
Backscatter Cloud Probe with Polarization Detection (BCPD)

Operator Manual

DOC-0347, Revision B



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Warranty

The seller warrants that the equipment supplied will be free from defects in material and workmanship for a period of one year from the confirmed date of purchase of the original buyer. Service procedures and repairs are warranted for 90 days. The equipment owner will pay for shipping to DMT, while DMT covers the return shipping expense.

Consumable components, such as tubing, filters, pump diaphragms, and Nafion humidifiers and dehumidifiers are not covered by this warranty.

Laser Safety Information

CAUTION: The requirement for the BCPD to be non-intrusive to aircraft operations (i.e., no external components) dictates the absence of a laser beam-stop mechanism. The laser beam will project unimpeded from the optical window. At distances within 5 meters of the probe, the laser beam is not eye-safe, so precautions must be enforced for operation on the bench or ground.

Benchtop operation: The BCPD can be safely operated on the bench if certain precautions are followed. The optical block should be secured on the technician's bench and a beam-stop must be secured in such a position that the direct beam or reflections cannot be seen by the operator or others in the room.

Aircraft operation: Operators should wear protective optical glasses, preventing the 658 nm wavelength from passing. This protects against unlikely events such as a wind-borne scrap of aluminum foil reflecting the beam into the cockpit. For operation on an aircraft, it is the responsibility of the system operator or power distribution system to apply 28 VDC power to the BCPD only after airborne. The laser beam diverges quickly, and does become eye-safe after 5 meters, so the instrument can safely be operated while airborne. It is also the operator's or power distribution system's responsibility to deactivate the BCPD before landing.

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1.0 Product Description

1.1 Introduction

The Backscatter Cloud Probe with Polarization Detection (BCPD) measures cloud particle size distributions, which are then used to derive the total number concentrations, liquid water content (LWC), median volume diameter (MVD), and effective diameter (ED). The BCPD's non-intrusive optical housing allows use in a range of ground-based or airborne applications with no contamination from ice crystal shattering or airflow distortions.

Droplet Measurement Technologies (DMT) has implemented state-of-the-art electronics and optics, which offer flexibility to the BCPD user in a variety of applications. The non-intrusive optical housing allows use in a range of ground-based or airborne applications. This housing contains the laser module, backscatter optical components, optical heating circuit, photodetector, and analog signal-conditioning circuit. The analog signal is transmitted to the BCPD Electronics Processing Module, where it is digitized and processed. Once digitized, particle pulse height is categorized into a selectable 10, 20, 30 or 40-bin histogram¹. Analog “housekeeping” parameters are combined with the size information and sent in a serial data stream (RS-422) to the data system.



Figure 1: BCPD with Window Interface

¹ Users must specify the number of bins when order the BCPD. 30 bins is standard.

1.2 BCPD Specifications

| | |
|-----------------------------|--|
| Measurement Technique: | Single-particle light scattering |
| Data Parameters: | <ul style="list-style-type: none"> • Particle optical diameter • Particle number concentration • Liquid water content (LWC) • Effective diameter (ED) • Median volume diameter (MVD) • Temperature • Pressure |
| Size Range: | To be determined |
| Number Concentration Range: | 0 - 1,000 cm ⁻³ |
| Air Speed Range: | 10 - 250 ms ⁻¹ |
| Number of Size Bins: | 10, 20, 30 or 40 (configured at time of purchase; 30 is standard) |
| Sampling Frequency: | Selectable, 0.04 sec to 20 sec |
| Light Collection Angles: | Center-line: 155°, +/- 18.5° |
| Laser Wavelength: | 658 nm |
| Laser Power: | 85mW or less |
| Data System Interface: | RS-422 serial interface |
| Additional components: | Electronics box, 1 m connecting cable |
| Calibration: | Glass beads |
| Routine Maintenance: | Optics cleaning before every field campaign |
| Recommended Service: | Annual cleaning and calibration at DMT service facility |
| Software: | Optional Particle Analysis and Display System (PADS) software |
| Temp: | -40 to +40 °C. Note: the laser will automatically shut down above +45 °C, preserving laser life-time. |
| Altitude: | 0 - 50,000 feet |
| Humidity: | 0 - 100% |

