of the key improvements made by Blaze is the algorithm that converts signal to chord length. The Blaze algorithm is much better at measuring agglomerates than older tools. It is very common that Blaze can see this second mode (as verified with the Blaze Microscopy) which does not show up in older tools. Quite important for many applications from crystallization to milling.
6. FBRM®, even the latest model, is prone to chord splitting, where the full length of a chord across a particle is broken into multiple smaller chords ([https://doi.org/10.1002/1521-4117\(200012\)17:4%3C167::AID-PPSC167%3E3.0.CO;2-T](https://doi.org/10.1002/1521-4117(200012)17:4%3C167::AID-PPSC167%3E3.0.CO;2-T) <https://doi.org/10.1016/j.ces.2008.07.023>)
7. The resulting increase in fines chords is often attributed to ‘secondary nucleation’. This effect is much less in the Blaze and if there is any increase in fine chords the Blaze microscopy can be used for verification and understanding.
8. The measurement zone volume of FBRM® is highly dependent upon solids loading and particle size causing non-linear and other unexpected measurement responses (<https://doi.org/10.1021/op800063n> <https://doi.org/10.1016/j.powtec.2007.09.011>). The Blaze hardware is designed to reduce this effect.
9. Critical nomenclature difference when comparing chord length data between FBRM® and Blaze. For both FBRM® and Blaze, the number of chords measured is proportional to their probability of measurement. For example, the edge (short) chords of a sphere have a lower probability because there is less area where edge chords can be measured, whereas the most common chords are those near the diameter because there is more area, hence a greater probability of measurement. For this reason, all chord measurements are inherently weighted by their chord length. In other words, the ‘as measured’ data is innately length weighted. To clear up the discrepancy with older chord length based technologies, the table below shows the correlation between the incorrect nomenclature and the correct nomenclature:

	FBRM®	Blaze
Chords as measured	Unweighted	Length weighted
Chords multiplied by length	Length weighted	Square Weighted
Chords multiplied by length ²	Square Weighted	Cube weighted
Chords multiplied by length ³	Cube weighted	Not available

It is important to note that both tools provide data that is a function of the optical properties of the solution and solid they are measuring. The Blaze and most FBRM® models use chord measurement algorithms that work for a broad range of materials, so they do not measure any material in an absolute way. Tuning an algorithm to accurately measure a specific material will reduce its ability to work well over a range of materials. For example, tuning an algorithm to absolutely size a PVC sample will reduce its ability to measure crystals due to their very different optical and physical properties. Blaze supports the use of different algorithms which can be implemented on a customer specific basis when the application is for a specific process. The default algorithm is Blaze model specific and generic for general research and development which sees a wide range of materials.

A key goal of Blaze development was to eliminate or reduce as much as possible the FBRM® artifacts described above. Even though the optical properties of the solution and solid will always play a role, Blaze has reduced these artifacts which impact process development, as well as other artifacts arising from the scanning methods of measurement.

A direct comparison, by measuring the same process with both FBRM® and Blaze, is a great way to test any of the statements above.

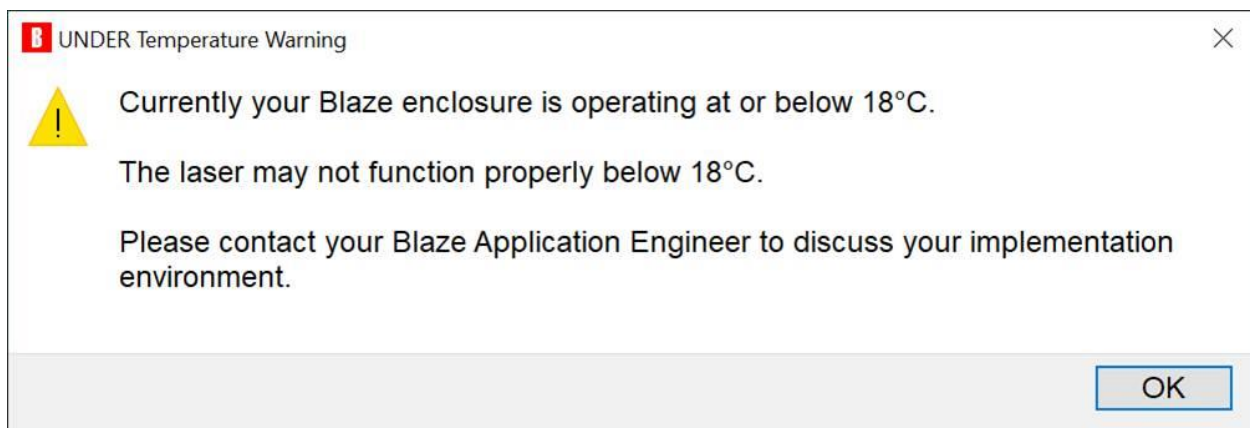
Appendix E Errors and Warnings

Laser

The laser for Blaze microscopy has upper and lower operational temperature limits. The laser is located in the main enclosure, not in the Blaze probe. Verify the cooling fans are not blocked, there is adequate space around the main enclosure and the room ambient temperature is between 18 and 35 °C. If these steps do not resolve the problem, contact your Blaze Application Engineer.

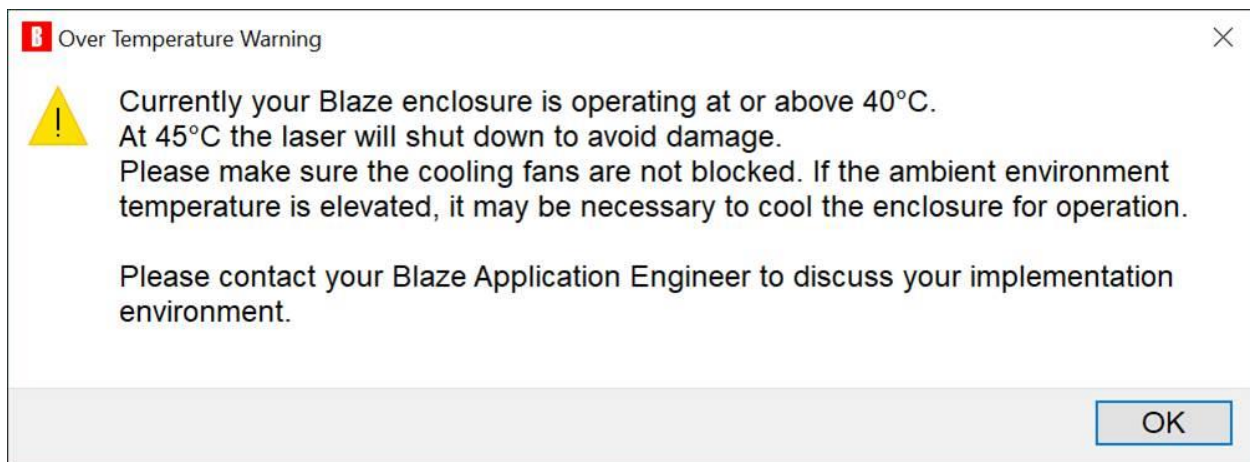
Under Temperature Warning

If the temperature is below the lower operational limit a warning will appear



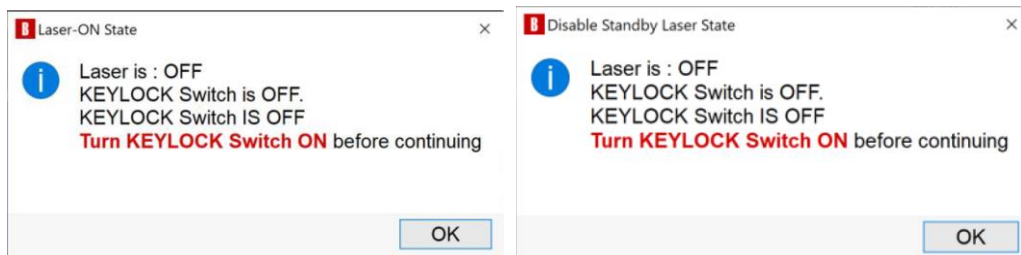
Over Temperature Warning

If the temperature is above the upper operational limit the laser will shut off and a notice will appear



Laser State Warning

If the laser is somehow off during either software start up or operation, one of the following messages will appear:



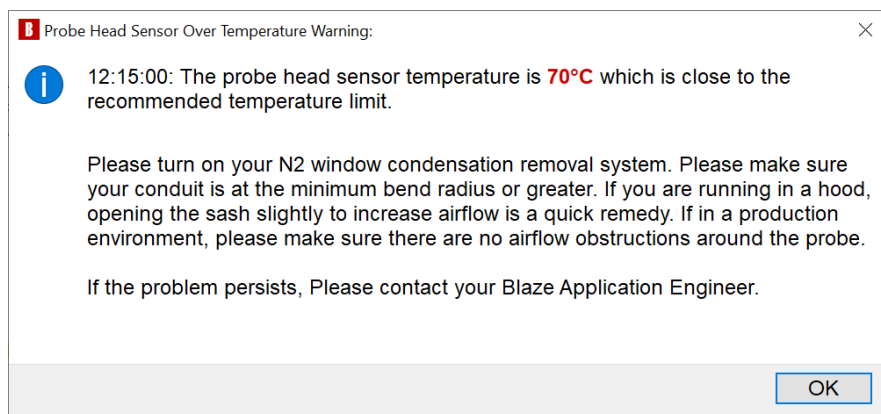
Make sure the laser key in the Blaze enclosure is turned to the on position, click 'ok', and make sure the laser icon in the software is on . If the laser icon is off,  click to switch it on. The Blaze should operate normally after these steps are taken.

Probe Head

The probe head for Blaze microscopy has an upper operational temperature limit. The temperature is measured directly in the Blaze probe head, near where the conduit enters. Primary cooling is by use of the Probe Head Cooling; the Condensation Prevention also provides some limited cooling. Verify the gas lines are connected, turned on and gas is flowing to the probe head. Check for air obstructions around the probe head and verify the conduit bend radius is at least 10" (25 cm) for conduits < 4m in length and at least 12" (31 cm) for conduits > 4m in length. Slightly open the sash of the fume hood to increase air flow as a quick remedy. If these steps do not resolve the problem, contact your Blaze Application Engineer.

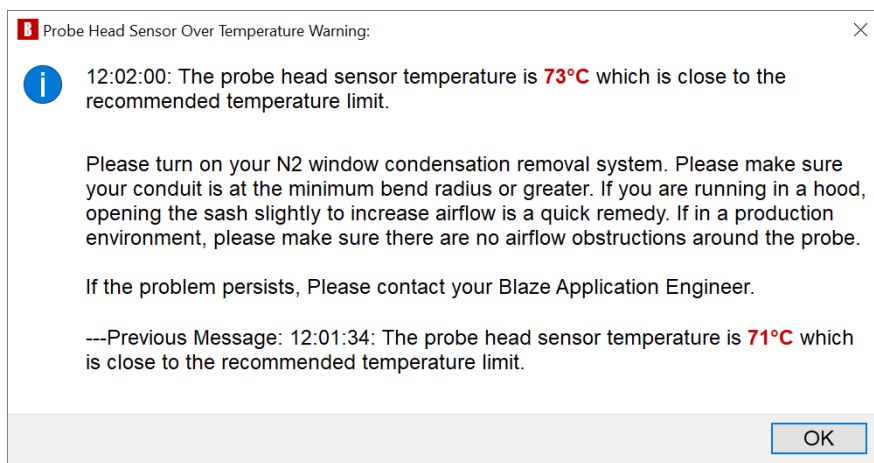
Over Temperature Notice

When the internal probe head temperature approaches its limit, a message appears:



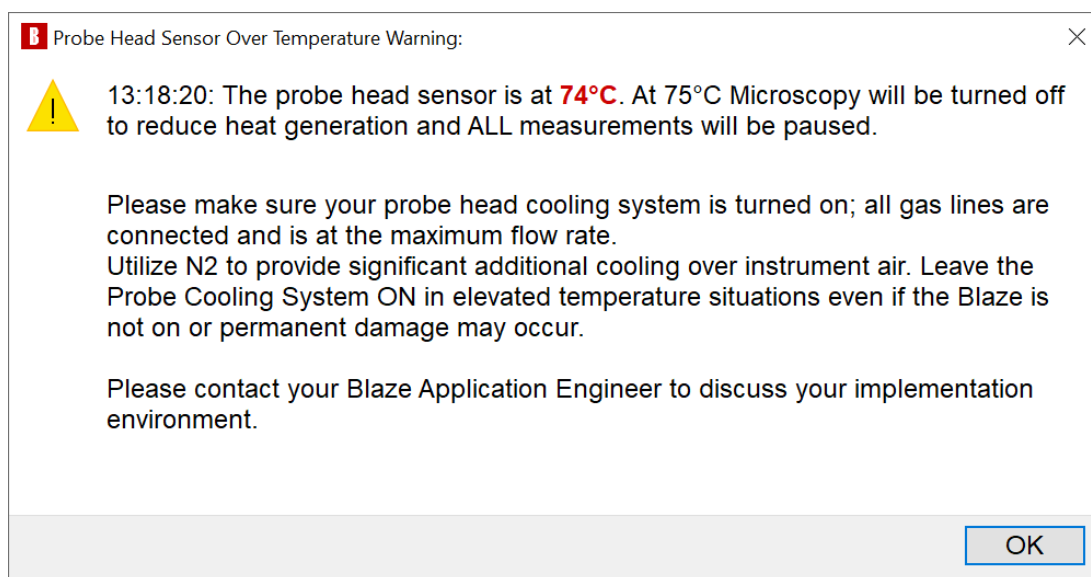
A new message appears with each increase in temperature.

If the message is ignored and the temperature increases the new message includes the temperature of the previous message:



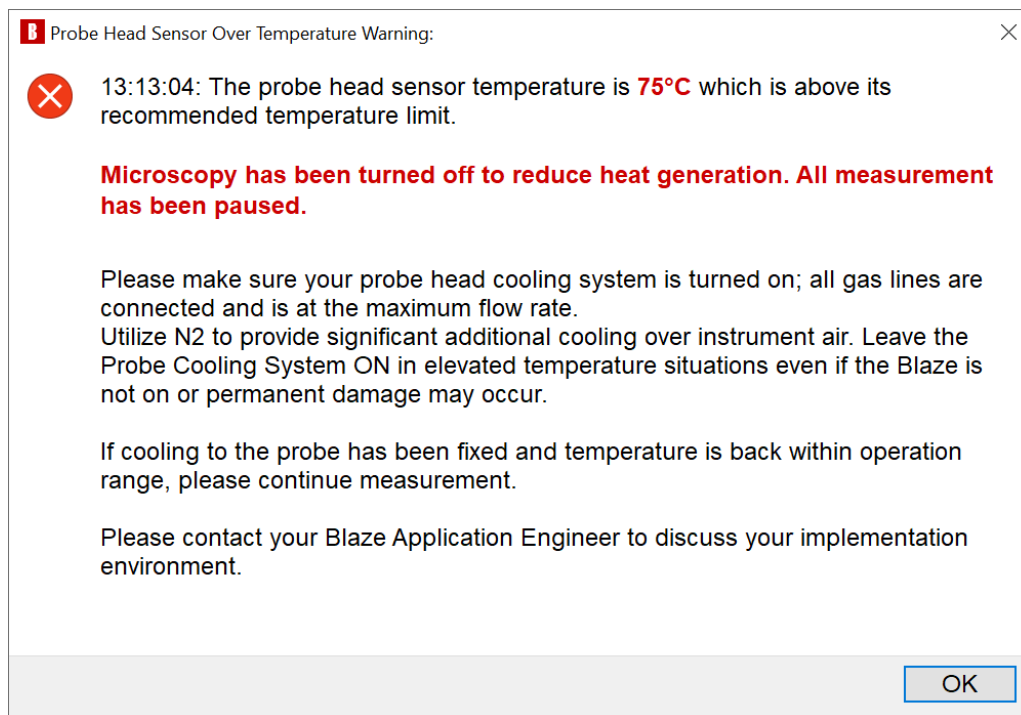
Over Temperature Warning

When the internal probe head temperature reaches its limit, a final warning appears:



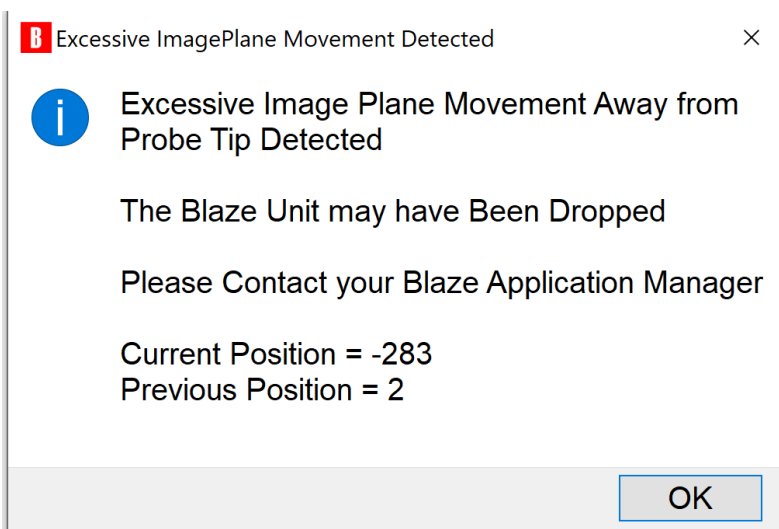
Over Temperature Error and Measurement Pause

When the internal probe head temperature exceeds its limit, Blaze imaging and measurements are paused, and an error message appears. To resume measurements first reduce the probe head temperature and then press play .



Excess Image Plane Movement Detected

If the system detects the image plane is far from its expected position this message appears:



The two most likely causes are dropping of the probe or manually setting the image plane to far outside of the normal operating range. Inspect the probe for signs of damage from dropping. Do not put the probe in solution if there are any signs of damage to the window! If there are no signs of having been dropped use the window reference procedure to re-establish the correct image plane position.

Appendix F Index, Glossary and Abbreviations

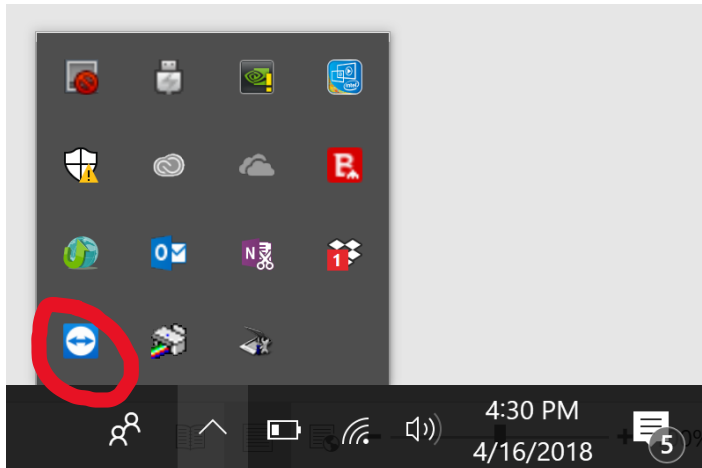
Channel Grouping	94	LW	92
Chord Length Weighting	91	Mean	91
Clean	105	Median	91
Counts.....	91	Mode.....	91
Cube weighted		Percentile	91
CW	92	Software License	12
Edge_to_edge		Square Weighted	
E2E	90	SW	92
High Dynamic Range Turbidity (HDR_Turbidity)	94	WEEE	13
Length weighted			

Appendix G Team Viewer

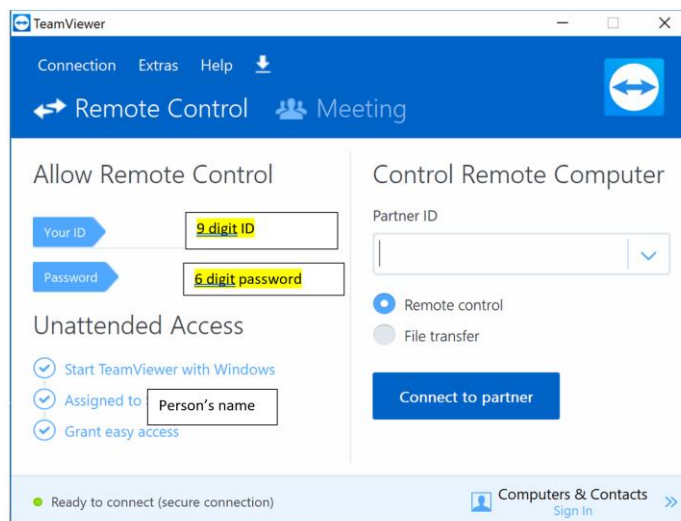
Team Viewer is software which allows remote viewing and control of one computer by another when both are connected to the intranet. All Blaze supplied computers are shipped with Team Viewer pre-installed to allow for instant service by remote access.

For training, software upgrades, service diagnostics, or to get a second opinion on the data simply contact Blaze with your Team Viewer log in information.

To access Team Viewer, click on the system tray icon in the lower right and select the Team Viewer icon



The Team Viewer window will appear as shown below:



For additional information about TeamViewer, please visit:

<http://teamviewer.com/>

Let Blaze know the 9-digit computer ID and 6-digit password. Note the password changes each time the computer is rebooted. For security reasons it is best to send the password and computer ID separately.

Appendix H First Time Installation Instructions for Blaze UI on Customer Supplied Computer

Main Steps

1. Install needed drivers for Blaze hardware and software for remote support
 - This is for a new computer without prior Blaze installation.
 - The drivers should only be installed once per system.
 - This step is not required for future upgrades to the Blaze software.
2. Install Blaze UI software for acquiring data with Blaze 400 or 900 systems.
 - For data analysis only install Blaze Office not the Blaze UI software.
 - Install this whenever we have a new version or if you are not sure what is needed. There is no harm installing this kit multiple times.
3. Optimize computer settings for fastest computer response
 - This ensures highest resolution display and fastest computer response.
 - This step is not required for future upgrades to the Blaze software.