1.2.1 Physical Specifications

| | |
|-----------------------------|---|
| Weight: | <ul style="list-style-type: none"> • 1.4 kg for head and flange • 0.9 kg for box |
| Probe Dimensions: | <ul style="list-style-type: none"> • Probe alone: 14.7 cm L x 13.3 cm W x 6.4 cm H • With window interface: 16.7 cm L x 13.3 W x 8.3 cm H |
| Electronics Box Dimensions: | 21.7 cm L x 12.0 cm W x 8.2 cm H |

1.3 Electrical Specifications

| | |
|---------------------|------------------------------------|
| Power Requirements: | 28 VDC, 5 A for system and heaters |
|---------------------|------------------------------------|

CAUTION: The requirement for the BCPD to be non-intrusive to aircraft operations (i.e., no external components) dictates the absence of a laser beam-stop mechanism. The laser beam will project unimpeded from the optical window. The laser is not eye-safe, so precautions must be enforced for operation on the bench or ground.

1.4 Summary of BCPD Electronic and Software Features

- Classification of particle optical diameter in histogram form.
- Size distributions accumulated in the probe, with serial transmission to any standard computer communications port (RS-422).
- Monitoring of multiple variables, e.g. total particles, average transit time, over-range particles, and various probe health indicators. See section **Error! Reference source not found.** for conversion equations for analog-to-digital channels.
- User-programmable sample rates and bin thresholds.
- Zero dead-time losses.
- Dynamic threshold feature (see section 3.0**Error! Reference source not found.**)

2.0 Theory of Operation

Particles passing through the laser beam scatter light in all directions, but only light within a cone subtending angles between 136.5° and 173.5° is collected and directed onto a slit that defines a region within the laser beam where particles are measured and counted. Light passing through the slit continues through a polarizing beam splitter. The P polarized component is directed to one photo-detector and the S polarized component

to the other photo-detector (see Figure 2). The photo-detector converts the photons scattered by each particle into an electrical pulse. These electrical pulses are then transmitted to a signal processor, which amplifies and digitizes them.

A spherical particle will scatter predominantly P polarized light—i.e., light with the same plane of polarization as the incident light. Non-spherical or crystalline particles will scatter less P polarized light and more S polarized light, which is light with a plane of polarization perpendicular to the incident light polarization. The P polarization signal is used to generate a size distribution that relates number concentration to each particle's optical diameter. This data is accumulated at programmable time intervals and stored along with information that monitors the data quality and health of the system.

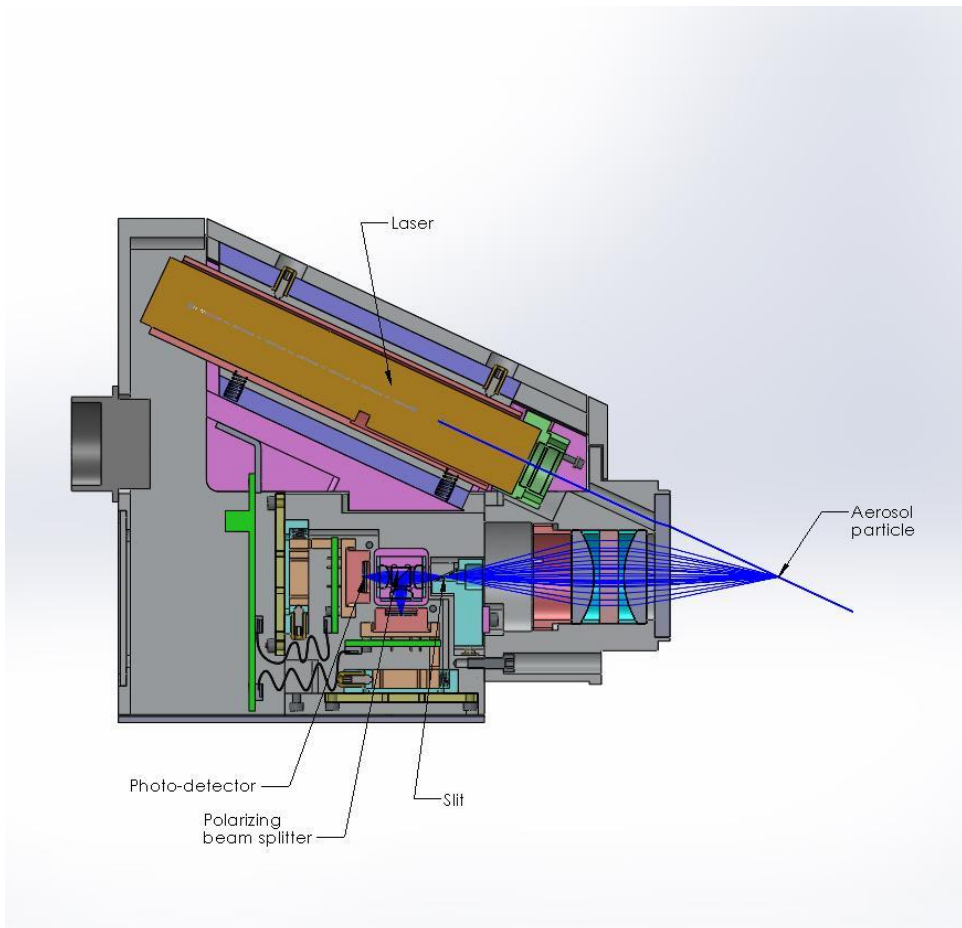


Figure 2: BCPD Optical Path

3.0 Dynamic Threshold Feature

The BCPD's dynamic threshold feature automatically adjusts the instrument's S and P polarization signals to account for drifts due to temperature changes.

The dynamic threshold feature works as follows. The instrument's S and P Detector voltages are digitized with a 12-bit ADC, which yields a value between 0 and 4095. A histogram is created of all counts between 0 and 512. (Signals above 512 are assumed to be responses to particles, and thus not relevant to establishing the baseline.) The system then identifies the narrowest band that contains at least 75% of counts in the histogram. This band, referred to as the “noise band,” is the system's attempt to identify a range for baseline noise when no particles are present.

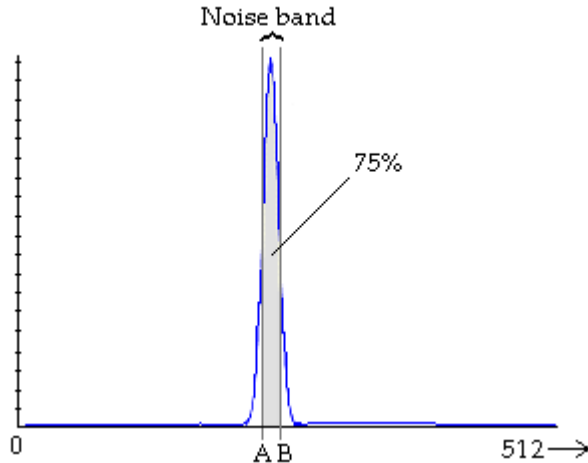


Figure 3: Identifying a Noise Band

If the noise band exceeds 20 counts (i.e., the width is too wide), or if no noise band was identified, the previous noise band is used. These qualifications are imposed in order to distinguish the noise from actual particle events. The instrument then uses the noise band to adjust the sizer baseline and identify particles. The noise band updates at a rate of 10 Hz.

There are four BCPD output channels related to dynamic thresholding. For the S Detector signal, **S Noise Bandwidth** is the width of the noise band—that is, $[B - A]$ in Figure 4. **S Baseline Threshold** is the upper boundary of the noise band, i.e. B in Figure 4. Both of these channels are given in digital counts. **P Noise Bandwidth** and **P Baseline Threshold** are the corresponding channels for the P detector.

4.0 Bench-top Testing

4.1 Bench-top test and Calibration Confirmation

CAUTION: The BCPD can be safely operated on the bench if certain precautions are followed. The requirement for the BCPD to be non-intrusive to aircraft operations (i.e., no

external components) dictates that there not be a laser beam-stop mechanism. The laser beam will project unimpeded from the optical window. The laser is not eye-safe, so precautions must be enforced for operation on the bench or ground. The optical block should be secured on the technician's bench and a beam-stop must be secured in such a position that the direct beam or reflections cannot be seen by the operator or others in the room. Operators should wear protective optical glasses, preventing the 658 nm wavelength from passing. In addition, the operator should be trained in safe handling of class IIIB lasers. The work space should be isolated from other people who are not also wearing such protective glasses and are not similarly trained.