Computer Requirements

Windows 10 or 11 OS 64 bit version. 32GB or more RAM; 1TB SSD (or second separate 512GB SSD for Blaze application and data only); Intel i9-8950HK processor, GTX 1070Ti GPU, and 4K monitor (or best Dell available in your region). Laptop or desktop (external 4K monitor for laptop recommended).

Other Requirements:

The following files provided by Blaze:

7z1900-x64.exe

3rd Party Drivers.7z

BlazeMetricsUI-148-02-09-XXXX.msi

Administrative privileges for installation

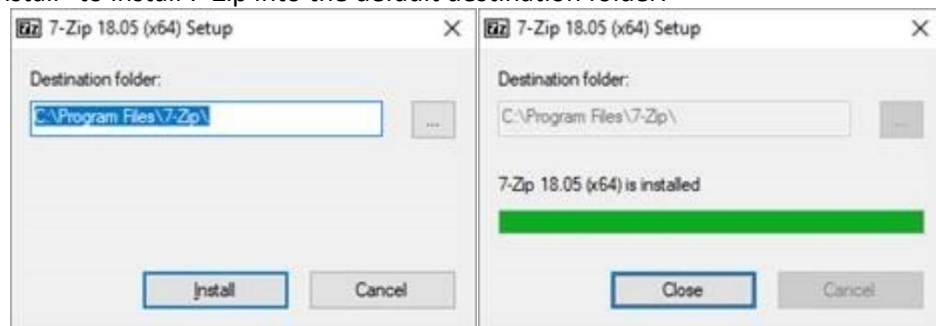
Internet access

DO NOT proceed until all requirements are met.

Step 1 Installing Drivers and Remote Support Software

DO NOT connect the computer to the Blaze system when doing this step

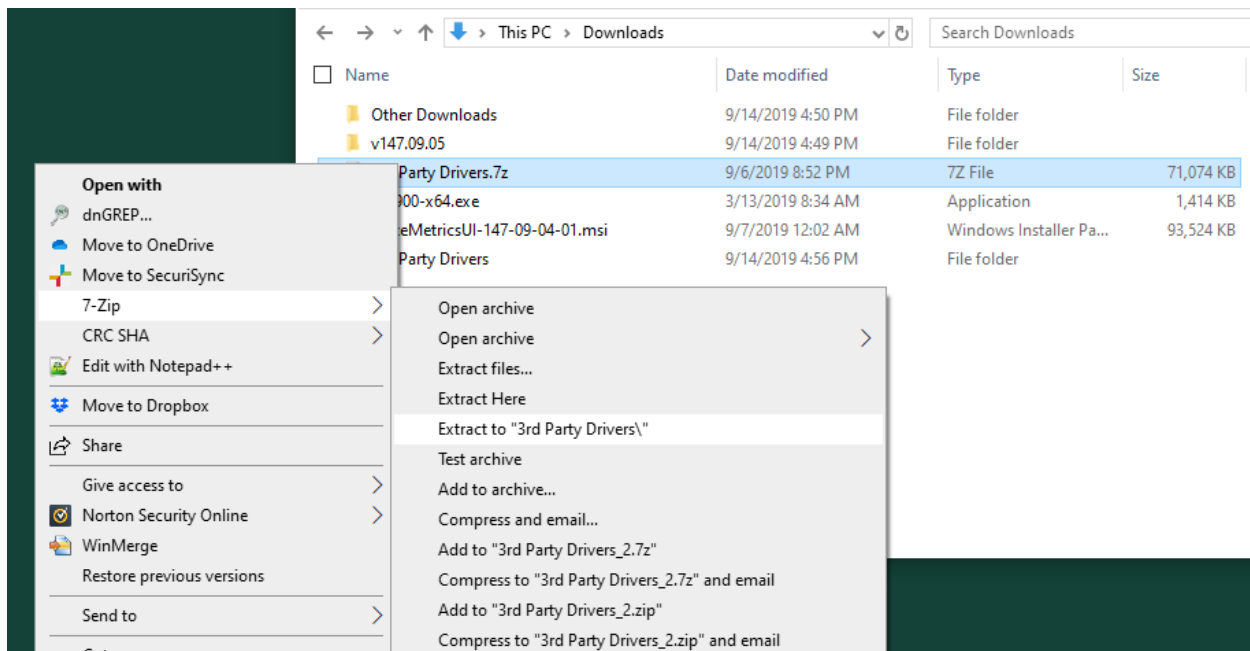
1. Copy these two files to the computer for use with the Blaze:
7z1900-x64.exe
3rd Party Drivers.7z
2. Install 7-Zip by double-clicking on the file “7z1900-x64.exe” (Blaze install files are compressed by 7-Zip)
 - a. Click “Yes” when asked if you “want to allow this app from an unknown publisher to make changes to your device?”
 - b. Click “Install” to install 7-Zip into the default destination folder:



Then click on “Close” to complete the installation.

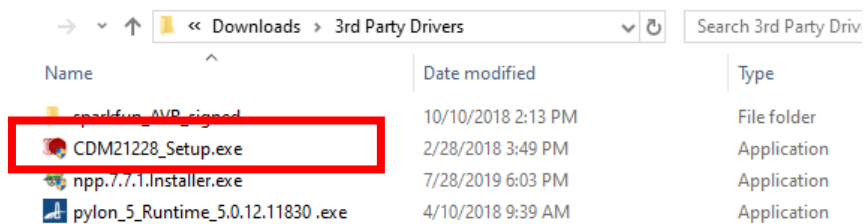
Note: if there is some corporate policy issue that prevents this version of 7-Zip (19.00) to be installed, any version newer than version 15.0 should work.

3. Use 7-Zip to extract (decompress) the file “3rd Party Drivers.7z”
 - a. Locate the file “3rd Party Drivers.7z” on the computer
 - b. Right Click on the file and select 7-Zip → extract to “3rd Party Drivers\”

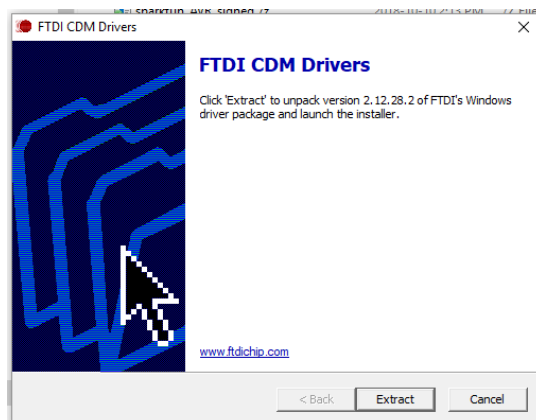


c. 7-Zip should create a folder called “3rd Party Drivers” in the current folder.

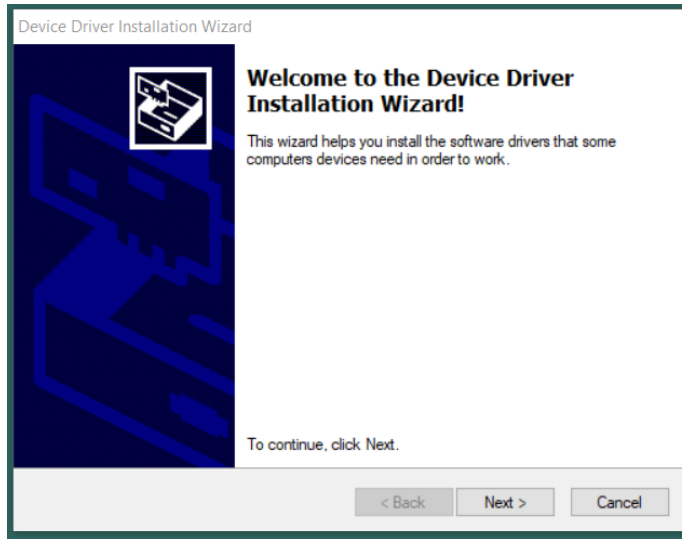
4. Open the folder “3rd Party Drivers” to install the driver: CDM21228



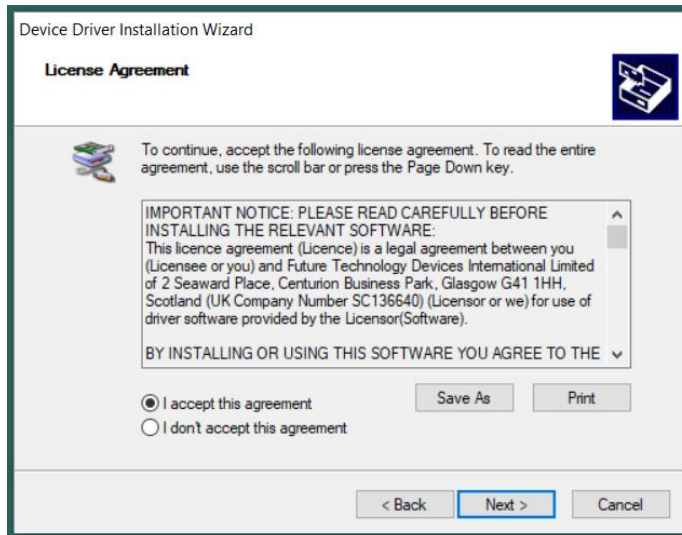
- Install “CDM21228_Setup.exe” by double-clicking on the file
- Click “Yes” when asked “Do you want to allow this app from an unknown publisher to make changes to your device?”
- Click “Extract” on the Extract FTDI CDM Drivers display:



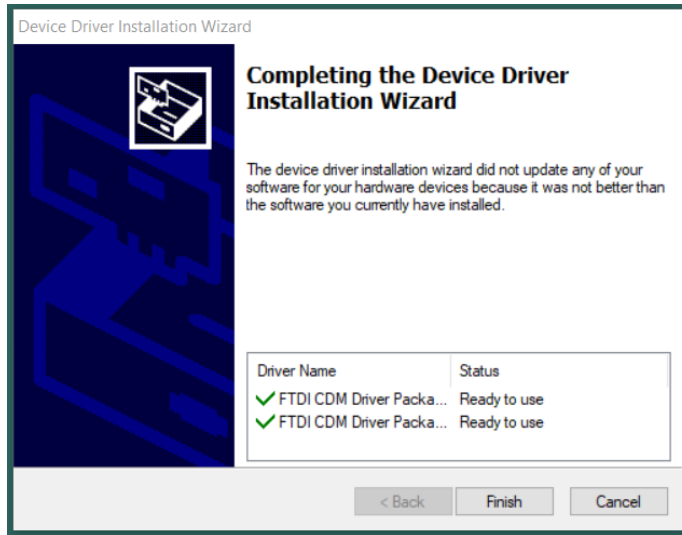
- d. Click “Next” on the Device Driver Installation Wizard:



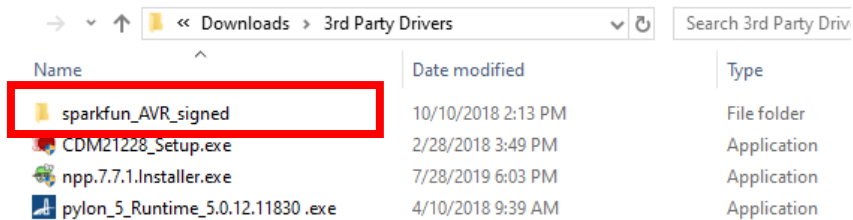
- e. Select “I accept this agreement” and click “Next” on the License Agreement:



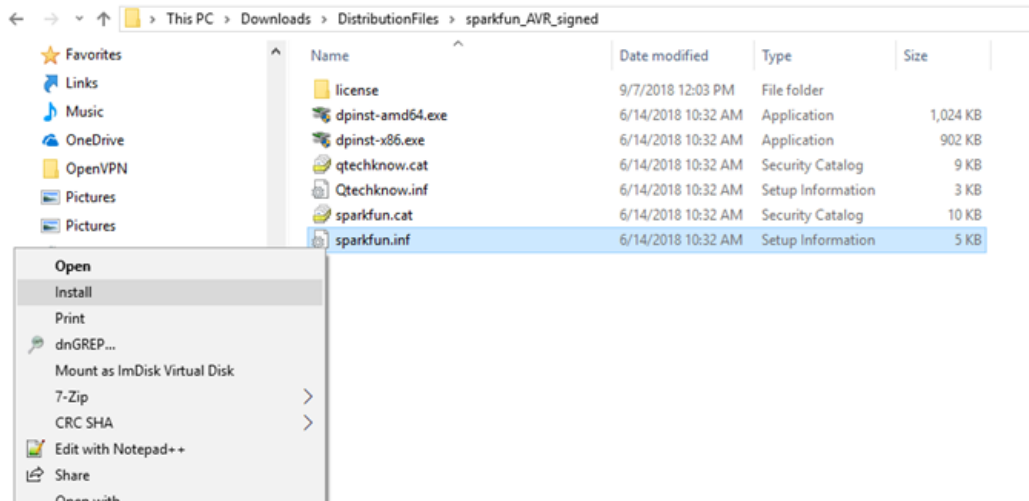
- f. Click “Finish” on the Device Driver Installation Wizard when it completes:



5. Open the folder “sparkfun_AVR_signed” to install the driver: Sparkfun

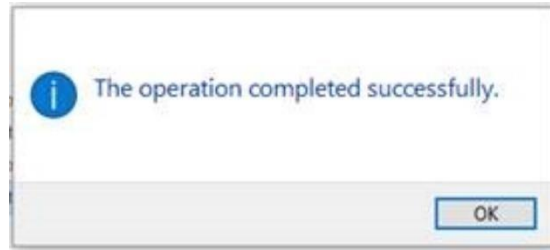


- a. Right-click on the “sparkfun.inf file” and select “Install” from the pop-up menu.

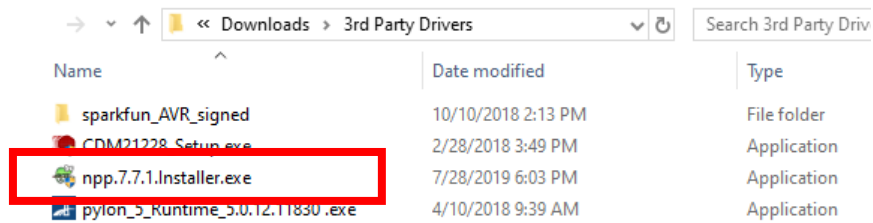


- b. Click “Yes” if you get any ‘are you sure?’ type of prompt.

- c. Click “OK” when “the operation completed successfully” message appears:



- d. Installation of drivers is complete.
6. Open the folder “3rd Party Drivers” to install NotePad++

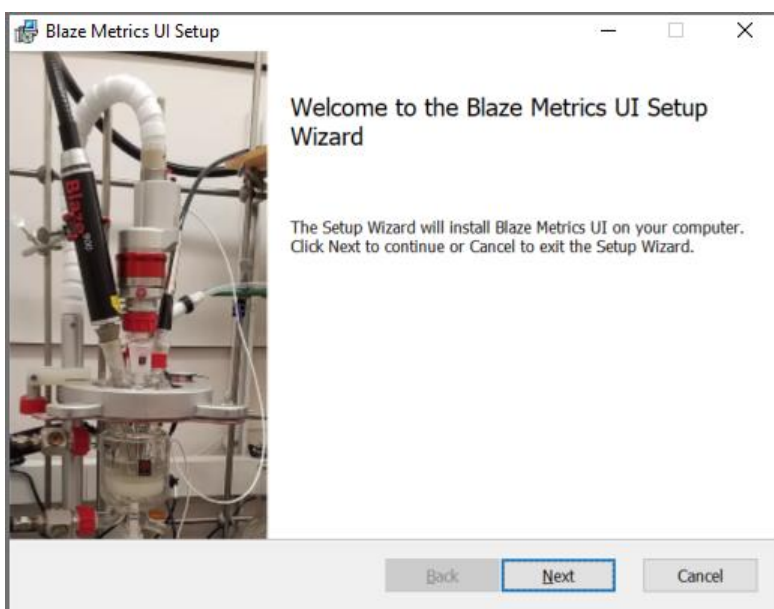


- g. Install “npp.7.7.1.Installer.exe” by double-clicking on the file
- h. Accept all of the defaults for the installation.
7. TeamViewer is used for remote service and diagnostics. Download and install TeamViewer from <https://www.teamviewer.com/en/download/windows/>

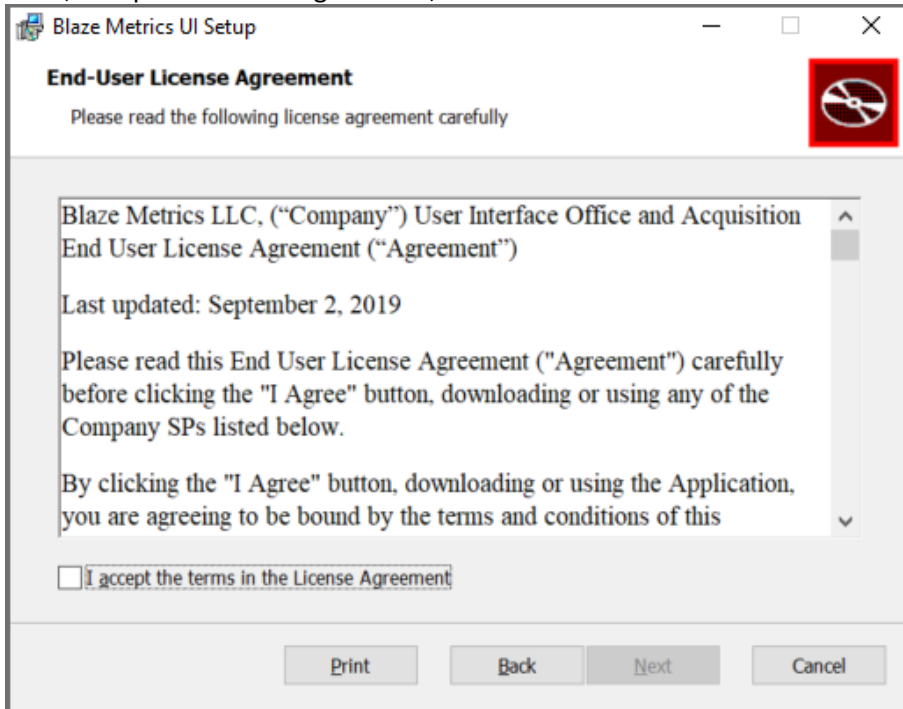
Step 2 Installing Blaze UI Software

DO NOT connect the computer to the Blaze system when doing this step.