Operation can be verified by using a can of "Freeze Mist," commonly available at electronic supply stores. Direct the mist through the laser beam at a point directly above the collection optics, about 4-5 cm from the sapphire window. Calibration with precision glass beads is performed at DMT's facility, as the company maintains a bead-dispenser fixture to ensure correct placement of particles in the beam.

Standard BCPD serial communication is configured for RS-422.

The BCPD will communicate with the PADS software package supplied with the BCPD. Review the PADS manual for details.

The BCPD heater circuits are temperature controlled and can be activated on the ground. The optics block heater and the electronic heaters are set for 20°C.

5.0 Aircraft Operation

For operation on an aircraft, it is the responsibility of the system operator or power distribution system to apply 28 VDC power to the BCPD only after airborne. The laser beam diverges quickly, and does become eye-safe after just several meters, so the instrument can safely be operated while airborne. It is also the operator's or power distribution system's responsibility to deactivate the BCPD before landing. DMT is not liable for misuse of the BCPD.

The Window Interface (MP-3413), shown on the left in Figure 4, is mounted to the inside of the aircraft skin. The BCPD Optics block is then attached to the Window Interface and secured via 4 post and nylon lock-nuts. The posts have M-4 threads. If the aircraft needs to be flown while the BCPD Window Interface is away for maintenance, the Blanking Cap can be installed to allow the aircraft to remain pressure-tight. The blanking cap, (MP-2363-A), is on the right in Figure 4.

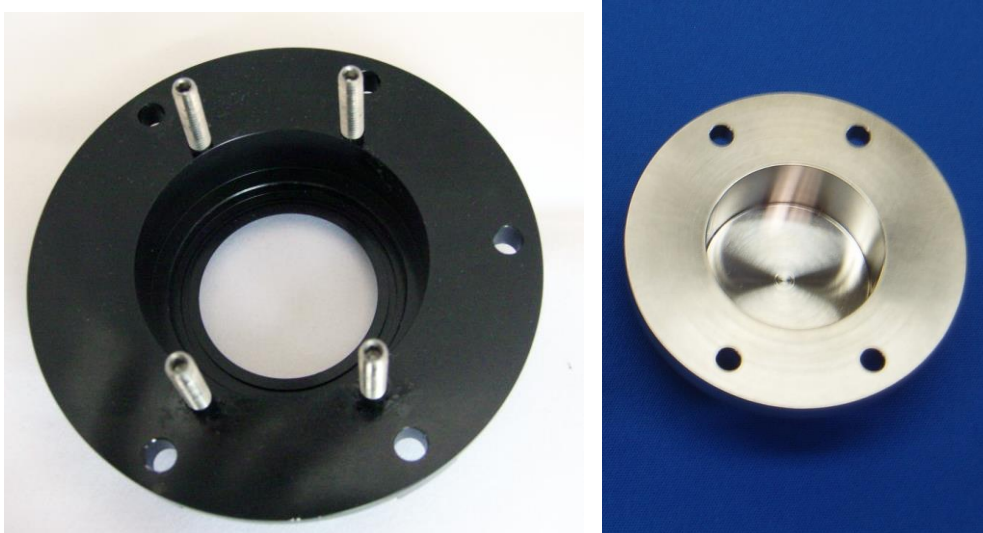


Figure 4: BCPD Window Interface (left) and Blanking Cap (right)

6.0 Particle Analysis and Display System (PADS)

DMT's Particle Analysis and Display Software (PADS) can be purchased with the BCPD, allowing any computer with an available serial port to act as the data logger. The PADS program needs Windows 2000, Windows 7 or Windows XP for successful operation (see the PADS manual for operating instructions). *The BCPD does not work with DMT's older PACS software.*

PADS allows the user to do the following tasks, among others:

- Start data recording and sampling
- View a size histogram of particles measured by the BCPD
- View particle volume and number concentrations, as well as Liquid Water Content (LWC), Median Volume Diameter (MVD) and Effective Diameter (ED)
- Monitor instrument operational parameters like optic block temperature, electronic box temperature, and the baseline monitor voltage

7.0 Routine Maintenance

The BCPD is environmentally sealed and is water resistant, *but not waterproof.*

The optical path is protected with a fused silica window. It can be seen through the water trough port. Water residue can cause contamination on the windows and this contamination will distort or attenuate the amount of scattered light collected from a particular particle.

To clean the sapphire window, follow accepted optical cleaning techniques:

- Use white vinegar on a Q-tip to remove water spots on the exposed sapphire window, then use alcohol or acetone for final cleaning procedures. Use the Q-tip for only one swipe of the window. Do not clean with a continued circular motion as that may cause scratches on the window.
- If the aircraft is “de-iced” before takeoff, the chemical residue may end up on the sapphire window and prevent correct operation during the flight. The window will need to be protected or cleaned before operation will be restored.

8.0 Communications between the PC and BCPD Firmware

Any computer capable of communications over an RS-422 port should be capable of communicating with the BCPD. The port parameters for communications should be set to the Baud rate specified in PADS, 8 data bits, and one stop bit with no parity checking. Since binary data are sent across the interface it is possible that some systems will react to the non-ASCII characters that are sent as control characters. It is recommended that all communications with the BCPD electronics be programmed at a low level to avoid this problem.

The host computer initiates all communications with the firmware electronics. There are several commands that the firmware responds to, which are listed in the table below. Each command is preceded by an ESC character (“1B”).The command number (e.g., “01”) follows.

| | |
|------|---|
| 1B01 | Initialize |
| 1B02 | get normal data, no PbP and no Raw PbP ² |
| 1B03 | get normal data and PbP data |
| 1B04 | get normal data and PbP data and Raw PbP data |
| 1B05 | get firmware version |

The firmware only responds with data after it has received a request for data, so all of the timing for data acquisition needs to be performed in the host processor. To increase the data rate from the probe, the host only needs to increase the rate at which it makes

² For descriptions of PbP (particle-by-particle) and raw PbP data, see sections 8.3.2 and 8.3.3.

requests for data. After filing a data request, the firmware clears all of its summation and starts taking a new set of data.

8.1 SETUP DATA ACQUISITION PARAMETERS COMMAND

The table below shows the format of the packet PADS sends to the firmware to set up the data acquisition parameters. These parameters will remain until power is cycled or a new setup data acquisition parameters command is sent.

| Start Byte | Length in Bytes | Parameter Name |
|------------|-----------------|------------------------------------|
| 0 | 2 | ESC and command number (1B01) |
| 2 | 2 | ADC Lower Thresh |
| 4 | 2 | # of PbP packets |
| 6 | 2 | Channel Count |
| 8 | 2 | # of bytes of raw data per channel |
| 10 | 2 | Spare |
| 12 | 2 | Spare |
| 14 | 80 | Thresholds (40 bins) |
| 94 | 2 | Checksum |

For command number 01 (setup data acquisition parameters) the probe responds with two ACK characters (ASCII character 6).

8.2 SEND DATA (POLL REQUEST) COMMAND

PADS sends the firmware one of the following commands to get data:

- 1B02 get normal data, no PbP and no Raw PbP
- 1B03 get normal data and PbP data
- 1B04 get normal data and PbP data and Raw PbP data

8.3 Response to SEND DATA COMMAND

After the BCPD receives a Send Data request, it responds with the data packet below. Note that the data in italics is only sent if it was requested. PbP data is sent in the event of a 03 or 04 command, while raw data is only sent with an 04 command. The total length of this packet depends on the number of PBP particles recorded.