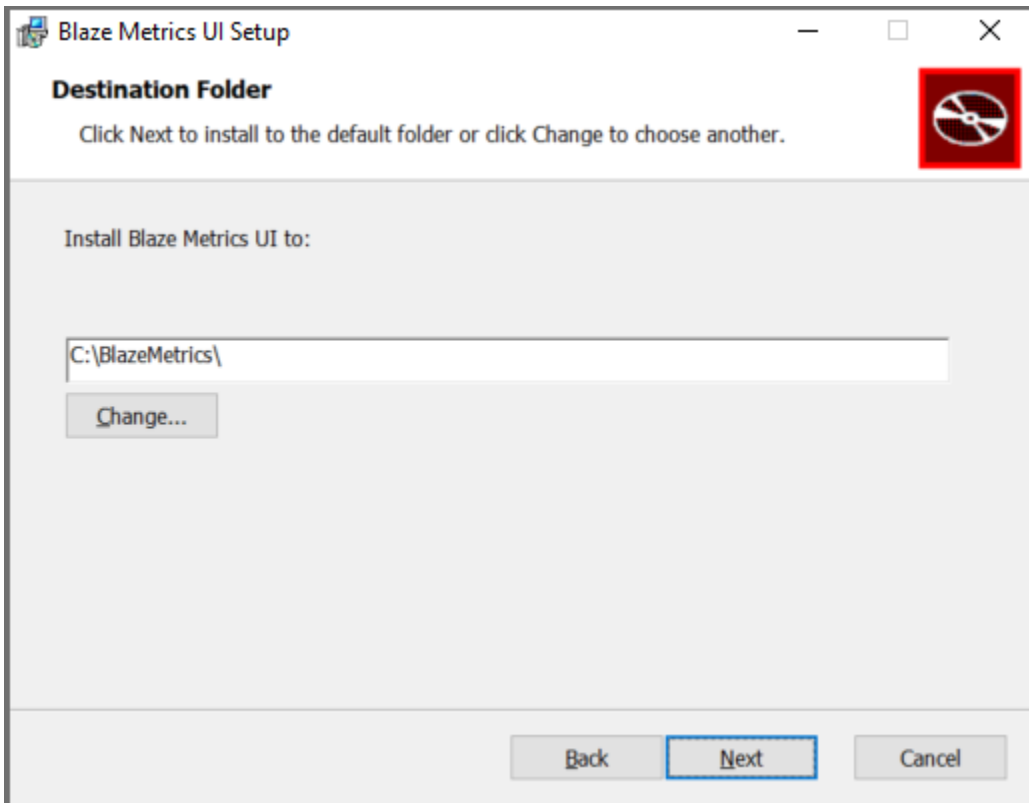
1. Copy the file “BlazeMetricsUI-148-02-09-XXXX.msi” to the computer for use with the Blaze:
2. Double-clicking on the file “BlazeMetricsUI-148-02-09-XXXX.msi”. If a system warning asks if you want to let this file make changes to your system, click on “Yes” to allow the Blaze Metrics UI Setup to continue.
3. Click “Next” on the Welcome Screen:



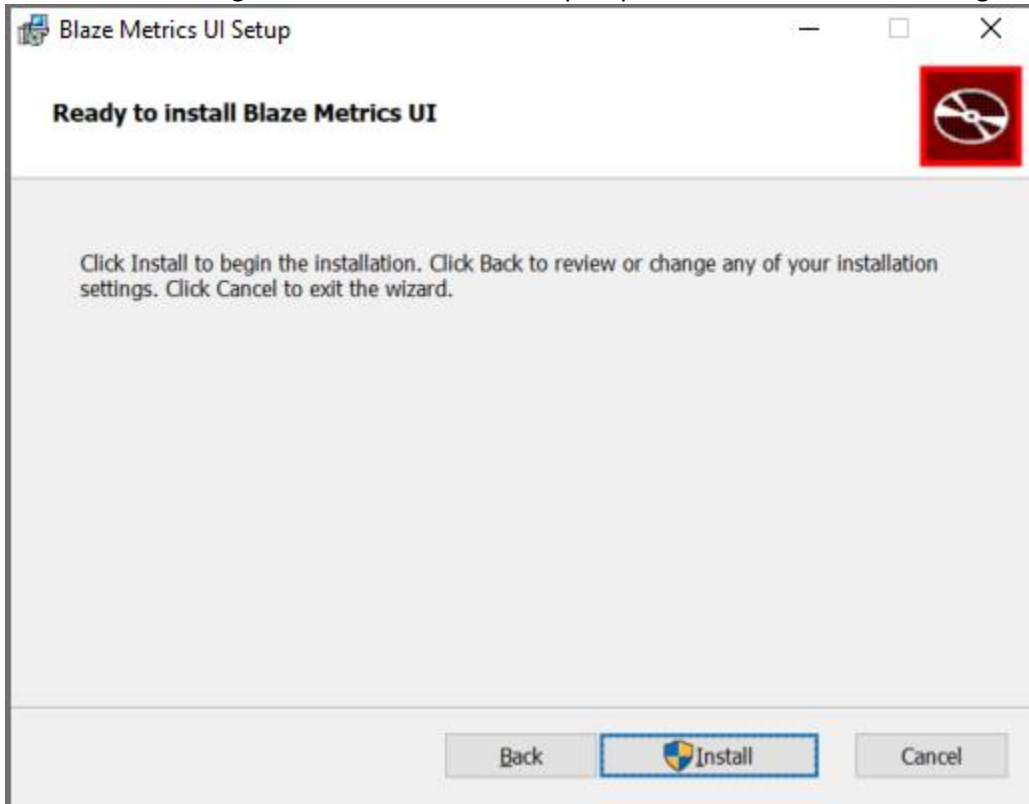
4. Read, accept the license agreement, and click “Next” to continue:



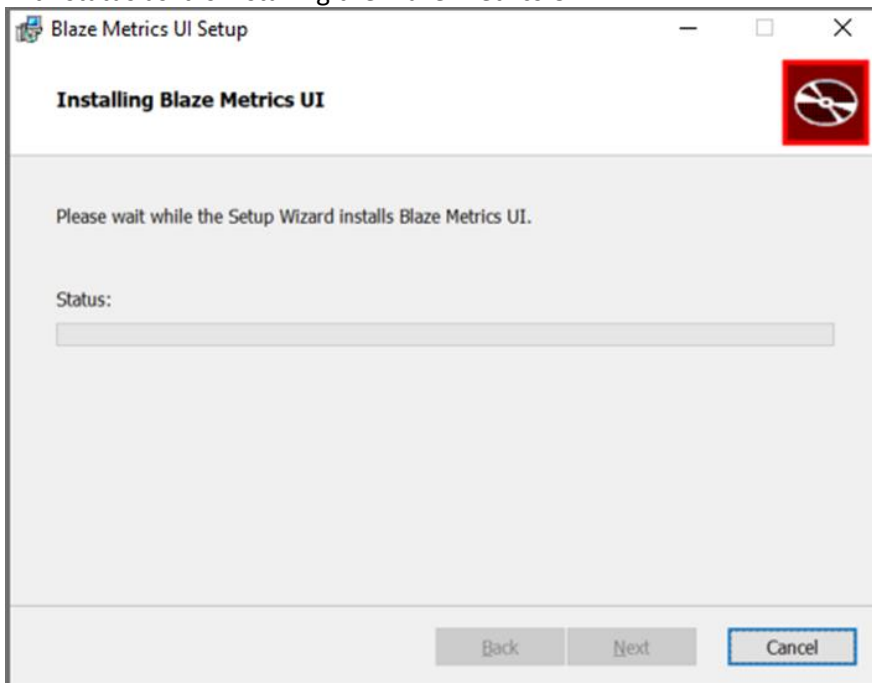
5. Accept or modify the installation location. The default location of C:\BlazeMetrics\ is recommended. Blaze software should be installed on the solid state drive. Click “Next”



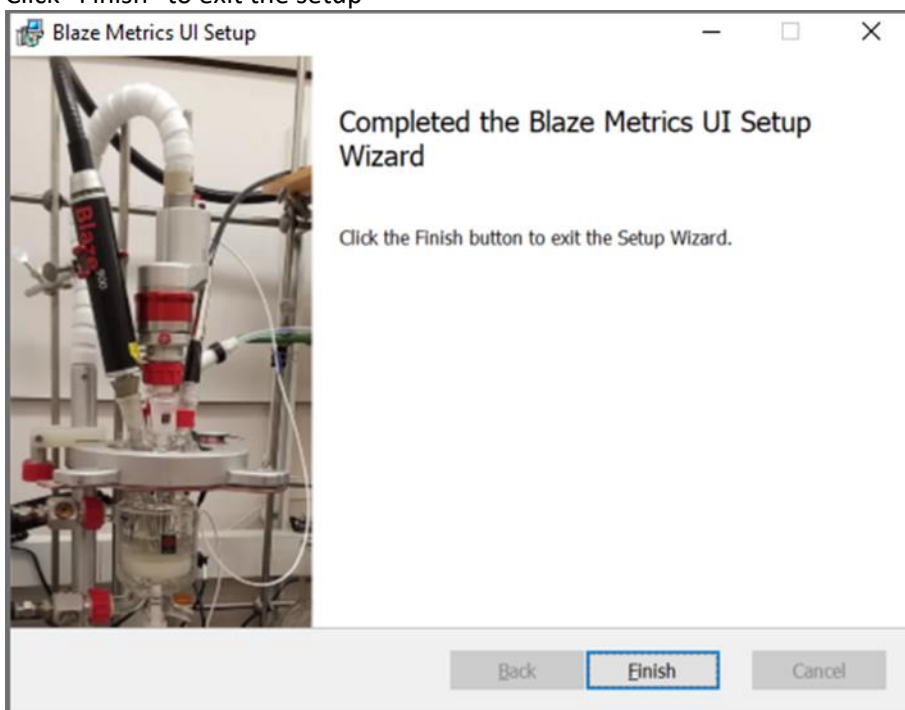
6. Click “Install” to begin the Installation. This step requires ADMINISTRATOR Privileges.



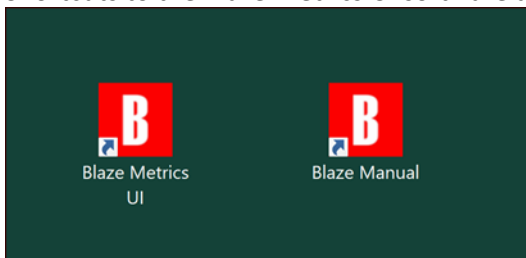
7. If there is a system warning asking if you want to let this file make changes to your system, click on “Yes” to allow the Blaze Metrics UI Setup to continue. Blaze UI Setup will update the screen with status as it is installing the Blaze Metrics UI:



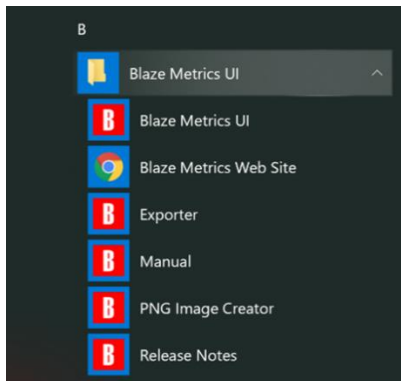
8. Click “Finish” to exit the setup



9. Shortcuts to the Blaze Metrics UI software and Blaze Manual are placed directly on the desktop:



10. All Blaze software is accessible from the START Menu in the “Blaze Metrics UI” Folder:

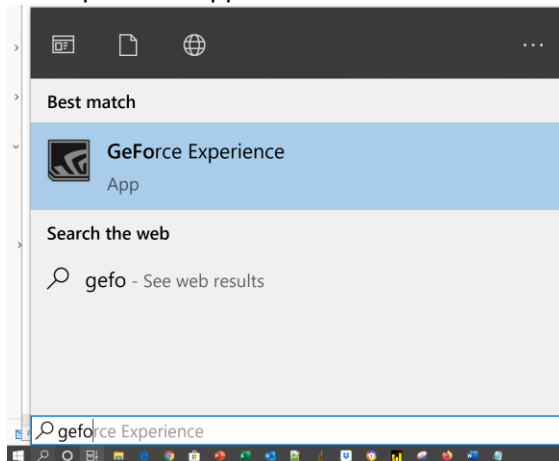


11. If using OPC for connection with reactor system please contact Blaze for additional installation step.

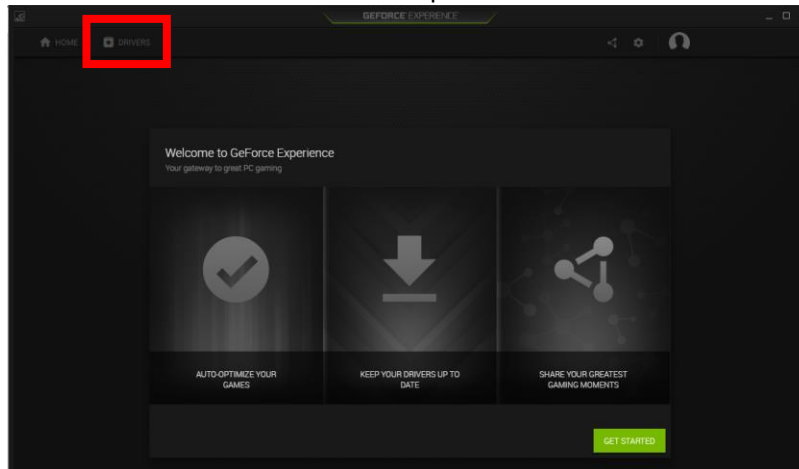
Step 3 Optimizing Computer Performance

Maximize computer responsiveness and prevent accidental interruption of data acquisition by doing these steps. If these steps are not done, the Blaze UI may lose communication with the Blaze system, may not save all images when saving at high rates, or generally be less responsive. These steps are for the initial installation of the Blaze UI on a new computer and do not need to be repeated when updating the Blaze UI on the same computer.

1. Verify the NVIDIA graphics card is using the “studio” version of the driver.
 - a. Run GeForce Experience by typing GeForce in the search box and running the GeForce Experience App:



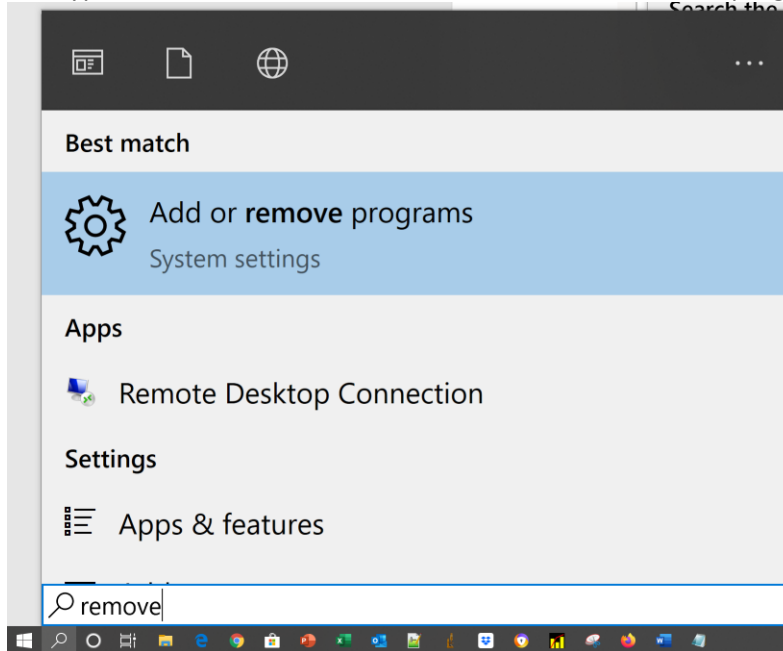
- b. Click the drivers menu at the top. Select the “studio driver” not “game ready” driver:



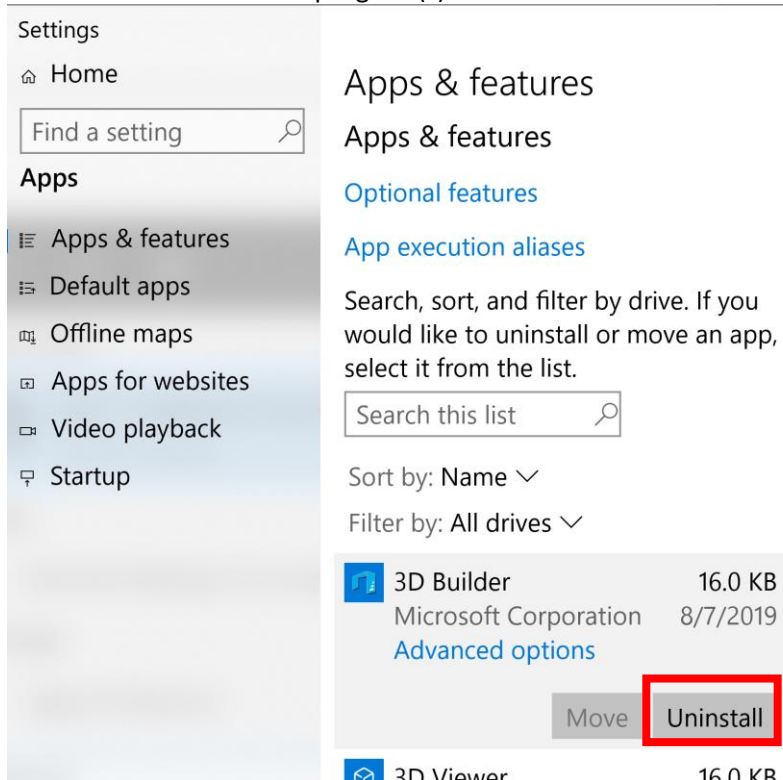
- c. If needed download the studio driver for the graphics card model from <https://www.geforce.com/drivers>

2. Uninstall unneeded software such as games, bloatware, free trial software that will not be used, etc.

- a. Type 'remove' in the search box and run 'add or remove programs':

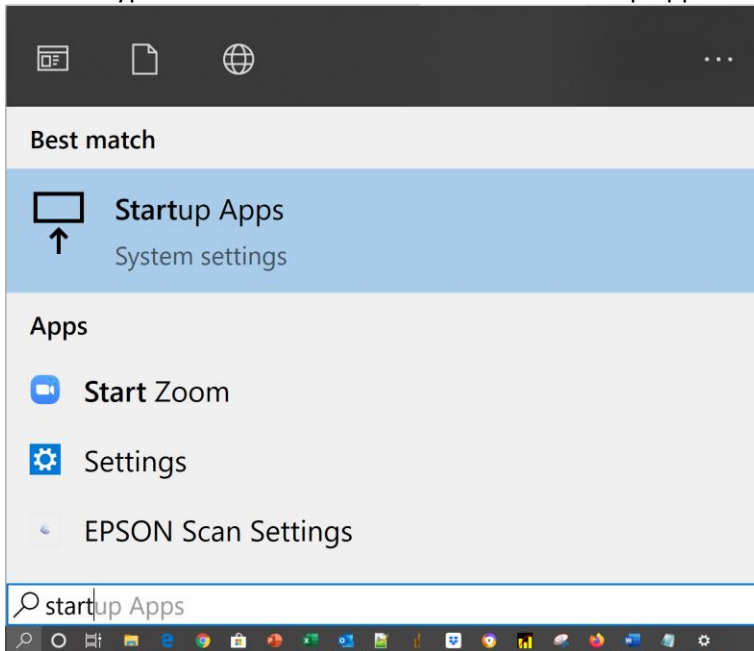


- b. Locate the unneeded program(s) and click 'uninstall':

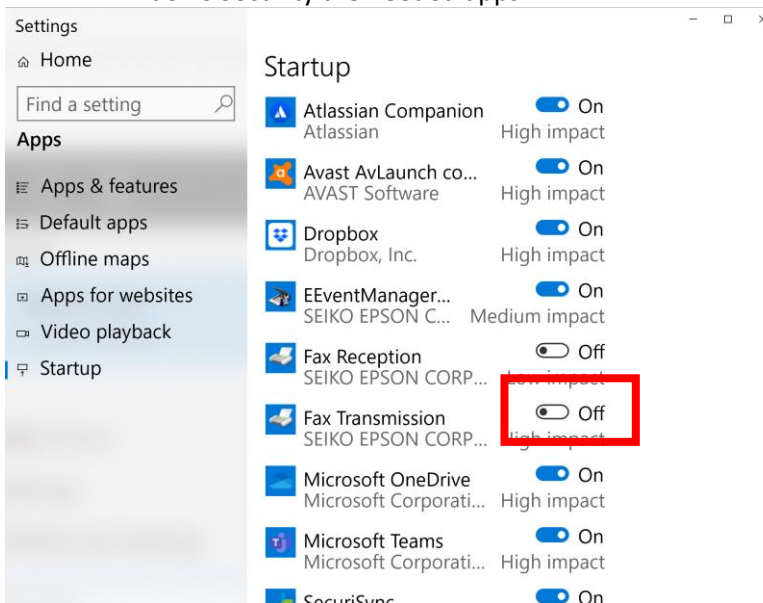


3. Limit Startup Apps to the minimum needed.

- a. Type 'start' in the search box and run 'startup apps':

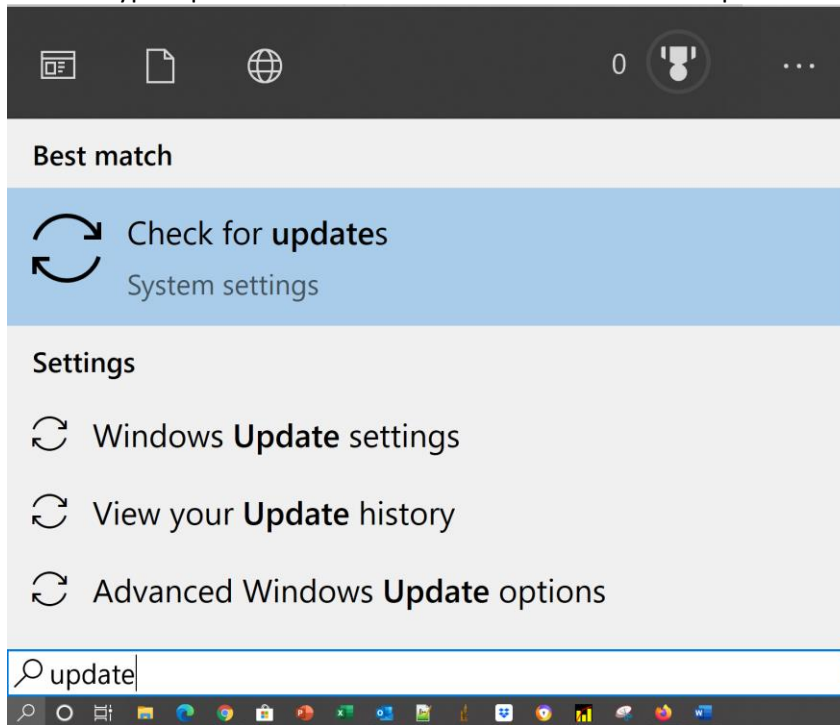


- b. Identify unneeded startup apps and set them to off. Note TeamViewer, NVIDIA, and Windows Security are needed apps:

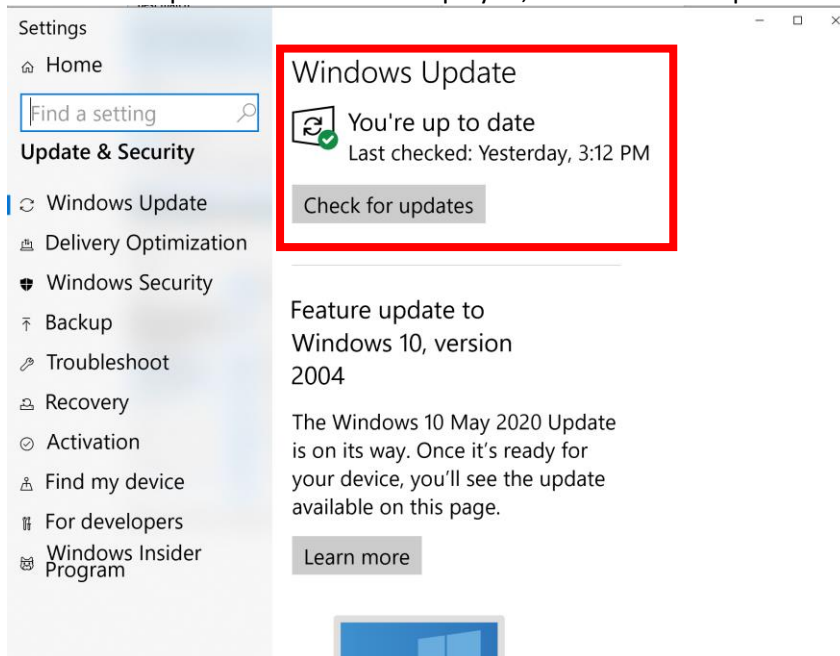


4. Check for Windows updates.

- a. Type 'update' in the search box and run 'check for updates':

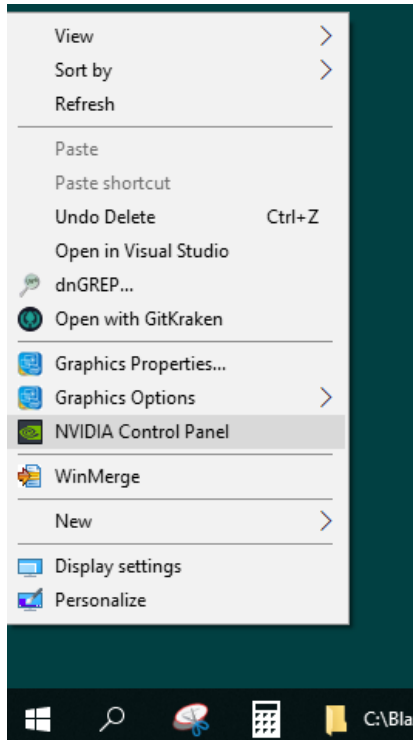


- b. The update status will be displayed, click 'check for updates' if needed:

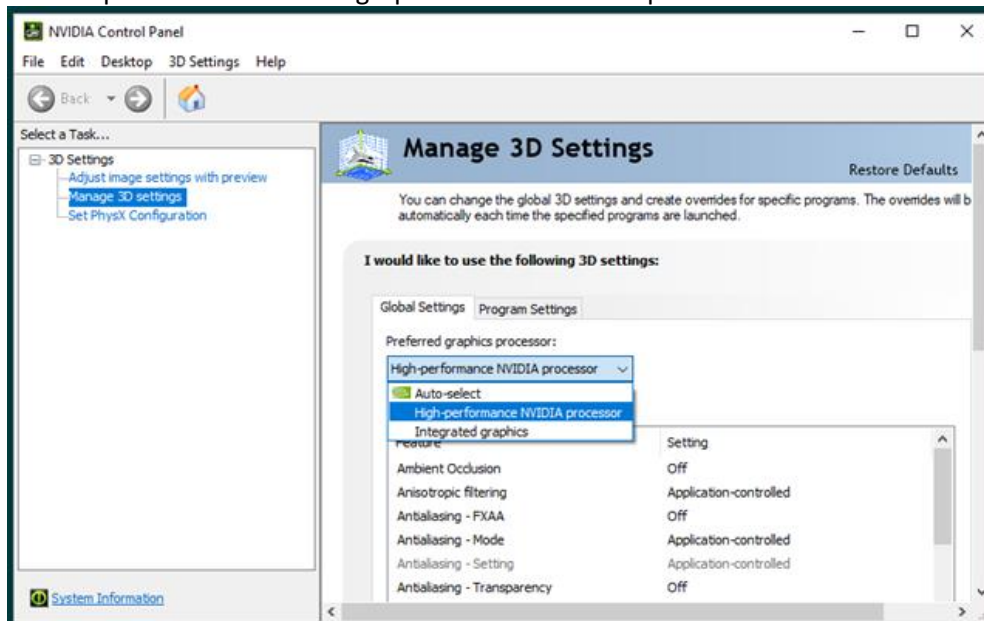


- c. If not up to date perform the update.