The first 16 channels in the data packet are analog-to-digital signals that must be converted by the data system (e.g., PADS) into meaningful numbers. The data arrive in

hex format. PADS or another data system must then use a scaling algorithm specified within the program to yield valid results. See Table 2 for scaling equations.

| Start Byte | # of Bytes | Name |
|------------|------------|---|
| 0 | 2 | HK 1 |
| 2 | 2 | HK 2 |
| 4 | 2 | HK 3 |
| 6 | 2 | HK 4 |
| 8 | 2 | HK 5 / P APD Voltage (V) |
| 10 | 2 | HK 6 / P APD Temp (C) |
| 12 | 2 | HK 7 / +5V Monitor |
| 14 | 2 | HK 8 / Board Temp (C) |
| 16 | 2 | HK 9 / S APD Voltage (V) |
| 18 | 2 | HK 10 / S APD Temp (C) |
| 20 | 2 | HK 11 |
| 22 | 2 | HK 12 |
| 24 | 2 | HK 13 |
| 26 | 2 | HK 14 |
| 28 | 2 | HK 15 |
| 30 | 2 | HK 16 |
| 32 | 4 | unused |
| 36 | 2 | unused |
| 38 | 2 | S Noise Bandwidth |
| 40 | 2 | S Baseline Threshold |
| 42 | 2 | P Noise Bandwidth |
| 44 | 2 | P Baseline Threshold |
| 46 | 4 | Oversize Reject |
| 50 | 120 | Histogram/Bin Data (4 bytes per bin, 30 bins) |
| 170 | 6 | Timer response header |
| 176 | * | <i>PbP Data (12 bytes per PBP particle)</i> |
| * | 2080 | <i>Raw Data</i> |
| * | 2 | Checksum |

* These numbers depend on the amount of PbP data sent.

Table 1: Data Packet BCPD sends to Host Computer in Response to Send Data Command

8.3.1 Definitions of the *Send Data Response Parameters*

Table 2 provides definition for the channels in the BCPD data packet. For housekeeping channels, shaded in gray, the appropriate conversion equation is also provided. This conversion equation allows the user to calculate meaningful values (i.e., values in volts or degrees Celsius) from the original analog reading, *x*.

| Channel | Definition | Conversion Equation |
|----------------------|--|---|
| Housekeeping [1-16] | An array which holds the most recent Analog-to-Digital conversion values for the 16 analog housekeeping channels. | Varies |
| P APD Voltage (V) | The voltage at the P-Detector's avalanche photodiode. This voltage will be between 100V and 200V and should stay stable $\pm 2V$. | $0.06105x$ |
| P APD Temp (C) | The temperature at the P-Detector's avalanche photodiode. This temperature should be approximately 25 °C and stay stable ± 3 °C. | $72.815 - 0.048325x + (1.4967 * 10^{-5})x^2 - (2.2627 * 10^{-9})x^3 + (1.2632 * 10^{-13})x^4$ |
| +5V Monitor (V) | The power 5V reference for the control system, which should be 5V +/- 0.3V. | $0.002442x$ |
| Board Temp (C) | The temperature of the digital board. This temperature will generally be higher than ambient temperature, since the board is enclosed in the instrument. | $158.029 - 0.0519x$ |
| S APD Voltage (V) | The voltage at the S-Detector's avalanche photodiode. This voltage will be between 100V and 200V and should stay stable $\pm 2V$. | $0.06105x$ |
| S APD Temp (C) | The temperature at the S-Detector's avalanche photodiode. This temperature should be approximately 25 °C and stay stable ± 3 °C. | $72.815 - 0.048325x + (1.4967 * 10^{-5})x^2 - (2.2627 * 10^{-9})x^3 + (1.2632 * 10^{-13})x^4$ |
| S Noise Bandwidth | The width of the S detector's noise band in digital counts. See section 3.0 for more information. | |
| S Baseline Threshold | The upper boundary of the S detector's noise band in digital counts. See section 3.0 for more information. | |
| P Noise Bandwidth | The width of the P detector's noise band in digital counts. See section 3.0 for more information. | |
| P Baseline Threshold | The upper boundary of the P detector's noise band in digital counts. See section 3.0 for more information. | |
| Oversize Reject | A counter for how many times that the Analog to Digital Converter was at its maximum digitized count (4096). These particles are not processed into the calculated parameters and only reported as "over-range particles". | |

| | |
|------------|--|
| Bin Counts | An array which holds the digital thresholds for the different peak size channels which are defined in the Setup command. |
| Checksum | The 16-bit sum of the characters in the packet. |

Table 2: Definitions and Conversion Equations for Channels in the BCPD Data Packet

8.3.2 PBP Data

Fourteen bytes of PBP data are sent for each PBP particle. These bytes break down as follows, with each datum taking up two bytes:

- S arrival time in one-microsecond resolution
- S peak (0 to 4095)
- P peak (0 to 4095)
- S transit time (full width of half max)
- P transit time (full width of half max)
- S peak address (0 to 511)
- P peak address (0 to 511)

8.3.3 Raw Data

The BCPD electronics capture one raw waveform of S and P during each sampling period. The sample resolution is 25 nanoseconds, and each sample is 12 bits (0 - 4095 counts). The S and P samples are concatenated to give 24 bits, or 3 bytes. There are 512 samples of interweaved S and P samples sent to PADS. The total sample size is thus $512 * 3 = 1536$ bytes.

The two waveforms can be displayed in PADS. See Figure 5. The ideal waveform will look like a Gaussian curve.

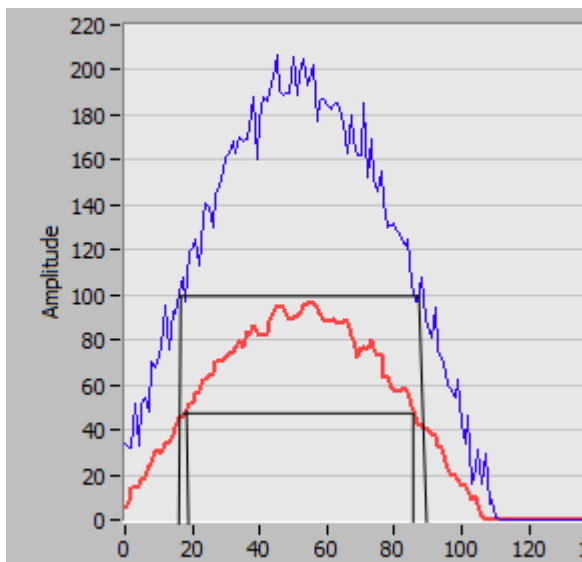


Figure 5: Example Raw Data Plot of the S Polarization (top) and P Polarization (bottom)

Appendix A: Revisions to Manual

| Rev. Date | Rev No. | Summary | Section |
|-----------|---------|---|------------|
| 11-5-12 | A | Updated BCP to reflect polarization component | Throughout |
| 2-13-14 | B | Updated picture of BCPD | 1.1 |
| | | Updated weight and dimensional specs | 1.3 |
| | | Added dimensional drawings | Appendix B |
| | | Added mounting bolt pattern | Appendix C |

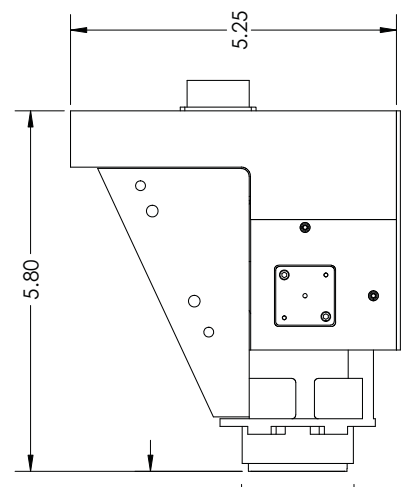
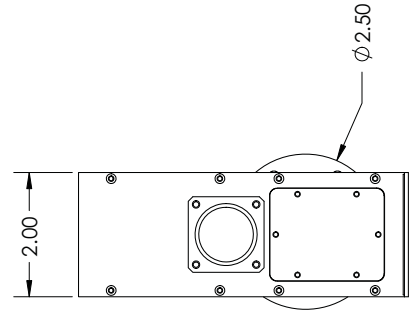
Appendix B: Dimensional Drawings

Dimensional drawings for the BCPD head, window interface, and electronics box can be found on the following pages.