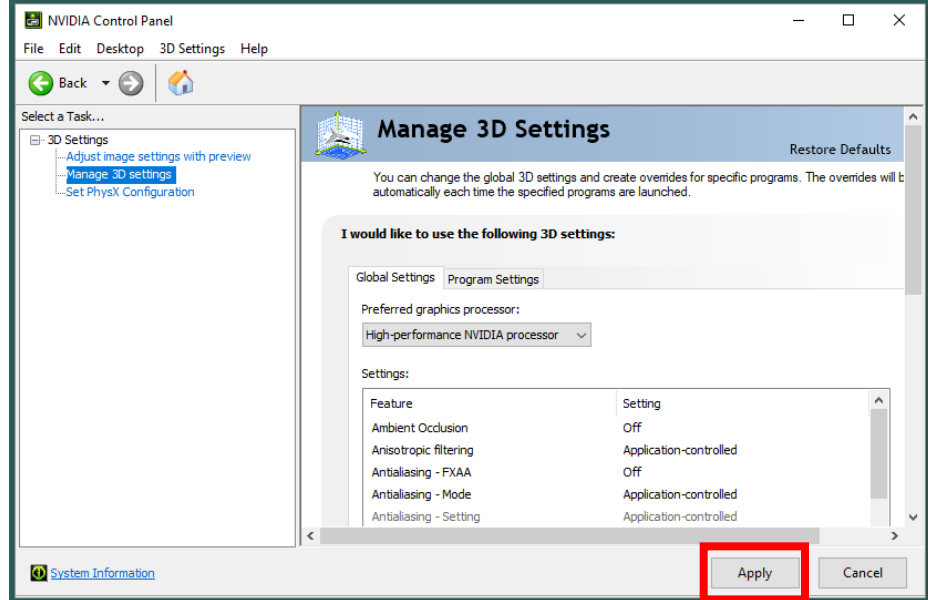
5. Use the Blaze UI with the high-performance graphics card.
 - a. On an EMPTY spot on the desktop, Right-click to get the pop-up menu – select “NVIDIA Control Panel”:



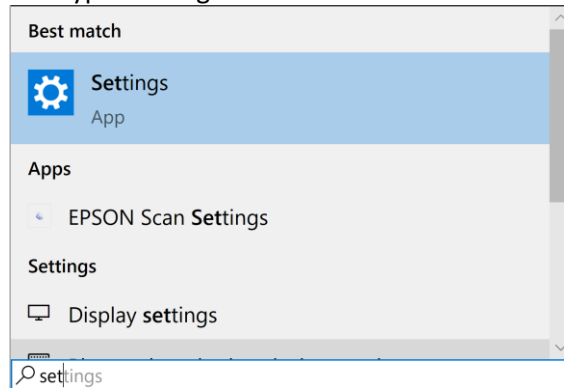
- b. Click 3D Settings -> Manage 3D Settings -> Global Settings -> Preferred graphics processor: Select “High-performance NVIDIA processor”:



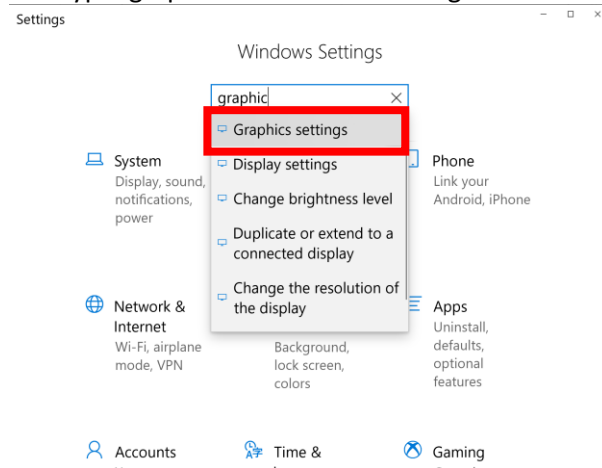
- c. After selecting click the "Apply" button then close the window by clicking in the upper right corner:



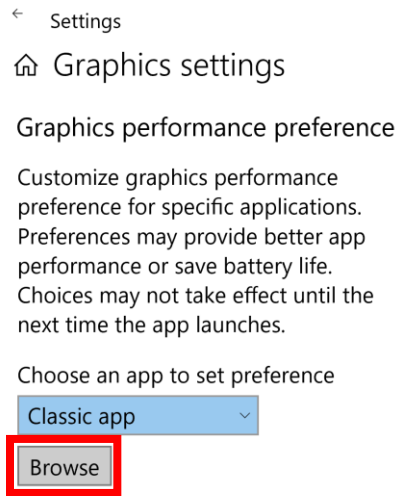
- d. Type 'settings' in the search box and run 'settings' app:



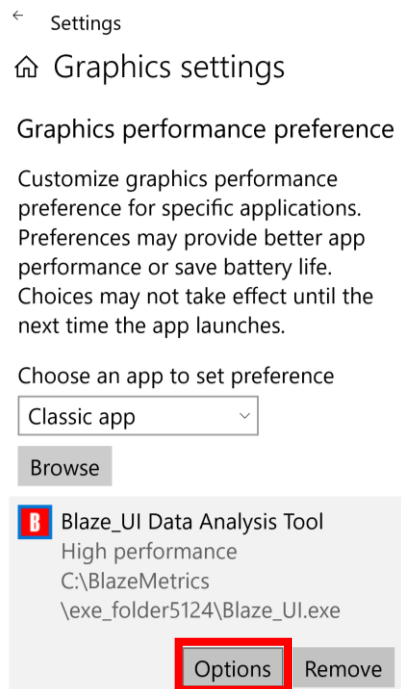
- e. Type 'graphic' in the find a setting box and run 'graphic settings':



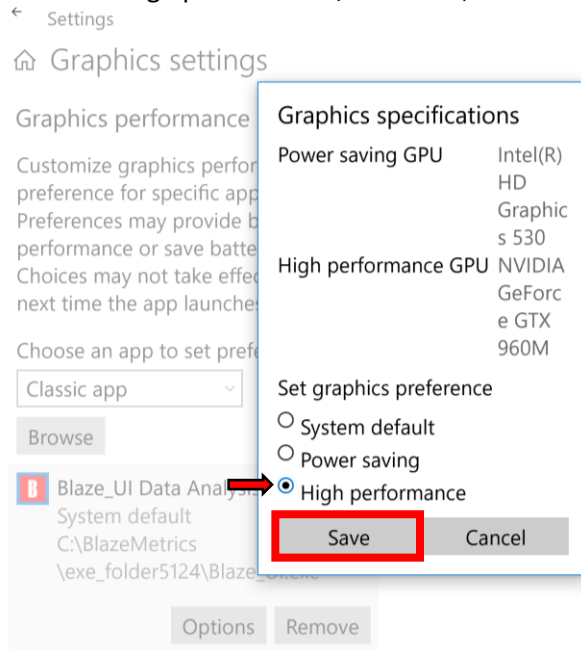
- f. Select classic app and click on browse:



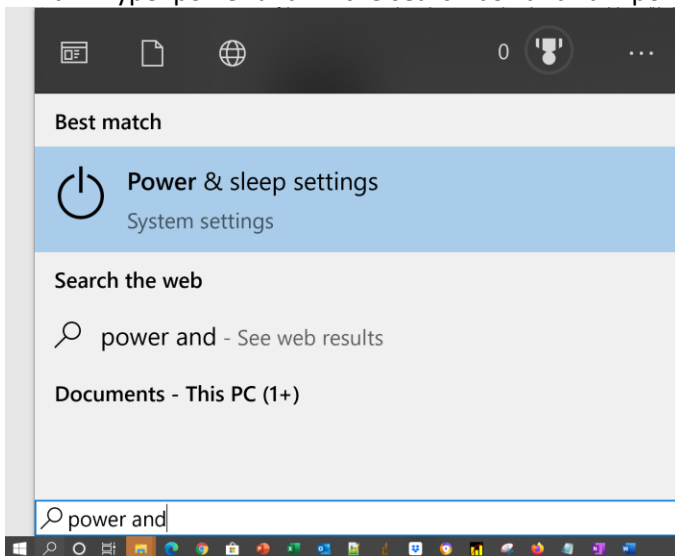
- g. Go to the directory “C:\BlazeMetrics\exe_folder5124”, select “Blaze_UI.exe”, and click add. The following display will appear, click on the button “options” below the Blaze icon:



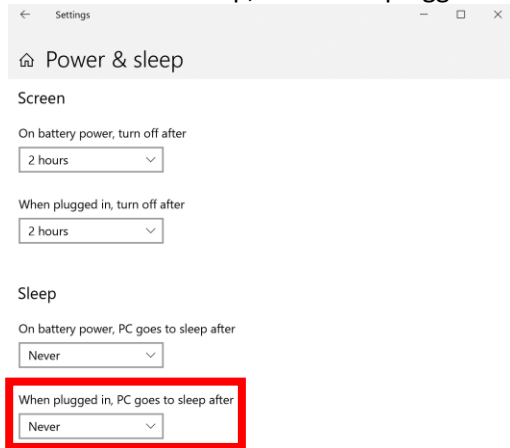
- h. Select high performance, click save, and exit settings:



6. Prevent Windows settings from forcing the computer to sleep while acquiring data. Note there may be an additional company specific computer policy which forces computers to sleep that the company's IT group must disable. This can be done manually as described below or using an automated script available from Blaze. The Blaze power management scheme is called "Blaze_UI Always On". The automated script requires administrative privileges to run.
- a. Type 'power and' in the search box and run 'power & sleep settings':



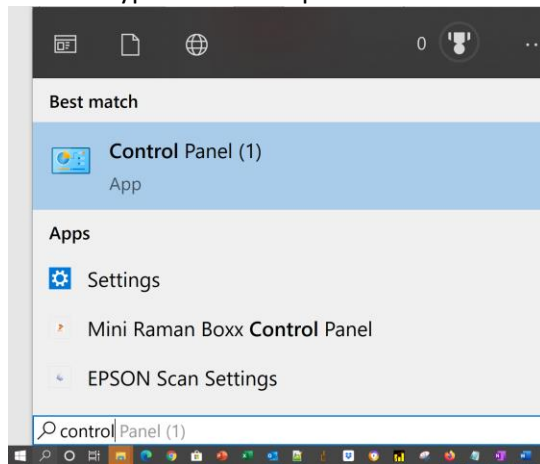
b. Under sleep, set 'when plugged in PC goes to sleep after' to "never":



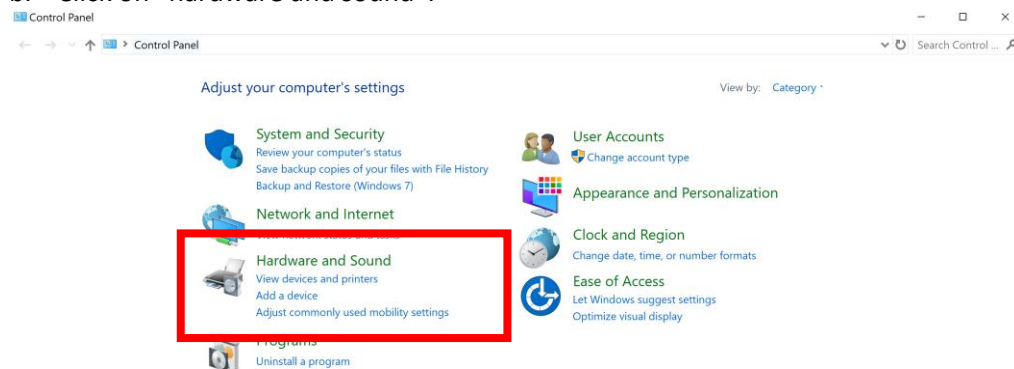
c. After selecting click the "Apply" button then close the window by clicking in the upper right corner.

7. Prevent Windows from suspending USB ports and interrupting communication with the Blaze system.

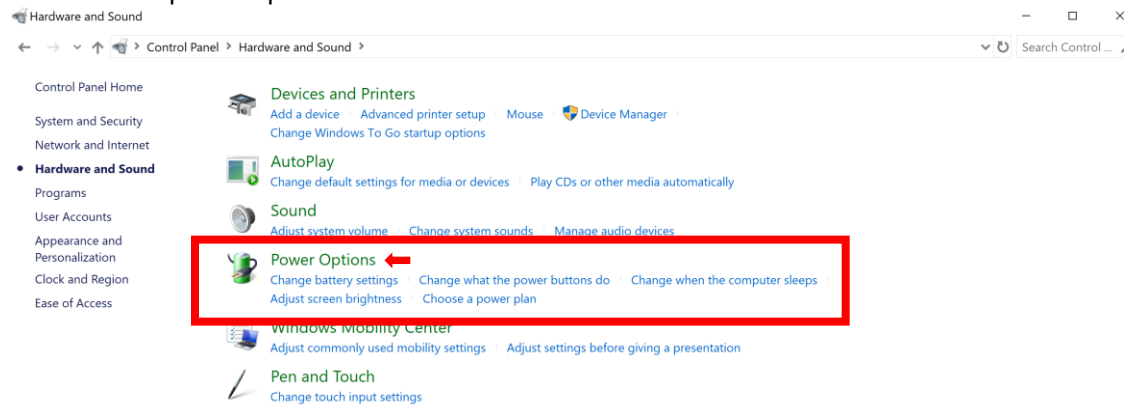
a. Type in "control panel" in the windows search bar, and click on the control panel app:



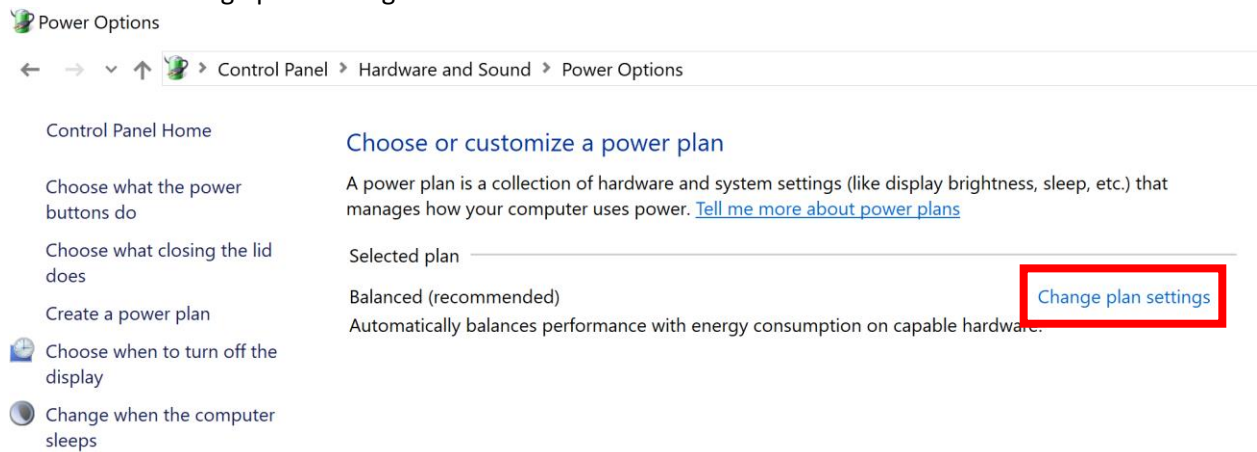
b. Click on "hardware and sound":



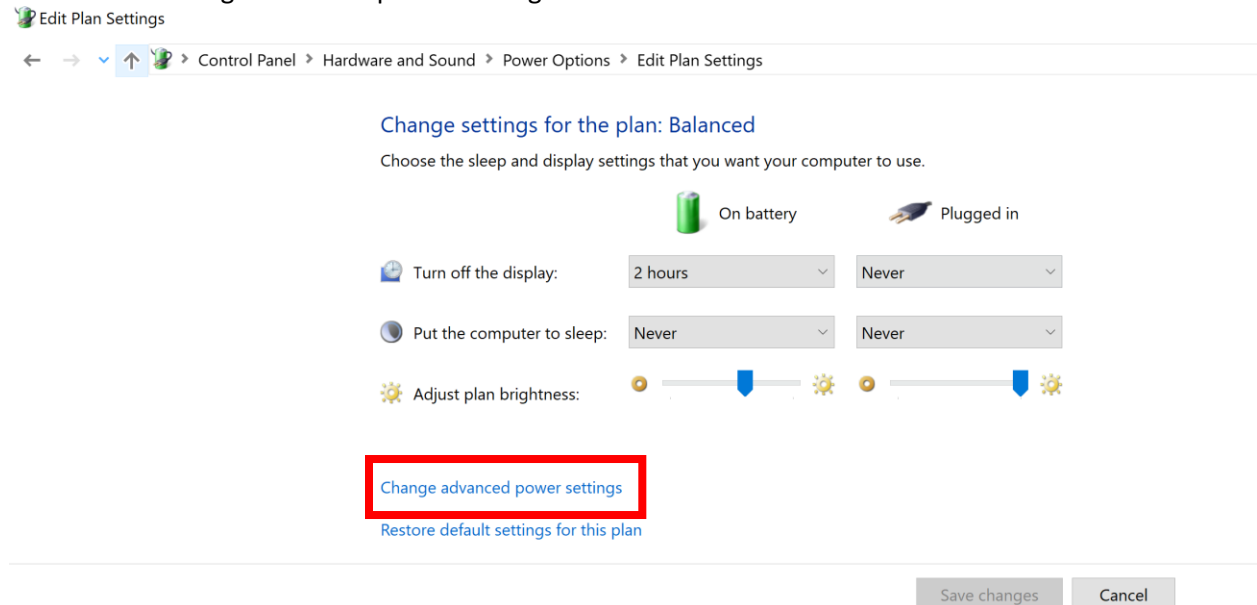
c. Click on “power options”:



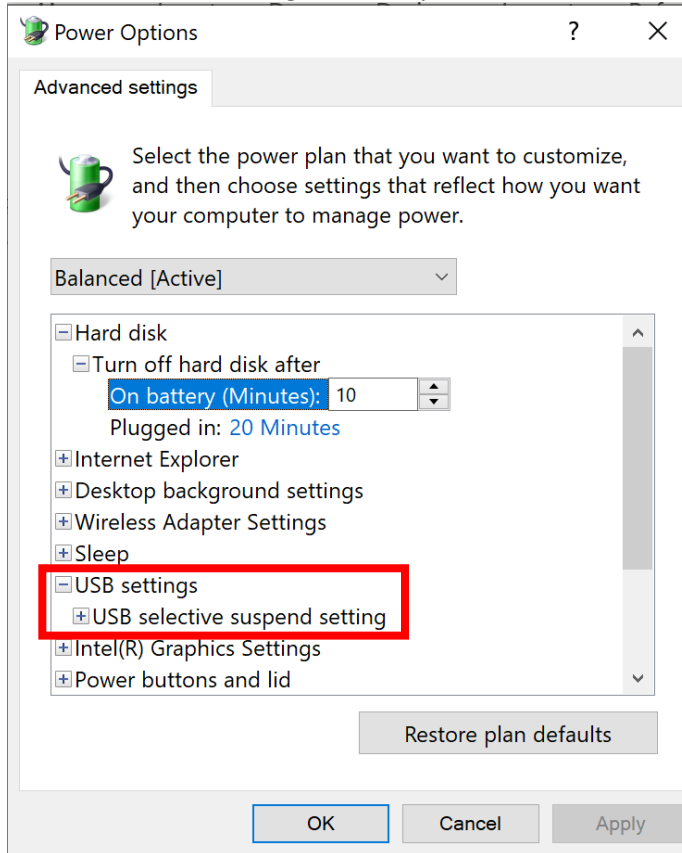
d. Click on ‘change plan settings’:



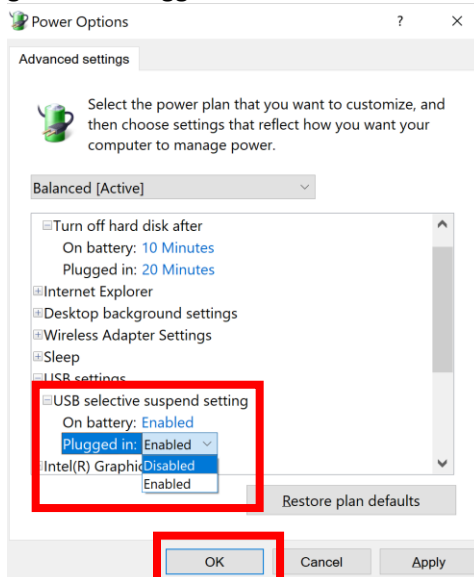
e. Click on ‘change advanced power settings’:



f. Click on 'USB settings', then expand 'USB selective suspend setting':

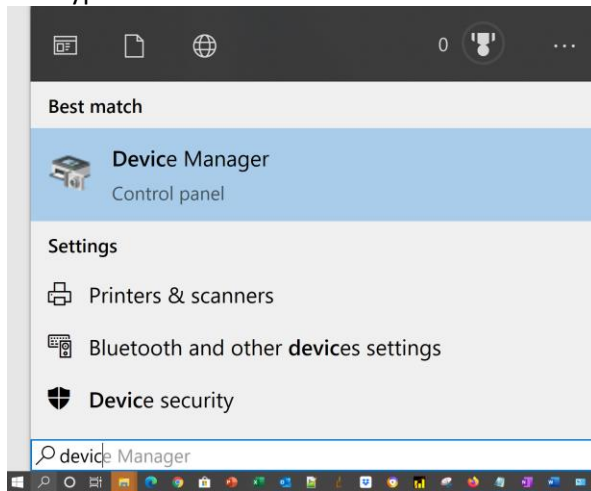


g. Click 'Plugged in' and select 'Disabled'. Repeat for 'On battery' options. Click OK:

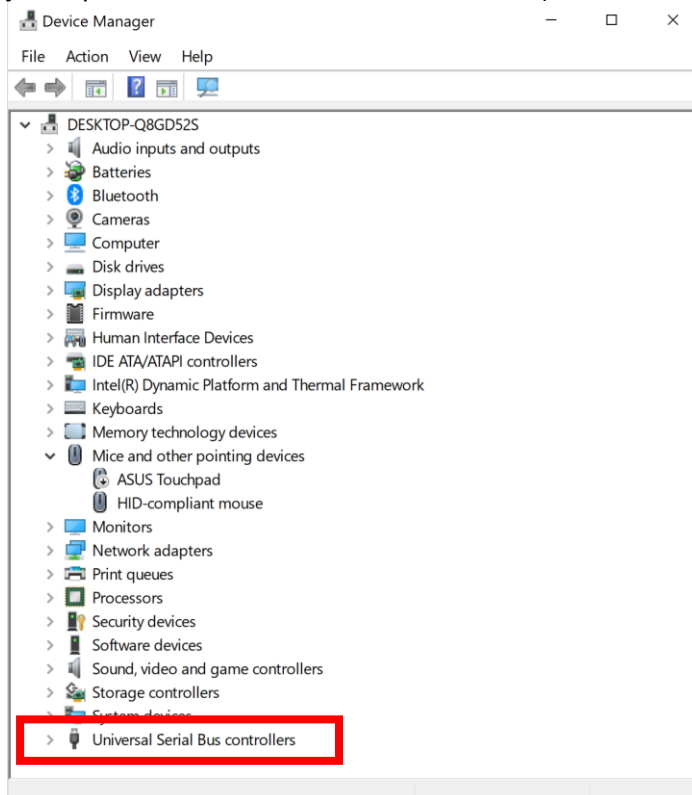


h. Note: some computers may not have the 'USB selective suspend setting'.

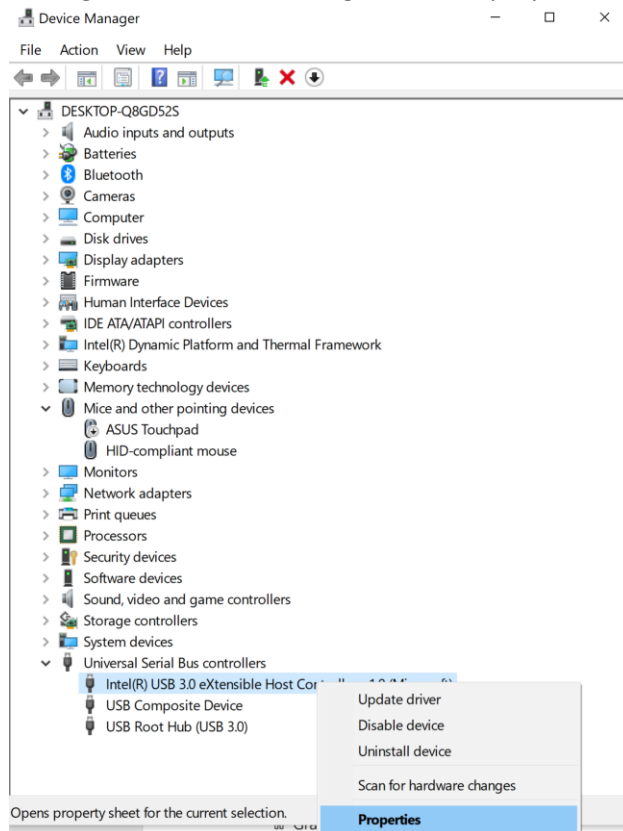
- i. Type in “device” in the windows search bar and click on ‘device manager’:



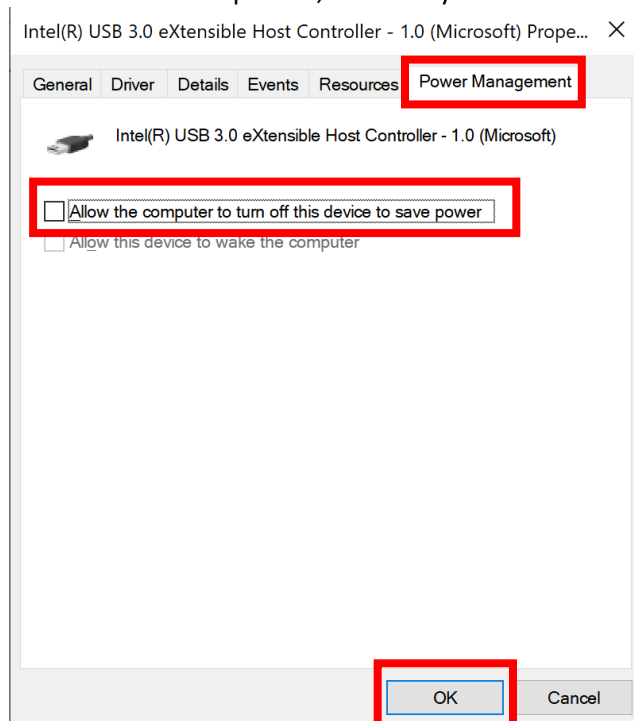
- j. Expand ‘Universal Serial Bus controllers’ (at the bottom of the list):



k. Right click on each listing and select properties:



l. Select the 'power management' tab and uncheck 'Allow the computer to turn off this device to save power', click 'okay':

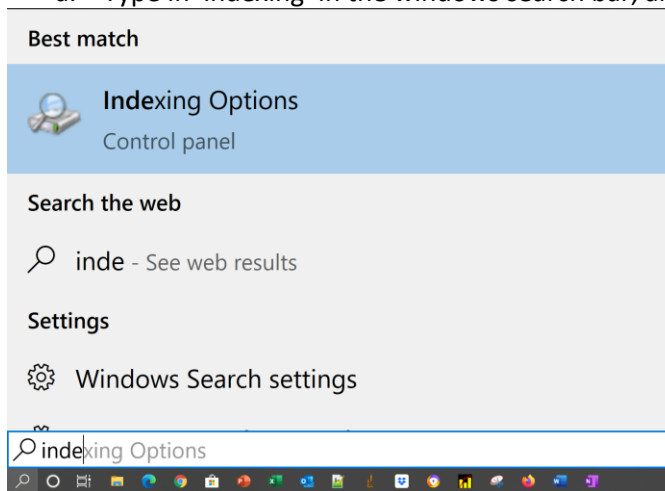


- m. Repeat prior step for every controller, hub and listing under universal serial bus controllers. Note: USB composite devices do not have a power management setting.

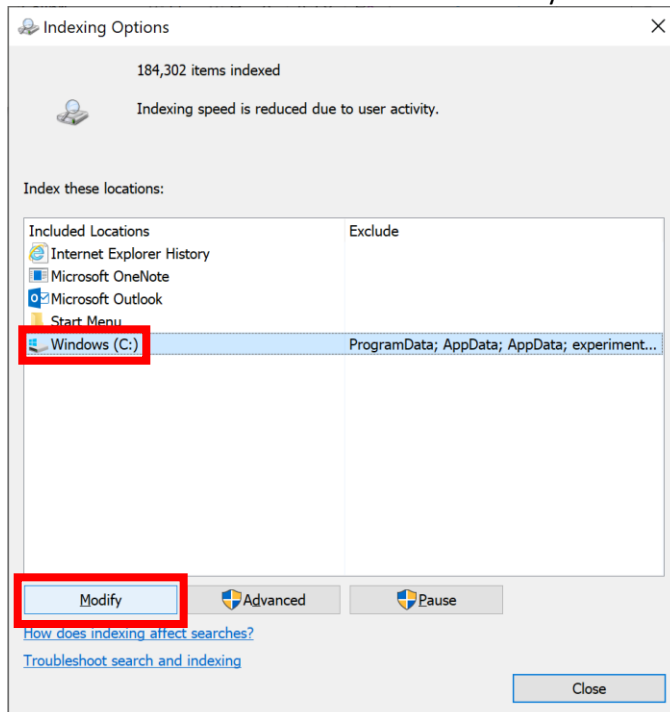
Summary of Settings of Blaze Power Management Scheme

Setting	A/C Value	Battery Value	Comments
System Idle – Sleep	NEVER	NEVER	
System Idle – Hibernate	NEVER	NEVER	
DISPLAY Brightness	100%	50%	To preserve battery – won't affect acquisition
Display - OFF	30 minutes	10 minutes	To preserve battery – won't affect acquisition
Lid Close	Do Nothing	Do nothing	Keep running even if the lid is closed.
Power Button	Hibernate	Hibernate	This is the Hardware button – keeps settings even if unplugged.
CPU - max	100%	100%	
USB Selective suspend	Off	Off	Recommended by Basler
PCI Express Power Mgmt	Off	Off	Recommended by Basler
USB 3 Link Power Mgmt	Off	Off	Recommended by Basler
Wireless Network Adapter	Max Performance	Medium power savings	
Intel Graphics Settings	Max Performance	“Balanced” setting	

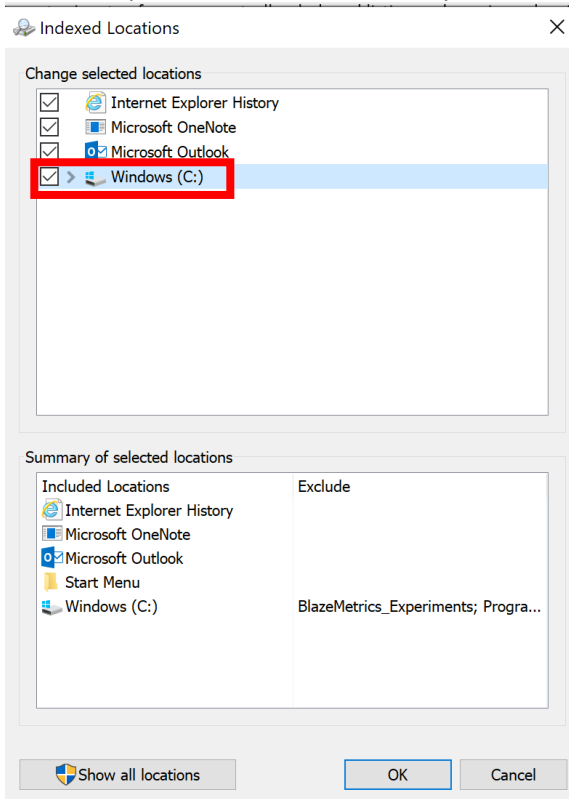
8. Exclude Blaze data saving directory from Windows indexing.
 - a. Type in 'indexing' in the windows search bar, and click on the 'Indexing Options':



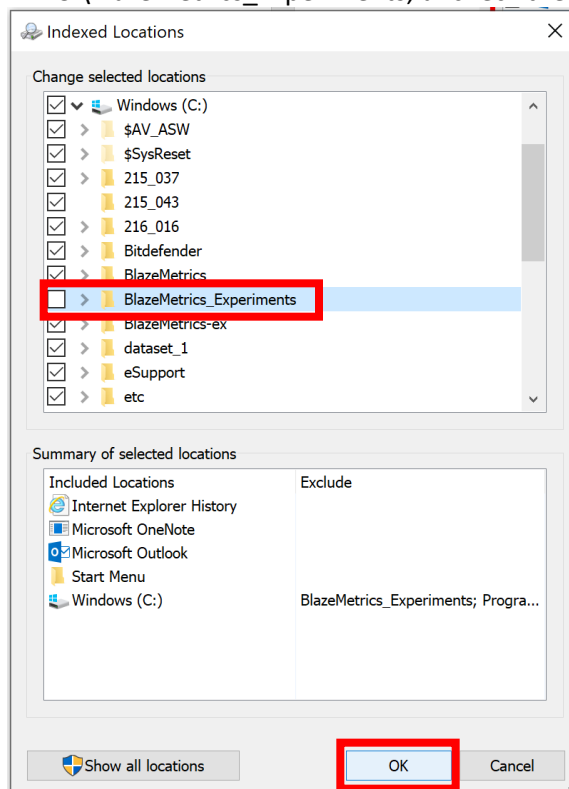
- b. Select the C Drive and click on 'Modify':



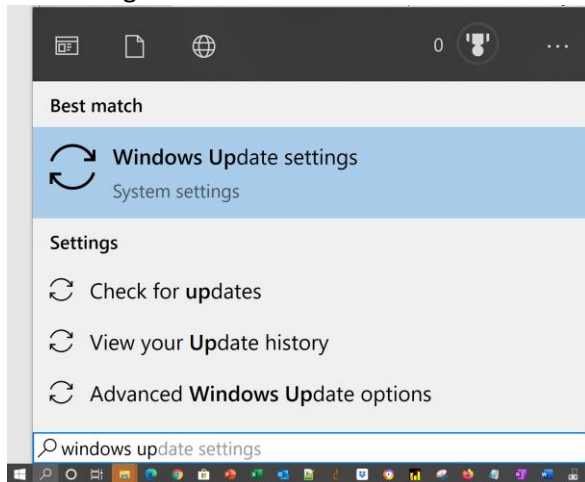
c. Expand the C Drive on the top of the window:



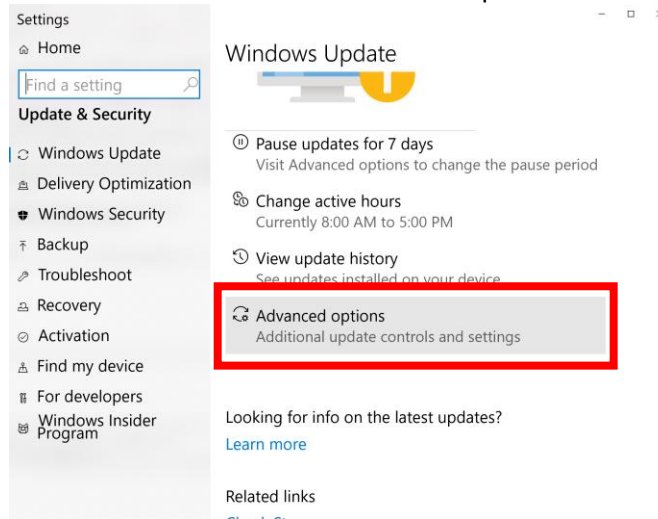
d. Uncheck 'BlazeMetrics_Experiments' and click 'OK'. If the Blaze data is not stored in C:\BlazeMetrics_Experiments, uncheck the location where it's stored instead:



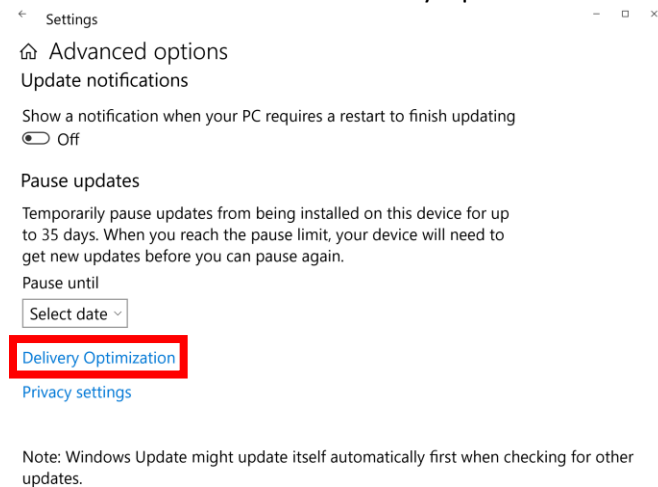
9. Exclude Blaze data saving directory from real time anti-virus scanning. Default anti-virus scan settings can noticeably slow down the computer and interfere with Blaze software operation. Instructions vary by anti-virus software and version, here are general instructions for more commonly used anti-virus programs:
 - a. For Norton the experiment folder and its sub-folders should be Excluded from Auto-Protect:
https://support.norton.com/sp/en/us/home/current/solutions/v3672136_ns_retail_en_us
 - b. For AVAST for Business, the process is to Customize the File System Shield to exclude the experiment folder from scanning on: Writing & Opening.
 - c. For Windows Defender do not turn real time scanning off, it will increase the vulnerability to viruses. Unlike other anti-virus software Windows Defender does not allow exclusion of specific directories from real time scanning.
 - d. Other anti-virus or anti-malware products have similar functions using their own terminology. Note: Blaze does not recommend excluding the experiment folder from scheduled scans, only from the real-time processing when possible.
10. Turn off receiving Windows updates from other PCs.
 - a. Type in 'windows up' in the windows search bar, and click on the 'Windows Update settings':



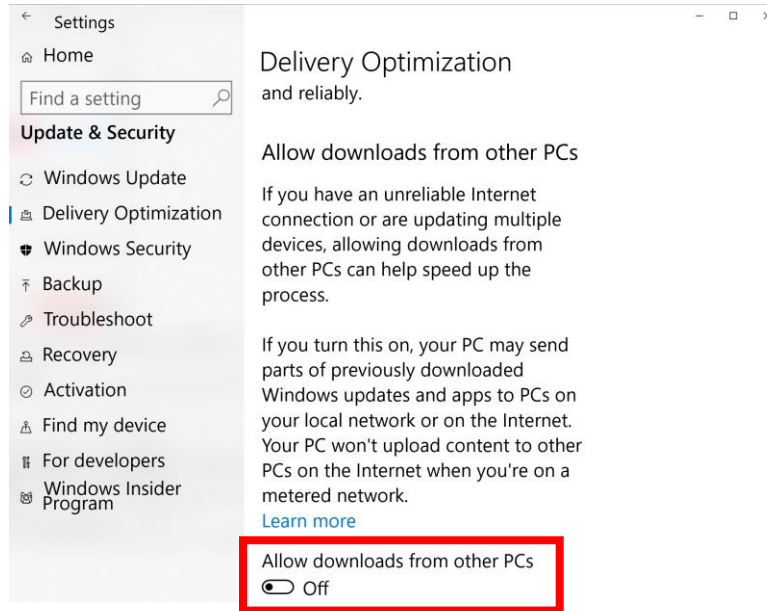
b. Scroll down and select 'Advanced Options':



c. Scroll down and select 'Delivery Optimization':



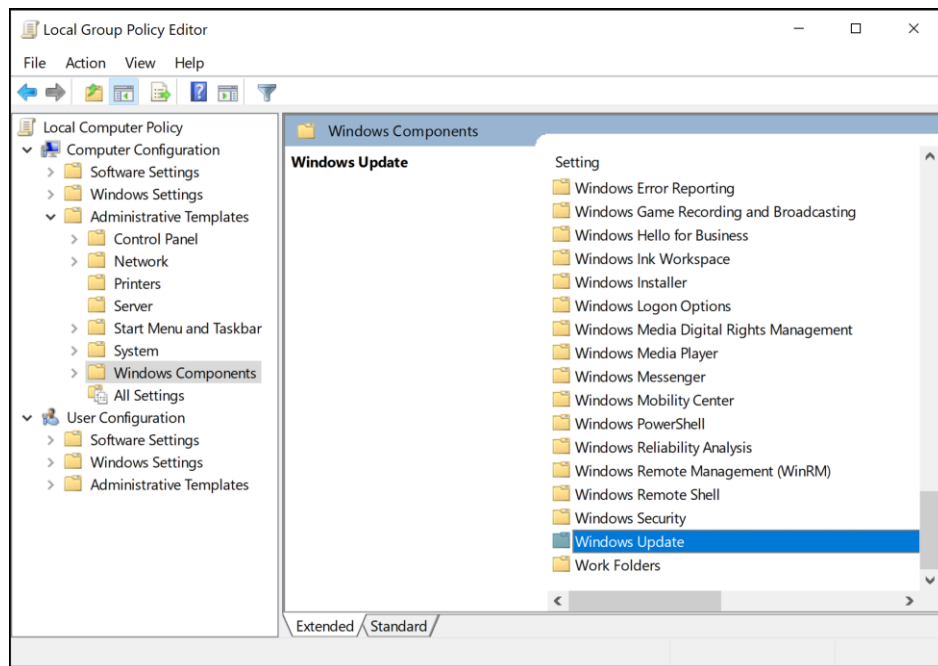
d. Scroll down and turn off 'Allow downloads from other PCs'



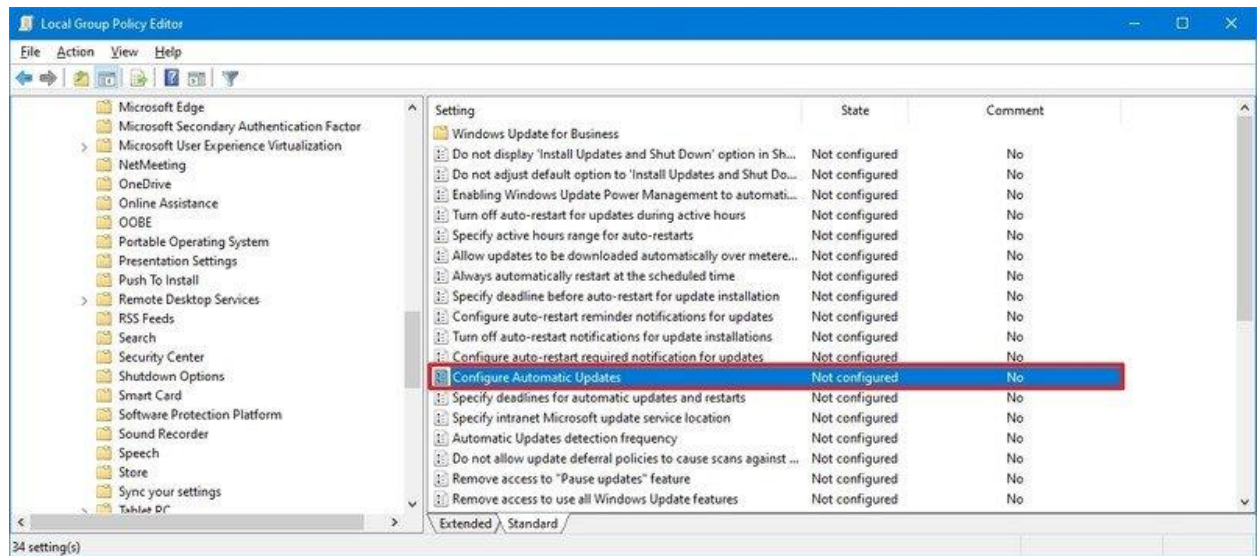
To disable automatic updates on Windows 10 permanently, use these steps:

1. Open **Start**.
2. Search for **gpedit.msc** and click the top result to launch the **Local Group Policy Editor**.
3. Navigate to the following path:

Computer Configuration > Administrative Templates > Windows Components > Windows Update



4. Double-click the **Configure Automatic Updates** policy on the right side:



Source: Windows Central

5. Check the **Enabled** option.
6. Under 'Configure automatic updating' select option 3 or 4. If option 2 is chose the computer may restart while an experiment is running and no data will be recorded after the restart.

Configure Automatic Updates

Previous Setting Next Setting

☐ Not Configured Comment:

☒ Enabled

☐ Disabled

Supported on: Windows XP Professional Service Pack 1 or At least Windows 2000 Service Pack 3
Option 7 only supported on servers of at least Windows Server 2016 edition

Options:

Configure automatic updating: 2 - Notify for download and auto install

The following settings are only relevant if you have selected "2 - Notify for download and auto install"

☐ Install during automatic maintenance

Scheduled install day: 0 - Every 7 - Auto Download, Notify to install, Notify to Restart

Scheduled install time: 03:00

If you have selected "4 - Auto download and schedule the install" for your scheduled install day and specified a schedule, you also have the option to limit updating to a weekly, bi-weekly or monthly occurrence, using the options below:

☒ Every week

☐ First week of the month

☐ Second week of the month

☐ Third week of the month

☐ Fourth week of the month

☐ Install updates for other Microsoft products

Help:

Specifies whether this computer will receive security updates and other important downloads through the Windows automatic updating service.

Note: This policy does not apply to Windows RT.

This setting lets you specify whether automatic updates are enabled on this computer. If the service is enabled, you must select one of the four options in the Group Policy Setting:

2 = Notify before downloading and installing any updates.

When Windows finds updates that apply to this computer, users will be notified that updates are ready to be downloaded. After going to Windows Update, users can download and install any available updates.

3 = (Default setting) Download the updates automatically and notify when they are ready to be installed

Windows finds updates that apply to the computer and downloads them in the background (the user is not notified or interrupted during this process). When the downloads are complete, users will be notified that they are ready to install. After going to Windows Update, users can install them.

4 = Automatically download updates and install them on the schedule specified below.

When "Automatic" is selected as the scheduled install time, Windows will automatically check, download, and install updates. The device will reboot as per Windows default settings unless configured by group policy. (Applies to Windows 10 and Windows Server 2016)

OK Cancel Apply

Click the **Apply** button.

- Click the **OK** button.

OR Limit updates

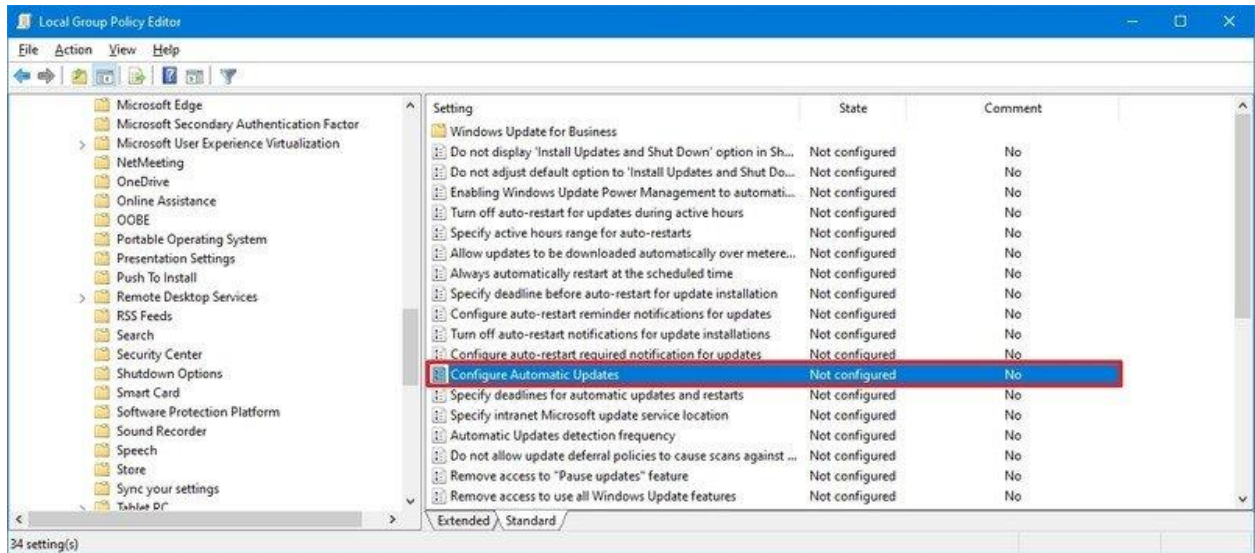
Alternatively, the Local Group Policy Editor lets you device how to disable automatic updates.

To manage Windows Update automatic downloads with Group Policy, use these steps:

- Open **Start**.
- Search for **gpedit.msc** and select the top result to launch the experience.
- Navigate to the following path:

Computer Configuration > Administrative Templates > Windows Components > Windows Update

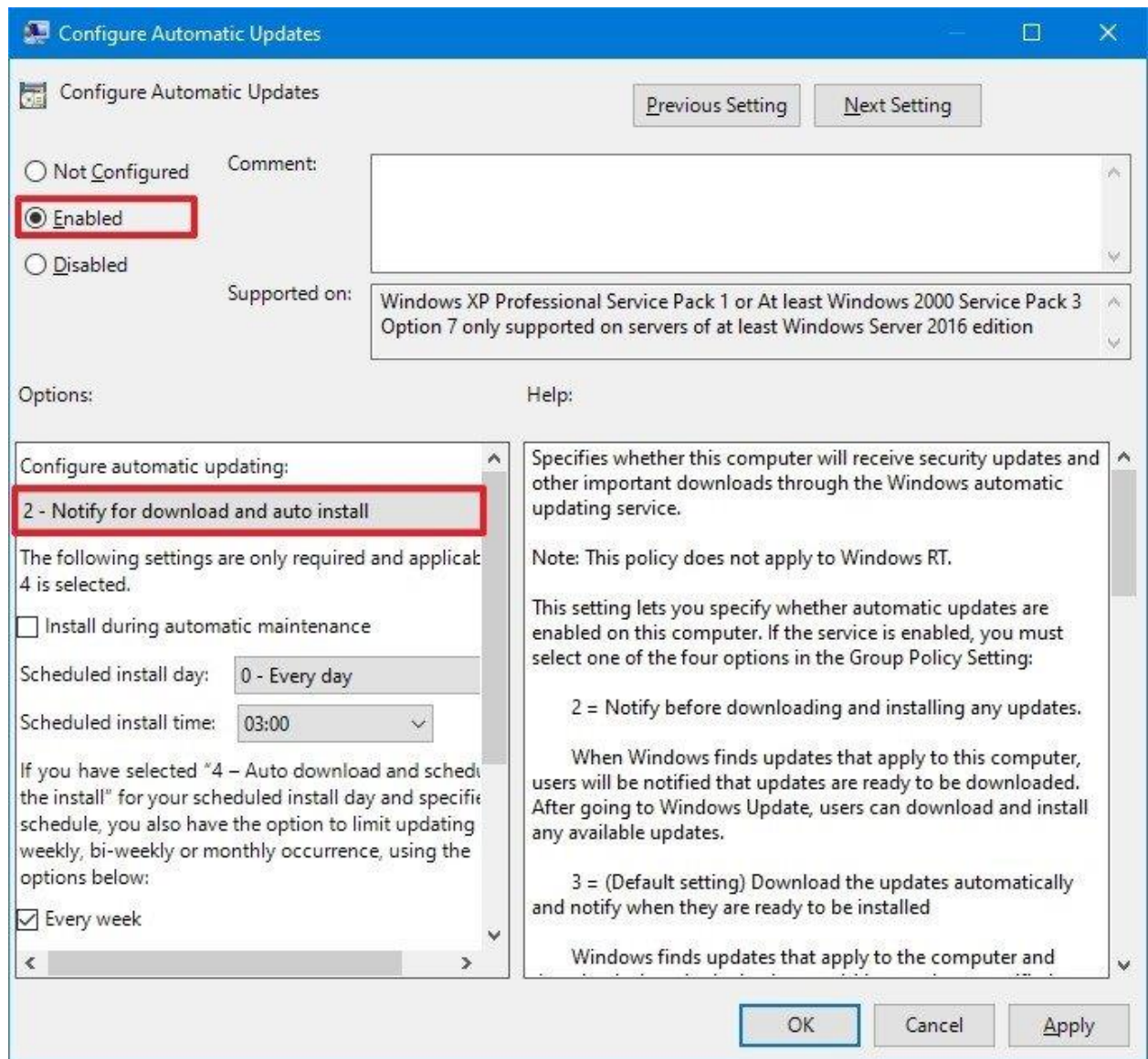
- Double-click the **Configure Automatic Updates** policy on the right side.



Source: Windows Central

5. Check the **Enable** option to turn on the policy.
6. Under the "Options" section, select the option to prevent updates from downloading and installing automatically on Windows 10:
 - 2 - Notify for download and auto install.
 - 3 - Auto download and notify for install.
 - 4 - Auto download and schedule the install.
 - 5 - Allow local admin to choose setting.
 - 7 - Auto Download, Notify to install, Notify to Restart.

Quick tip: The best option to disable automatic updates is the **2 - Notify for download and auto install** option, but you can make a different selection. If you choose option number **2**, updates won't download automatically. Instead, in the Windows Update settings page, you will now see an "Install now" button to manually trigger an update.



Source: Windows Central

7. Click the **Apply** button.
8. Click the **OK** button.

Once you complete the steps, automatic updates will be permanently disabled on Windows 10. However, when new updates become available, you will be able to install them manually from the Windows Update settings page.

Appendix I Installation Instructions for Blaze Office on Customer Supplied Computer

Computer Requirements

Windows 10 OS 64-bit version. 16GB or more RAM; 1TB SSD (or second separate 512GB SSD for Blaze application and data only); minimum Intel i5 processor (i7 or higher recommended), GTX 1070Ti GPU, and 4K monitor (or best Dell available in your region). Laptop or desktop (external 4K monitor for laptop recommended).

Other Requirements:

The following files provided by Blaze:

BlazeMetricsOffice-148-02-09-XXXX.msi

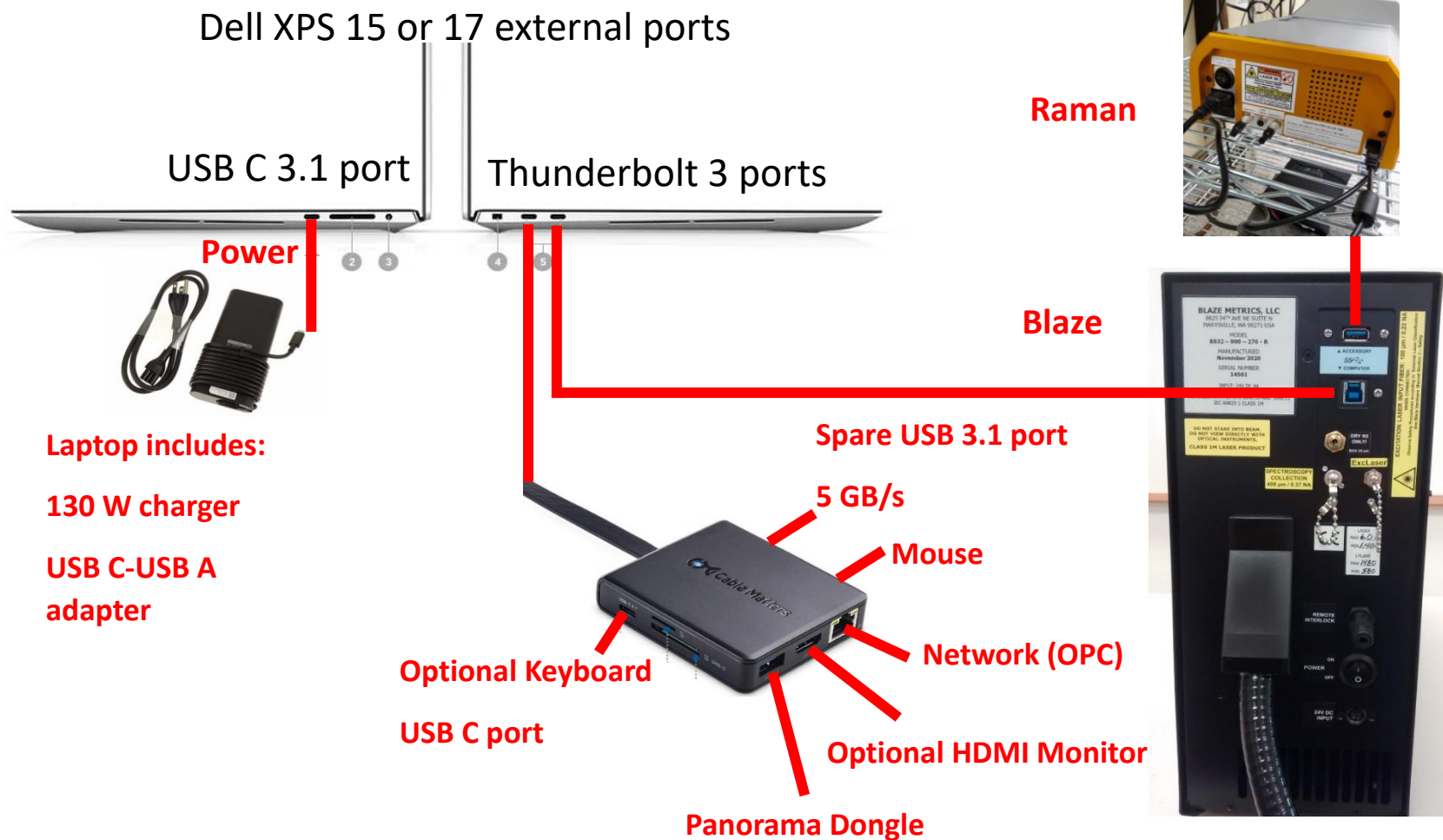
Administrative privileges are not needed for default installation unless company specific IT policies are in place.

Internet access

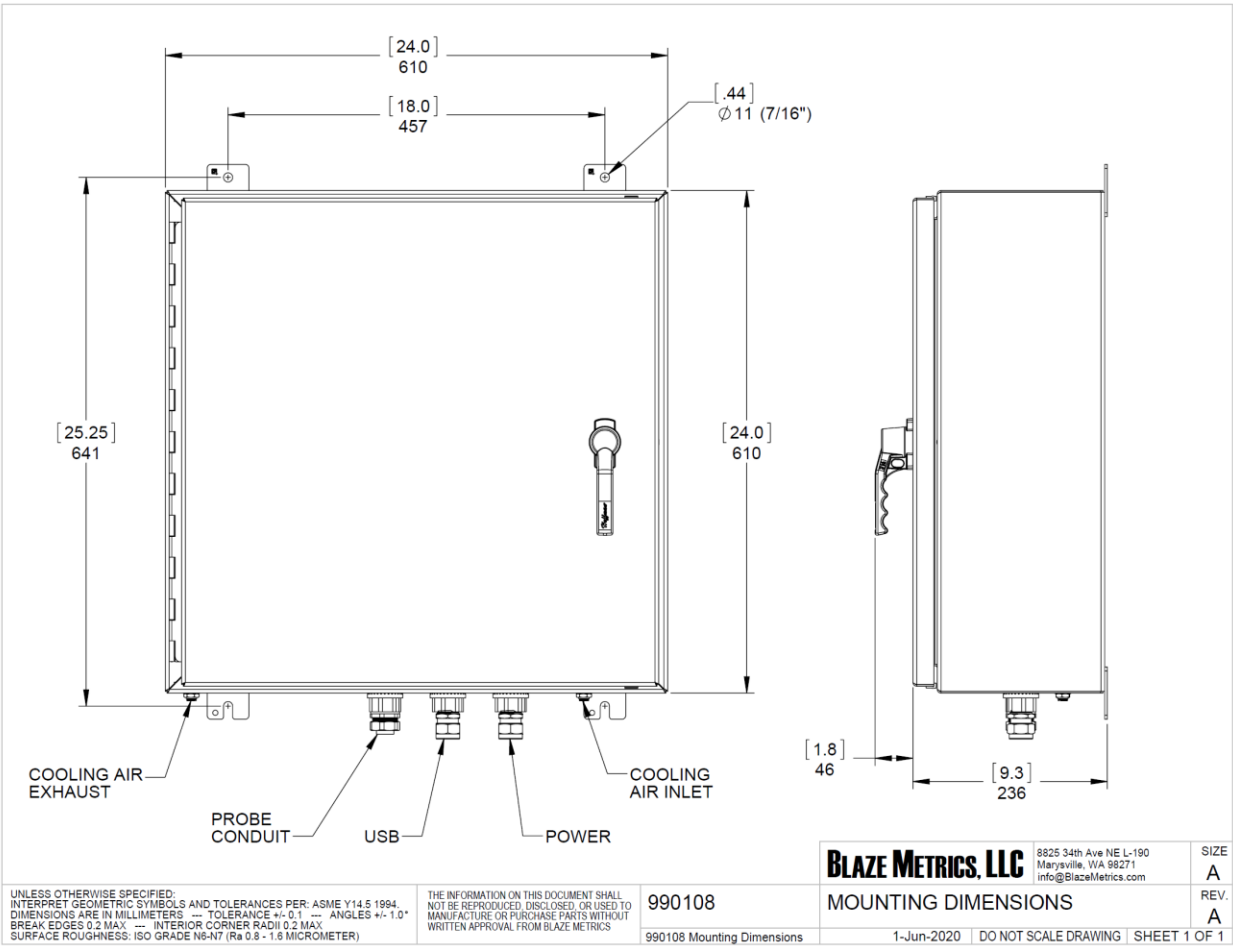
DO NOT proceed until all requirements are met.

Run the installation file (*.msi), follow the prompts, and accept all defaults. A shortcut to Blaze Office will be on the computer desktop.

Appendix J Laptop Port Expander Connections



Appendix K Blaze Pilot NEMA Enclosure Drawing



Appendix L Terms and Conditions

Blaze Metrics, LLC Standard Terms and Condition of Sale

Statement of Terms and Conditions

The information in this document and other documents such as Quotations and Specification Sheets are believed to be accurate. However, Blaze Metrics, LLC (Herein Blaze) assumes no responsibility for errors, omissions, or inaccuracies, and shall not be liable for incidental, indirect, special, direct, or consequential damages resulting from any such error or omission.

Standard Terms and Conditions of Sale and Service

Blaze quotations are valid for 30 days unless otherwise stated. Unless you have a separate written agreement from Blaze that specifically applies to this order, your order will be subject to and governed by this agreement.

You acknowledge having read and agree to be bound by these applicable terms in their entirety. Any terms and conditions set forth in your purchase order or any other correspondence that are in addition to, inconsistent or in conflict with, the foregoing terms will be of no force or effect unless specifically agreed to in a writing signed by Blaze that expressly references such terms.

Pricing, Taxes, and Additional Information

All product, pricing, and other information is valid for U.S. customers and U.S. addresses only and is based on the latest information available and may be subject to change. Blaze reserves the right to cancel quotes and orders arising from pricing or other errors. Blaze's prices do not include any applicable sales, goods/services, use, excise or similar taxes, and the amount of any such tax which Blaze may be required to pay or collect will be added to each invoice and paid by Customer unless Customer has furnished Blaze with a valid tax exemption certificate acceptable to the taxing authorities prior to shipment. If an exemption certificate provided to Blaze by Customer is, through no fault of Blaze, subsequently determined to be invalid, the previously unpaid sales, use, excise or similar tax will be billed to and paid by Customer. Sales tax on products shipped is based on your "Ship To" address, and for software downloads are based on your "Bill To" address. Please indicate any tax-exempt status on your PO and email a copy of your exemption certificate to Blaze.

For certain products shipped to end-users in California, a State Environmental Fee will be applied to your invoice. Blaze encourages customers to dispose of electronic equipment properly.

All information supplied to Customer for the purpose of this proposal is to be considered confidential information belonging to Blaze.

Privacy Policy

Blaze respects your privacy. Across our business, around the world, Blaze will collect, store, and use customer information only to support and enhance our relationship with your organization, for example,

to process your purchase, provide service and support, and share product, service, other Blaze information with you. Blaze does not sell your personal or corporate information.

By placing your order, you accept and are bound to this Standard Terms and Conditions document.

1. Introduction

These Standard Terms and Conditions of Sale (the “Agreement”), made between you (“Customer”) and Blaze Metrics, LLC (Blaze), govern your purchase and use of Products and Services from Blaze. This Agreement is effective upon the earliest of (i) your issuance of a purchase order to Blaze, or (ii) your acceptance of these terms.

A. Definitions. “Hardware” means all mechanical, electrical, optical, and computer hardware, related devices and other accessories including all embedded components (excluding Software). “Software” means any software, library, utility, tool, or other computer or program code, in object (binary) form, and “Documentation” means the related media, printed materials, online and electronic documentation, including copies. “Products” means Hardware, Software, or both. “Services” means services and Deliverables provided by Blaze. “Deliverables” means the tangible materials, including reports, studies, drawings, software, manuals or written procedures and recommendations that Blaze delivers to you under a Statement of Work. “ThirdParty Products” means products, software, or services that are not manufactured or performed by Blaze.

B. Additional Agreements. This Agreement, the Service Agreements and the Software Agreements (each as defined below) form a legally binding contract between you and Blaze. In the event of a conflict or ambiguity, the applicable Service Agreement or Software Agreement will take precedence over this Agreement.

2. Term; Auto-Renewal

“6. Agreement not to replicate” will remain in force for a period of 7 years or until all services, product warranties, or licenses have expired or been terminated, whichever is longer. The rest of this Agreement will continue until all Services, Product warranties, or licenses have expired or been terminated. Hardware Service and non-perpetual Software licenses may be renewed if you pay a renewal invoice from Blaze or continue to use the Hardware Service or Software past its initial term in which case a renewal fee will be due.

3. Quotes; Ordering; Payment; Taxes; Order Changes

A. Quotes and Orders. “Order” means your order of Products or Services by submitting a purchase order that references a Blaze quote. Your Order is subject to acceptance by Blaze. Acceptance of one Order is independent from any other Order. Quoted prices are effective until the expiration date of the quote but may change due to shortages in materials or resources, increase in the cost of manufacturing, or other factors. Prices shown on published price lists and other published literature issued by Blaze are not unconditional offers to sell and/or perform services and are subject to change without notice. Orders for Third-Party Products are subject to availability and are cancellable only by Blaze. Blaze is not responsible for pricing, typographical, or other errors in any offer, and may cancel orders affected by such errors. Any purchase or service order issued by Customer upon an expired quotation may be

accepted by Blaze at its sole discretion; any such acceptance will be communicated to Customer in writing.

B. Changed or Discontinued Products or Services. Blaze may revise or discontinue Products and Services at any time, including after Customer places an Order, but prior to Blaze's shipment or performance. As a result, Products and Services Customer receives might differ from those ordered. However, Blaze-branded Products will materially meet or exceed all published specifications for the Products. Parts used in repairing or servicing Products may be new, equivalent-to-new, or reconditioned.

C. Changes. Customer may, with the express written consent of Blaze, make changes in the specifications for products or work covered by the contract. In such event the contract price and delivery dates shall be equitably adjusted. Blaze shall be entitled to payment for reasonable profit plus expenses incurred by it for work and materials rendered unnecessary as a result of such changes and for work and materials required to effect said changes.

D. Order Cancellation. Blaze must receive, in writing, Customer's cancellation request at least forty five (45) days prior to the scheduled shipment date of any such order. The date on which the cancellation notice is received will dictate the conditions to be applied. Orders may not be cancelled within forty five (45) days of the scheduled shipment date. With notification greater than forty five (45) days, undelivered parts of any order may be canceled by Customer only with the prior written approval of Blaze. In the event of any cancellation of this order, Customer will pay to Blaze the reasonable costs and expenses (including engineering expenses and all commitments to its suppliers and subcontractors) incurred by Blaze prior to receipt of notice of such cancellation, plus Blaze's usual rate of profit for similar work. The minimum cancellation charge will be 25% of the quoted price.

E. Assignment to Creditors. If Customer makes an assignment for the benefit of creditors, or in the event Blaze has reason to believe that Customer is unwilling or unable to perform, Blaze will have the unconditional right to cancel this sales transaction and utilize the terms in D. above, or demand full or partial payment in advance.

F. Delivery; Shipping Charges; Title; Risk of Loss. Shipping and handling charges are not included in Product prices unless expressly indicated at the time of sale. Shipping and Delivery dates are estimates only. Blaze will use its best efforts to meet the indicated delivery and service dates but will not be held responsible for its failure to do so. Title to the product and risk of loss shall pass from Blaze to Customer upon delivery to a carrier. In the event of any delay in delivery caused by Customer, Blaze will store and handle all items at Customer's risk and will invoice Customer for the unpaid portion of the contract price, plus applicable storage, insurance, and handling charges. Payment of invoice is not contingent upon installation of equipment. Blaze will not accept responsibility for any shortages or damages unless all shipping containers and packing materials are retained for inspection. Delivery of Software is FOB Origin. Loss or damage that occurs during shipping (including returns) is the responsibility of the party that selected the carrier. You must notify Blaze within 21 days of your invoice date if you believe any part of your Order is missing, wrong, or damaged.

G. Payment. Unless otherwise agreed in writing by Blaze and Customer, product sale terms are 35% deposit due at time of order and 65% net 30 days from date of shipment. Invoices are due and payable within the time period stated on your invoice, or if not stated, within 30 days from the invoice date. For

services and training, payment is due net 30 days from performances of services and/or training. Payment must be made in the method and currency identified by Blaze.

I) Credit approval may be revoked at any time. Blaze may invoice parts of an Order separately or together in one invoice. All invoices shall be deemed accurate unless Customer advises Blaze in writing of a material error within 10 days following receipt. If Customer advises Blaze of a material error, (i) any amounts corrected by Blaze in writing shall be paid within 14 days of correction and (ii) all other amounts shall be paid by Customer by the due date. If Customer withholds payment upon an assertion that an invoiced amount is erroneous, and Blaze concludes that such amount is accurate, Customer shall pay interest as described below from the due date for such amounts until Blaze's receipt of those amounts. Customer may not offset, defer or deduct any invoiced amounts that Blaze determines are not erroneous following the notification process set forth above. Any assignment of Customer payment obligations to a third-party financing company must be approved in advance in writing by Blaze, and Customer will not be excused from their obligations under this Agreement. Blaze may charge a late penalty of 1.5% per month on undisputed overdue amounts, or the maximum rate permitted by law, whichever is less. Late penalties will be recalculated every 30 days based on your current outstanding balance. Blaze, without waiving any other rights or remedies and without liability to Customer, may suspend or terminate any or all Services and refuse additional orders for Products until all overdue amounts are paid in full. Blaze shall be entitled to all reasonable legal and attorney fees and associated costs of collecting overdue amounts.

II) Upon default and placing of Customer's account for collection or repossession of equipment, Customer agrees to reimburse collection costs, legal fees, and court costs incurred by Blaze in connection therewith. If Blaze deems that by reason of the financial condition of Customer or otherwise, the continuance, production or shipment on the terms specified is not justified, Blaze may require full or partial payment in advance. Certain orders may require a deposit or progressive payments as referenced in the quote. Such deposits may be increased at Blaze's sole discretion upon receipt of purchase order based upon the Customer's most current credit rating. Subject to the limited warranties expressly stated in 9. below, all sales are final without right of return.

H. Security Interest. Customer hereby grants to Blaze a purchase money security interest in the equipment, acknowledges the validity of and its own assent to such a grant, and agrees not to challenge the legitimacy of such a grant. Customer will assist Blaze in taking all necessary actions to perfect and protect Blaze's security interest. In the event of a default by Customer, Blaze will be entitled to any of the rights and remedies provided by law or in equity.

I. Taxes. You, the customer, are responsible for sales tax and any other taxes or governmental fees associated with your Order. If you qualify for a tax exemption, you must provide Blaze with a valid certificate of exemption or other appropriate proof of exemption. Blaze's prices do not include any applicable sales, goods/services, use, excise or similar taxes, and the amount of any such tax which Blaze may be required to pay or collect will be added to each invoice and paid by Customer unless Customer has furnished Blaze with a valid tax exemption certificate acceptable to the taxing authorities prior to shipment. If an exemption certificate provided to Blaze by Customer is, through no fault of Blaze, subsequently determined to be invalid, the previously unpaid sales, use, excise or similar tax will be billed to and paid by Customer. Sales tax on products shipped is based on your "Ship To" address, and for software downloads are based on your "Bill To" address. Please indicate any tax-exempt status on

your PO and email a copy of your exemption certificate to Blaze. Customer shall also pay all freight, insurance, and taxes (including but not limited to import or export duties, sales, use, value add, and excise taxes) unless otherwise stated in the quotation. Blaze's invoice shall be in accordance with applicable law. If Customer is required by law to make a withholding or deduction from payment, Customer will make payments to Blaze net of the required withholding or deduction. Customer will supply to Blaze satisfactory evidence (e.g. official withholding tax receipts) that Customer has accounted to the relevant authority for the sum withheld or deducted.

J. Importation. Customer shall be responsible for complying with any legislation or regulations governing the importation of the Products into the country of destination and for the payment of any duties thereon.

K. Resale/Exportation. Any re-sale of or use of Products by Customer shall at all times be subject to all applicable export control laws and regulations of the United States, including, but not limited to, U.S. Export Administration Regulations. Customer agrees and assures Blaze that no items, equipment, materials, services, technical data, technology, software or other technical information or assistance furnished by Blaze, or any good or product resulting from these, shall be exported or re-exported by Customer or its authorized transferees, if any, directly or indirectly, unless in accordance with applicable U.S. export laws and regulations. This obligation shall survive any expiration, termination or discharge of these Terms or any other contractual obligations of Customer.

L. Hardware Returns and Exchanges. Before returning or exchanging Hardware, you must contact Blaze to obtain an RMA (Return Materials Authorization) number for your return. You must return Hardware in its original or equivalent packaging, and you are responsible for risk of loss and shipping and handling fees. For returns in original box unopened within 30 days of the original shipping, a 10% restock fee will be charged. For returns of opened box, but original condition, within 60 days of original shipping, a 25% restocking fee will be charged. If you fail to follow the return or exchange instructions, Blaze will not be responsible for any loss, damage, or modification of Hardware, or processing of Hardware for disposal or resale. Title to returned or exchanged Hardware shall pass to Blaze upon receipt at the specified Blaze facility.

4. Services and Software

A. Service Agreements. Blaze may provide Services, Service-related Software, or Deliverables to Customer in accordance with one or more "Service Agreements." Each Service Agreement will be interpreted separately from any other Service Agreement.

B. Hardware Services.

I) Definition. "Hardware Services" are Services necessary to repair a defect in materials or workmanship of Hardware.

II) Exclusions. Hardware Services do not include preventive maintenance or repairs required due to (a) software problems; (b) alteration, adjustment, or repair of the Hardware by anyone other than Blaze or Blaze's representatives; (c) accident, misuse, or abuse of the system or component (such as but not limited to fire, water leakage, use of incorrect line voltages or fuses, use of incompatible devices or accessories, improper or insufficient ventilation, or failure to follow operating instructions) that have not

been caused by Blaze; (d) moving of the system from one geographic location or entity to another; or (e) an act of nature.

III) Customer Authorization for Provision of Services. Some warranties or service contracts for Third-Party Products may become void if Blaze provides services for such products. Blaze shall not be responsible for any effect that hardware service may have on those warranties or service contracts. You authorize Blaze to use or otherwise access any and all Third-Party Products you provide to us as may be necessary to perform the Services or as requested by you, including but not limited to copying, storing, and reinstalling a backup system or data.

C. Software. The Software is subject to, and you are bound by, the applicable Software Agreement. "Software Agreement" means the software license agreements included with the software media packaging or presented to Customer during the installation or use of the Software.

5. Proprietary Rights.

The Products and Software are protected pursuant to copyright laws and international copyright treaties, as well as other intellectual property laws and treaties. All right, title, and interest in the intellectual property (including all copyrights, patents, trademarks, trade secrets, and trade dress) embodied in the Software, Products and Deliverables, and the methods by which the Services are performed and the processes that make up the Services, shall belong solely and exclusively to Blaze or its suppliers or licensors. Subject to Blaze's receipt of payment in full for the applicable Services, Blaze grants you a non-exclusive, non-transferable, royalty free right to use the Deliverables solely (i) in the country or countries in which you do business; (ii) for your internal use; and (iii) as necessary for you to enjoy the benefit of the Services as stated in the applicable Service Agreements. The sale and delivery of Blaze's equipment and/or software to Customer will in no way transfer to Customer any right of ownership in any patents, copyrights, trademarks, technologies, designs, specifications, drawings, or other intellectual property incorporated into the equipment and/or software.

6. Agreement Not to Replicate.

CUSTOMER AGREES NOT TO COPY, REPLICATE OR REVERSE ENGINEER THE PRODUCTS OR TO PERMIT SUCH ACTIONS BY ANY THIRD PARTY. THE PARTIES ACKNOWLEDGE AND AGREE THAT THEY ARE ENTERING INTO THIS AGREEMENT ON THE UNDERSTANDING THAT THE PRICE FOR THE PRODUCTS TO BE PROVIDED HAS BEEN SET TO REFLECT THE FACT THAT CUSTOMER AGREES NOT TO COPY OR REPLICATE PRODUCTS. THIS OBLIGATION SHALL SURVIVE ANY EXPIRATION, TERMINATION OR DISCHARGE OF THESE TERMS OR ANY OTHER CONTRACTUAL OBLIGATIONS OF CUSTOMER.

7. Ownership and Grant of Rights.

Unless otherwise specifically agreed in writing by the Customer and Blaze, Customer retains all right, title and interest in and to all specifications and drawings provided by Customer to Blaze, and all inventions, ideas, processes, methods, know-how, skills and techniques independently developed, discovered or conceived by Customer or its employees (the "Customer Rights"). Such rights include, but are not limited to, patent rights, copyrights, trade secret rights, trademark rights, mask work rights and other proprietary rights throughout the world. Unless otherwise specifically agreed in writing by the Customer and Blaze, Blaze retains all right, title and interest in and to all specifications, drawings, inventions, ideas, processes, methods, knowhow, skills and techniques independently developed,

discovered or conceived by Blaze or its employees or contractors, including without limitation those developed and/or used in connection with the manufacture of the Products or performing Services hereunder (collectively, the “Blaze Rights”). Such rights include, but are not limited to, patent rights, copyrights, trade secret rights, trademark rights, mask work rights and other proprietary rights throughout the world. Blaze hereby grants to the Customer a nonexclusive, nontransferable, worldwide, limited license to use and exploit the Blaze Rights solely to the extent required for the Customer to use, operate or incorporate into Customer’s end products the Products or Software sold or licensed hereunder.

8. Regulatory Laws and/or Standards.

The performance of the parties hereto is subject to the applicable laws of the United States of America. Blaze takes reasonable steps to keep its products in conformity with various nationally recognized standards and such regulations, which may affect its products. However, Blaze recognizes that its products are utilized in many regulated applications and that from time to time standards and regulations are in conflict with each other. Blaze makes no promise or representation that its product will conform to any federal, provincial, state or local laws, ordinances, regulations, codes or standards except as particularly specified and agreed upon in writing by authorized officers of Customer and Blaze. Blaze prices do not include the cost of any related inspections or permits or inspection fees.

9. Limited Warranty.

A. Warranties. ABSENT A SEPARATE WARRANTY ISSUED TO Blaze BY CUSTOMER IN WRITING, Blaze EXPRESSLY WARRANTS THE EQUIPMENT MANUFACTURED AND THE SERVICES PERFORMED BY IT TO CUSTOMER SOLELY AS SET FORTH HEREIN. Blaze DISCLAIMS ALL OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED (INCLUDING WITHOUT LIMITATION WARRANTIES AS TO MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE). THESE WARRANTIES MAY BE TRANSFERRED TO A SUBSEQUENT PURCHASER OF THE EQUIPMENT ONLY WITH THE PRIOR WRITTEN CONSENT OF Blaze. IN ADDITION, THE FOLLOWING SHALL CONSTITUTE THE SOLE AND EXCLUSIVE REMEDIES OF CUSTOMER FOR ANY BREACH BY Blaze OF ITS WARRANTY HEREUNDER.

B. New Product.

1) Hardware: Blaze warrants its products against defects in materials and workmanship for Sixteen (16) months from the date of installation or Eighteen (18) months from the date of shipment to Customers’ destination, whichever is earlier, so long as all necessary maintenance has been performed on the products and said products have been used in accordance with the published specifications. Should any product contain such defects, Customer shall give Blaze written notice of the defect during the warranty period and within ten days after its discovery. Thereafter, Blaze will, at its option (i) repair or replace the product at no additional charge except as set forth below or (ii) refund the purchase price for such defective product after the return of the product by Customer to Blaze as set forth below. Any refunded amount under this provision shall be determined in Blaze’s sole discretion. If the warranted Product at issue was delivered to Customer more than six (6) months prior to Blaze’s receipt of notice from Customer of the valid warranty claim, Blaze expressly reserves the right to pro-rate the refunded amount in its sole discretion, and Customer shall not receive a full refund for the warranted Product at issue. Prior to repair or replacement, Blaze shall have the right to examine the equipment or the part claimed defective. Repairs may be performed at Customer’s facility or Blaze’s facility, at Blaze’s option. If

performed at Customer's facility, Customer shall pay 65% of Blaze's reasonable travel time and expenses to and from Customer's facility. If repairs are performed at Blaze's facility or Blaze elects to replace or refund the product, Customer shall pay 50% of all necessary freight charges to and from Blaze's facility, including funds adequate to insure the product fully protecting against risk of loss or damage in transit. Customer shall use the original padded shipping container or equivalent to return the product. The return of any product or parts thereof to Blaze requires prior written authorization from Blaze. Where warranty service includes replacement and return of parts, components or modules to Blaze, it shall be Customer's obligation to perform complete decontamination of the item, as necessary, and to so certify on a document accompanying the returned item. In the event that items are received without a decontamination certificate, Customer will be charged the value of the replacement part.

II) Material certification. Unless specifically noted in product description as quoted, products are not automatically supplied with a report providing materials analysis. Such analysis is available upon special request at the time of order and will be subject to additional costs.

C. Software. Blaze warrants that software developed by Blaze will be free from significant programming errors or defects when properly installed. The warranty period for software shall be the same as the warranty period for Blaze equipment supplied with the software. If the software is not embedded within Blaze equipment, the terms and conditions of the respective end user license agreement of Blaze shall apply exclusively. If no end user license agreement is applicable, the warranty period will be 90 days. If there is an identified error, and the Customer promptly notifies Blaze of the error or defect in reasonable detail sufficient to allow Blaze to identify and replicate such error or defect, Blaze shall, at no cost to Customer, use commercially reasonable efforts to repair and correct such errors or defects in the Software. In the event that Blaze reinstalls Customer's software, Blaze will not be responsible for loss of Customer's data. The warranty set forth above shall not apply to any errors or defects in the Software to the extent caused in whole or in part by (a) any combination of the Software with functionality, software, hardware or other products not supplied or approved by Blaze; (b) any modification of the Software not made by Blaze or modifications made by Blaze but to Customer's written specifications; or (c) the failure of Customer to use the most current release of the Software provided to Customer or to follow the most current instructions as may be provided by Blaze from time to time with respect to the proper use of the Software. This warranty does not apply to, and does not obligate Blaze to develop or to provide, any future releases, updates, upgrades or modifications to the Software or develop or provide Software development tools to Customer. On-site repair service is not covered under the foregoing warranty.

Customer is granted a non-exclusive, limited license to use and to make copies of such programs for use only with the equipment for which such programs were acquired. If the software is not being supplied with Blaze equipment, the warranty provided in the terms and conditions accompanying the software shall apply. Blaze will use industry-standard practices to verify that the software to be provided to Customer under this Agreement shall not, at the time it is provided, contain any malicious code or computer virus (collectively referred to as "Virus") that could damage or render inoperable any software, data or information of Customer.

D. Repaired Product. Any covered product or part which has been the subject of warranty service by Blaze carries Blaze's warranty only until the later of (i) the expiration of the original sixteen-month warranty period or (ii) ninety (90) days from the date the product or part was replaced or other

warranty service was performed on it. Parts repaired or replaced outside the applicable warranty period are warranted against defects in materials and workmanship for ninety (90) days from the date of the repair and shall only apply to parts repaired or replaced by Blaze. No separate warranty shall apply to repaired products as a whole or to parts not repaired or replaced by the Blaze.

E. Non-Warranty Repair Service. On-site repair service is not covered under the foregoing warranties. For on-site repair service, or for any other repair service for the Products or the Software that is not covered by the foregoing warranties, Customer shall pay for such repair service (including travel time, if applicable) at Blaze's then-current time and materials rates, and shall reimburse Blaze for its reasonable travel and lodging expenses. Out-of-warranty repairs are warranted for 90 days following shipment of the repaired Product to Customer.

F. Third-Party Hardware or Software. ANY WARRANTY FOR A THIRD-PARTY PRODUCT IS PROVIDED BY THE PUBLISHER, PROVIDER, OR ORIGINAL MANUFACTURER. ALL THIRD-PARTY PRODUCTS ARE PROVIDED BY Blaze "AS IS." THE LIMITED WARRANTIES FOR NON-Blaze BRANDED OR NON-Blaze-LICENSED HARDWARE SHALL BE AS STATED IN THE DOCUMENTATION PROVIDED WITH THE THIRD-PARTY HARDWARE. THE LIMITED WARRANTIES FOR SOFTWARE SHALL BE AS STATED IN THE APPLICABLE SOFTWARE AGREEMENT.

G. Service. Blaze warrants that services will be performed in a workmanlike manner in conformity with standard industry practice. Should any nonconformity be detected within 30 days after the work is completed and prompt notification is made by Customer in writing to Blaze, Blaze will supply the necessary service, direction or consultation to correct the nonconformity.

H. Blaze Employees, agents or representatives. Blaze employees and agents are not authorized to make any representation or warranty with respect to the Products, unless confirmed by Blaze in a writing which expressly acknowledges the applicable Order Confirmation. By entering into these Terms, Customer acknowledges that it has not and does not rely upon, and hereby waives, any claim for breach of any such representation or warranty which is not so confirmed in writing by Blaze. If any advice or recommendation given by Blaze or its employees or agents to Customer, including, but not limited to, any advice as to the storage, application or use of the Products, which is not confirmed in a writing by Blaze which expressly acknowledges the applicable Order Confirmation, is followed or acted upon by Customer, Customer does so entirely at Customer's sole risk, and accordingly, Blaze shall not be liable to Customer or any other person for any such actions, or failure to act, by Customer.

I. Performance out of normal hours. If Customer requests the performance of warranty work provided for under the foregoing warranties during other than normal Blaze work periods, the Customer shall be required to pay for all premium time.

J. General Provisions.

I) (i) THE ABOVE WARRANTIES DO NOT COVER DAMAGE DUE TO EXTERNAL CAUSES, SUCH AS BUT NOT LIMITED TO ACCIDENT, NEGLIGENCE, ALTERATION, ABUSE, MISUSE, PROBLEMS WITH ELECTRICAL POWER, DIRTY AIR SUPPLY, NORMAL WEAR AND TEAR, OR USE OF PARTS AND COMPONENTS NOT SUPPLIED OR INTENDED FOR USE WITH THE PRODUCTS OR SERVICES, CUSTOMER-SUPPLIED SOFTWARE, HARDWARE, OR INTERFACING OR CUSTOMER'S FAILURE TO MAINTAIN THE EQUIPMENT IN ACCORDANCE WITH EQUIPMENT'S ROUTINE MAINTENANCES AS SET FORTH IN ANY MANUALS COVERING THE EQUIPMENT,

FAILURE ON THE PART OF CUSTOMER TO ENSURE THE PROPER AND SUITABLE ENVIRONMENT, STORAGE, OPERATION, SERVICES NOT PERFORMED OR AUTHORIZED BY Blaze (INCLUDING INSTALLATION OR DEINSTALLATION), USAGE NOT IN ACCORDANCE WITH PRODUCT INSTRUCTIONS. THE FOREGOING WARRANTY WILL ALSO NOT APPLY IF THE “WARRANTY VOID IF BROKEN” SEAL LOCATED ON ANY PRODUCT HAS BEEN REMOVED, BROKEN OR OTHERWISE TAMPERED WITH. (ii) EXCEPT AS EXPRESSLY STATED ABOVE OR IN THE EXPRESS WARRANTIES, AND TO THE MAXIMUM EXTENT PERMITTED BY LAW, Blaze (INCLUDING Blaze AFFILIATES, CONTRACTORS, AND AGENTS, AND EACH OF THEIR RESPECTIVE EMPLOYEES, DIRECTORS, AND OFFICERS), ON BEHALF OF ITSELF AND ITS SUPPLIERS AND LICENSORS MAKES NO EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO ANY OF THE PRODUCTS OR SERVICES, INCLUDING BUT NOT LIMITED TO ANY WARRANTY

II) (i) OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, PERFORMANCE, SUITABILITY, OR NON-INFRINGEMENT; (ii) FOR ANY THIRD-PARTY PRODUCTS; (iii) FOR THE PERFORMANCE OF OR RESULTS TO BE OBTAINED FROM ANY PRODUCTS OR SERVICES; OR (iv) THAT THE PRODUCTS OR SERVICES WILL OPERATE OR BE PROVIDED WITHOUT INTERRUPTION OR ERROR.

K. Not Fault-Tolerant. The Blaze-branded Products and Services are not fault-tolerant and are not designed or intended for use in hazardous environments requiring fail-safe performance, such as any application in which the failure of the Products or Services could lead directly to death, personal injury, or severe physical or property damage (collectively, “High-Risk Activities”). Blaze expressly disclaims any express or implied warranty of fitness for High-Risk Activities.

L. Excluded From Warrantee. These warranties shall not apply to parts consumed in the normal operation of the equipment, including without limitation, test tubes, filters, pipettes, gripper fingers, injection seals, valve seals, syringes, standards/standard samples, cannulas and similar parts.

M. Methods of Correction of Defects During Warranty. To correct defects Blaze may attempt to diagnose and resolve the defect over the telephone or electronically. Certain equipment contains self-diagnostic capabilities which can be viewed through the user’s desktop remotely. When Customer contacts Blaze for warranty work, it must follow the problem determination, resolution and procedure that Blaze specifies. At any time following or to assist in problem determination, Blaze may require return of the part or product to depot for service. If Blaze determines on-site work is required, a service technician will be scheduled for on-site work. If Customer gives notice of a defect to Blaze and requests Blaze for on-site work when the defect could have been remedied remotely, or if Blaze responds to Customer’s notice of defect and no defect is found for which Blaze is liable, Blaze shall be entitled to compensation for any work performed and costs it has incurred as a result of Customer’s request. Blaze encourages Customer to use available remote support technologies. Failure to install and use available self diagnostic tools and equipment for problem reporting, problem determination and resolution may result in increased response-time and additional costs to Customer.

10. Confidentiality

“Confidential Information” means information that is designated as confidential or should reasonably be understood to be confidential. Confidential Information may only be disclosed to the receiving party’s personnel, professional advisors, agents, and subcontractors (“Representatives”), on a “need-to-know” basis in connection with this Agreement. Representatives shall be bound to treat the Confidential Information under terms at least as restrictive as those herein, and the receiving party shall be liable for

unauthorized disclosures by its Representatives. Each party will use at least the same degree of care as it employs with respect to its own Confidential Information, but not less than a commercially reasonable standard of care. The foregoing shall not apply to information that (i) is independently developed without use of the other party's Confidential Information; (ii) has been obtained from a source which is not under a confidentiality obligation; or (iii) is or becomes publicly available without fault of the receiving party. If receiving party must disclose Confidential Information as required by law, it shall give reasonable prior notice to the disclosing party. These obligations shall continue for 3 years from the initial date of disclosure, except that obligations related to information about a party's intellectual property shall never expire.

11. Indemnification

A. Products or Services Direct from Blaze. If you purchased Products or Services directly from Blaze, Blaze shall defend and indemnify you against any third-party claim that Blaze-branded Products or Services (excluding Third-Party Products and open source software) infringe or misappropriate that third party's United States ("U.S.") patent, copyright, trade secret, or other intellectual property rights ("Claim(s)"). In addition, if Blaze receives prompt notice of a Claim that Blaze believes is likely to result in an adverse ruling, then Blaze shall at its option, (i) obtain a right for you to continue using such Products or Deliverables or for Blaze to continue performing the Services; (ii) modify such Products or Services to make them non-infringing; (iii) replace such Products or Services with a non-infringing equivalent; or (iv) if you purchased directly from Blaze, refund any pre-paid fees for the allegedly infringing Services that have not been performed or provide a reasonable depreciated or pro rata refund for the allegedly infringing Product or Deliverables. Blaze shall have no obligation for any claim arising from (a) modifications of the Products and Services that were not performed by or on behalf of Blaze; (b) misuse, or the combination or use with Third-Party Products (the combination of which causes the claimed infringement); or (c) Blaze's compliance with your written specifications, including the incorporation of any software or other materials or processes you provide or request. Blaze's duty to indemnify and defend the Claim is contingent upon: (x) your prompt written notice of the Claim; (y) Blaze's right to solely control the defense and resolution of the Claim; and (z) your cooperation in defending and resolving the Claim. These are your exclusive remedies for any third-party intellectual property claim, and nothing in this Agreement or elsewhere will obligate Blaze to provide any greater indemnity.

B. Third Party Claim(s). You shall defend and indemnify Blaze against any third-party claim resulting or arising from:

I) (i) your failure to obtain any appropriate license, intellectual property rights, or other permissions, regulatory certifications, or approvals associated with technology or data provided by you, or associated with software or components requested by you to be used with, or installed or integrated as part of the Products or Services; (ii) your violation of Blaze's intellectual property rights; (iii) any inaccurate representation regarding the existence of an export license or any allegation made against Blaze due to your alleged violation of applicable export laws; or (iv) your transferring or providing access to Excluded Data (as defined below) to Blaze.

II) Each party shall defend and indemnify the other against any third-party claim for personal bodily injury, including death, where the injury has been exclusively caused by the indemnifying party's gross negligence or willful misconduct in connection with this Agreement.

12. Compliance with Laws

A. All Laws. In performing its obligations under this Agreement, each party agrees to comply with all laws and regulations applicable to such party including the customs and export control laws and regulations of the U.S.; and the country in which the Products or Services are delivered or performed.

B. Encryption and Other Regulatory Requests. Customer certifies that all items (including hardware, software, technology and other materials) it provides to Blaze for any reason that contain or enable encryption functions either (i) satisfy the criteria in the Cryptography Note (Note 3) of Category 5, Part 2 of the Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies or (ii) employ key length of 56-bit or less symmetric, 512-bit asymmetric or less, and 112-bit or less elliptic curve. Blaze is not responsible for determining whether any Third-Party Product to be used in the Products and Services satisfies regulatory requirements of the country to which such Products or Services are to be delivered or performed, and Blaze shall not be obligated to provide any Product or Service where the resulting Product or Service is prohibited by law or does not satisfy the local regulatory requirements.

13. Termination or Suspension

A. Suspension or Modification of Services. Blaze may suspend, terminate, withdraw, or discontinue all or part of the Services when Blaze believes, in its sole judgment, that you are involved in any fraudulent or illegal activities.

B. Termination. Either party may terminate a Service Agreement or Software Agreement if the other party commits a material breach and the breach is not cured within 90 days of receipt of written notice. Termination of any Service Agreement will not terminate other Service Agreements, and termination of all Service Agreements will not terminate this Agreement. Blaze may terminate this Agreement and all Service Agreements and Software Agreements immediately, if (i) you fail to make any payment when due; (ii) you declare bankruptcy or are adjudicated bankrupt; (iii) a receiver or trustee is appointed for you or substantially all of your assets; or (iv) you purchased through a reseller and, as applicable, the agreement between you and such reseller expires or is terminated, the agreement between Blaze and such reseller expires or is terminated, or your reseller is delinquent on its payment obligations to Blaze. Further, Blaze may terminate a Service Agreement immediately if you are acquired by or merge with a competitor of Blaze. Upon termination of this Agreement, all rights and obligations under this Agreement will automatically terminate except for rights of action accruing prior to termination, payment obligations, and any obligations that expressly or by implication are intended to survive termination.

14. Limitation of Liability

A. Blaze WILL NOT BE LIABLE FOR ANY INCIDENTAL, INDIRECT, PUNITIVE, SPECIAL, OR CONSEQUENTIAL DAMAGES ARISING OUT OF OR IN CONNECTION WITH THIS AGREEMENT, OMISSIONS OF CUSTOMER OR THIRD PARTIES, OR THE PRODUCTS OR SERVICES. EXCEPT FOR CUSTOMER BREACH OF SECTIONS 5. OR 6. OR 7. OR 10. OR 11. OR YOUR VIOLATION OF Blaze's INTELLECTUAL PROPERTY RIGHTS, NEITHER PARTY SHALL HAVE LIABILITY FOR THE FOLLOWING:

(i) LOSS OF REVENUE, INCOME, PROFIT, OR SAVINGS; (ii) LOST OR CORRUPTED DATA OR SOFTWARE, LOSS OF USE OF A SYSTEM OR NETWORK OR THE RECOVERY OF SUCH; (iii) LOSS OF BUSINESS

OPPORTUNITY; (iv) BUSINESS INTERRUPTION OR DOWNTIME; (v) THE PRODUCTS, DELIVERABLES OR THIRD-PARTY PRODUCTS NOT BEING AVAILABLE FOR USE; OR (vi) THE PROCUREMENT OF SUBSTITUTE PRODUCTS OR SERVICES.

B. Blaze's TOTAL LIABILITY FOR ANY AND ALL CLAIMS ARISING OUT OF OR IN CONNECTION WITH THIS AGREEMENT (INCLUDING PRODUCTS AND SERVICES) IN ANY 12 MONTH PERIOD SHALL NOT EXCEED THE TOTAL AMOUNT RECEIVED BY Blaze DURING THE PRIOR 12 MONTHS OF THIS AGREEMENT FOR THE SPECIFIC PRODUCT OR SERVICE GIVING RISE TO SUCH CLAIM(S). CUSTOMER WILL NOT TRANSFER, ASSIGN OR LEASE THE EQUIPMENT SOLD HEREUNDER TO ANY THIRD PARTY WITHOUT FIRST SECURING FROM SUCH PARTY THE PROTECTION AFFORDED TO Blaze HEREIN.

C. THESE LIMITATIONS, EXCLUSIONS, AND DISCLAIMERS APPLY TO ALL CLAIMS FOR DAMAGES, WHETHER BASED IN CONTRACT, WARRANTY, STRICT LIABILITY, NEGLIGENCE, TORT, OR OTHERWISE. THESE LIMITATIONS OF LIABILITY ARE AGREED ALLOCATIONS OF RISK CONSTITUTING IN PART THE CONSIDERATION FOR Blaze's SALE OF PRODUCTS OR SERVICES TO CUSTOMER, AND WILL APPLY NOTWITHSTANDING THE FAILURE OF ESSENTIAL PURPOSE OF ANY LIMITED REMEDY AND EVEN IF A PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH LIABILITIES.

15. Additional Terms

A. Independent Subcontractor Relationship; Assignment; Subcontracting. The parties are independent contractors. Neither party will have any rights, power or authority to act or create an obligation on behalf of the other party except as specified in this Agreement. Neither party's employees, agents, nor consultants shall be considered under any circumstances to be employees of the other party. Blaze has the right to assign, subcontract, or delegate in whole or in part this Agreement, or any of its rights, duties, obligations or liabilities provided that if it subcontracts its duties in providing Services, Blaze shall remain responsible for the performance of such Services under this Agreement. You may not assign this Agreement without Blaze's permission.

B. Excused Performance. A party shall not be liable to the other for any delay in performing its obligations if the delay is caused by circumstances beyond its reasonable control, provided that the other party is promptly notified in writing. If the circumstance lasts longer than 60 days, then the other party may terminate, in whole or in part, this Agreement or the affected Service Agreement or Software Agreement by giving written notice to the delayed party. This Section shall not relieve either party of its obligations under this Agreement (including payment), but rather will only excuse a delay in performance.

C. Excluded Data. Customer acknowledges that Products and Services provided under this Agreement are not designed to process, store or be used in connection with any of the following categories of data: (i) data that is classified and/or used on the U.S. Munitions list, including software and technical data; (ii) articles, services and related technical data designated as defense articles and defense services; (iii) ITAR (International Traffic in Arms Regulations) related data; and (iv) except for certain DSG Software, other personally identifiable information that is subject to heightened security requirements as a result of Customer's internal policies or practices or by law (collectively referred to as "Excluded Data"). You are solely responsible for reviewing data that will be provided to or accessed by Blaze to ensure that it does not contain Excluded Data.

16. Interpretation

If any of these terms and conditions contravenes or is invalid under applicable law, these terms and conditions shall not fail as a result but will be construed as if such term or provision was not included. The invalid, illegal or unenforceable provision shall be deemed to be automatically modified, and, as so modified, to be included in these terms and conditions, such modification being made to the minimum extent necessary to render the provision valid, legal and enforceable. Waiver or excuse by Blaze of any noncompliance with these terms and conditions shall not constitute a waiver or excuse of any prior or subsequent noncompliance.

17. Insurance

Upon request, Blaze shall provide evidence of insurance in accordance with its standard coverage and limits. Blaze does not provide third parties direct access to its insurance or give additional rights to its insurance, such as naming additional insured parties.

18. Force Majeure.

The inability of Blaze to fulfill its obligations required under these terms and conditions resulting from defaults or delays caused by conditions beyond Blaze's reasonable control including, but not limited to strikes, insurrection, acts of God, war, terrorist activities, emergencies, shortages or unavailability of materials, weather, change in law or other similar causes, will extend the period for the performance of the obligations for the period equal to the period(s) of any such delays(s) and Customer will not have the right to termination; provided that Blaze will continue to perform to the extent feasible in view of such force majeure.

19. Governing Law.

THIS AGREEMENT AND ANY RELATED SERVICE AGREEMENT(S), AND ANY CLAIM, DISPUTE, OR CONTROVERSY (WHETHER IN CONTRACT, TORT, OR OTHERWISE, INCLUDING STATUTORY, CONSUMER PROTECTION, COMMON LAW, INTENTIONAL TORT AND EQUITABLE CLAIMS) BETWEEN CUSTOMER AND Blaze, INCLUDING THEIR AFFILIATES, CONTRACTORS, AND AGENTS, AND EACH OF THEIR RESPECTIVE EMPLOYEES, DIRECTORS, AND OFFICERS (A "DISPUTE") WILL BE GOVERNED BY THE LAWS OF THE STATE OF WASHINGTON, WITHOUT REGARD TO CONFLICTS OF LAW. THE UN CONVENTION FOR THE INTERNATIONAL SALE OF GOODS AND THE UNIFORM COMPUTER INFORMATION TRANSACTIONS ACT WILL NOT APPLY.

A. Venue. The parties agree that any Dispute shall be brought exclusively in the state or federal courts located in King County, WA. The parties agree to submit to the personal jurisdiction of such courts.

B. Bench Trial. The parties agree to waive, to the maximum extent permitted by law, any right to a jury trial with respect to any Dispute.

C. No Class Actions. NEITHER PARTY SHALL BE ENTITLED TO JOIN OR CONSOLIDATE CLAIMS BY OR AGAINST OTHER CUSTOMERS, OR PURSUE ANY CLAIM AS A REPRESENTATIVE OR CLASS ACTION OR IN A PRIVATE ATTORNEY GENERAL CAPACITY.

D. Limitation Period. Neither party shall be liable for any claim brought more than 2 years after the cause of action for such claim first arose.

E. Dispute Resolution. Customer and Blaze will attempt to resolve any Dispute through negotiation or by utilizing a mediator agreed to by the parties, rather than through litigation. Negotiations and mediations will be treated as confidential. If the parties are unable to reach a resolution within 30 days of notice of the Dispute to the other party, the parties may pursue all other courses of action available at law or in equity.

F. Notices. Notice to Blaze under this Agreement or any related Service Agreement must be in writing and sent by registered or certified mail (postage prepaid first-class mail and return receipt requested) by overnight delivery service and by electronic mail to the address below, and will be effective upon receipt.

Richard Becker Managing Director Blaze Metrics, LLC 7301 W. Snoqualmie Valley RD NE Carnation, WA 98014 Richard.Becker@BlazeMetrics.com

20. Entire Agreement; Severability.

This Agreement is the entire agreement with respect to its subject matter and supersedes all prior or contemporaneous communications or agreements that may exist. If you purchased directly from Blaze, any preprinted terms on your purchase order shall be of no force or effect. Modifications to this Agreement will be made only through a written amendment signed by both parties. If any provision of this Agreement is found to be void or unenforceable, such provision will be stricken or modified, but only to the extent necessary to comply with the law, and the remainder of this Agreement will remain in full force. No rights may arise by implication or estoppel, other than those expressly granted herein.

Revision Date 3/22/2019