1 2 3 4 5 6 7 8

| REVISION HISTORY | | DATE | APPROVED |
|------------------|------|-----------|----------|
| EC | REV. | 2/13/2014 | R NEWTON |
| | A | | |

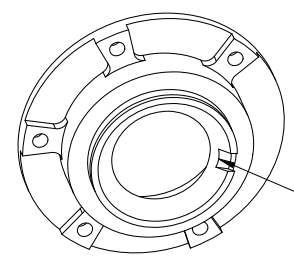
| DESCRIPTION | |
|--------------------|--|
| Added Airflow note | |



BCPD

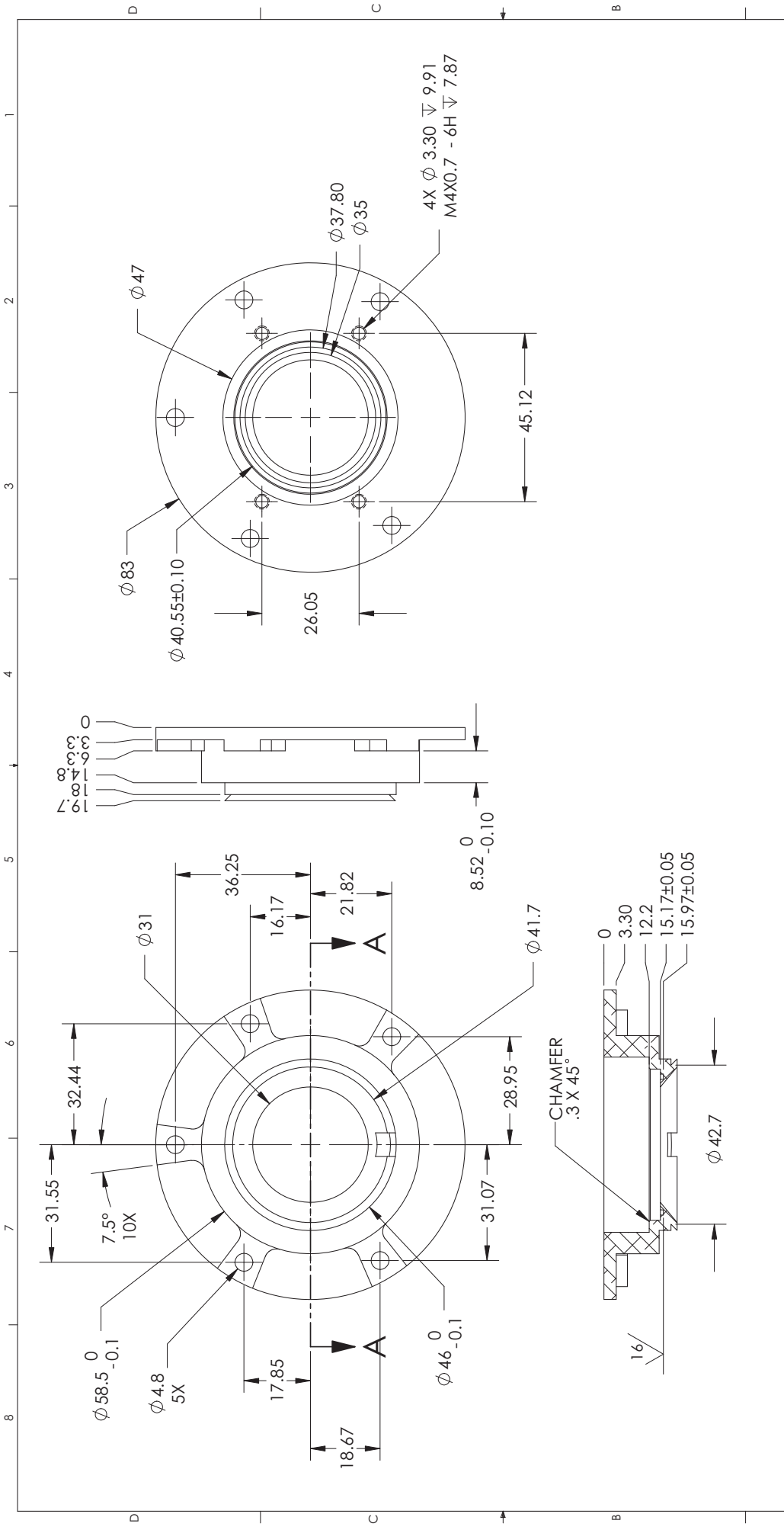
AIRFLOW CAN BE IN EITHER DIRECTION ALONG THIS AXIS BUT THE WINDOW INTERFACE SHOULD BE MOUNTED WITH THE DRAIN DOWN STREAM

SAMPLE AREA



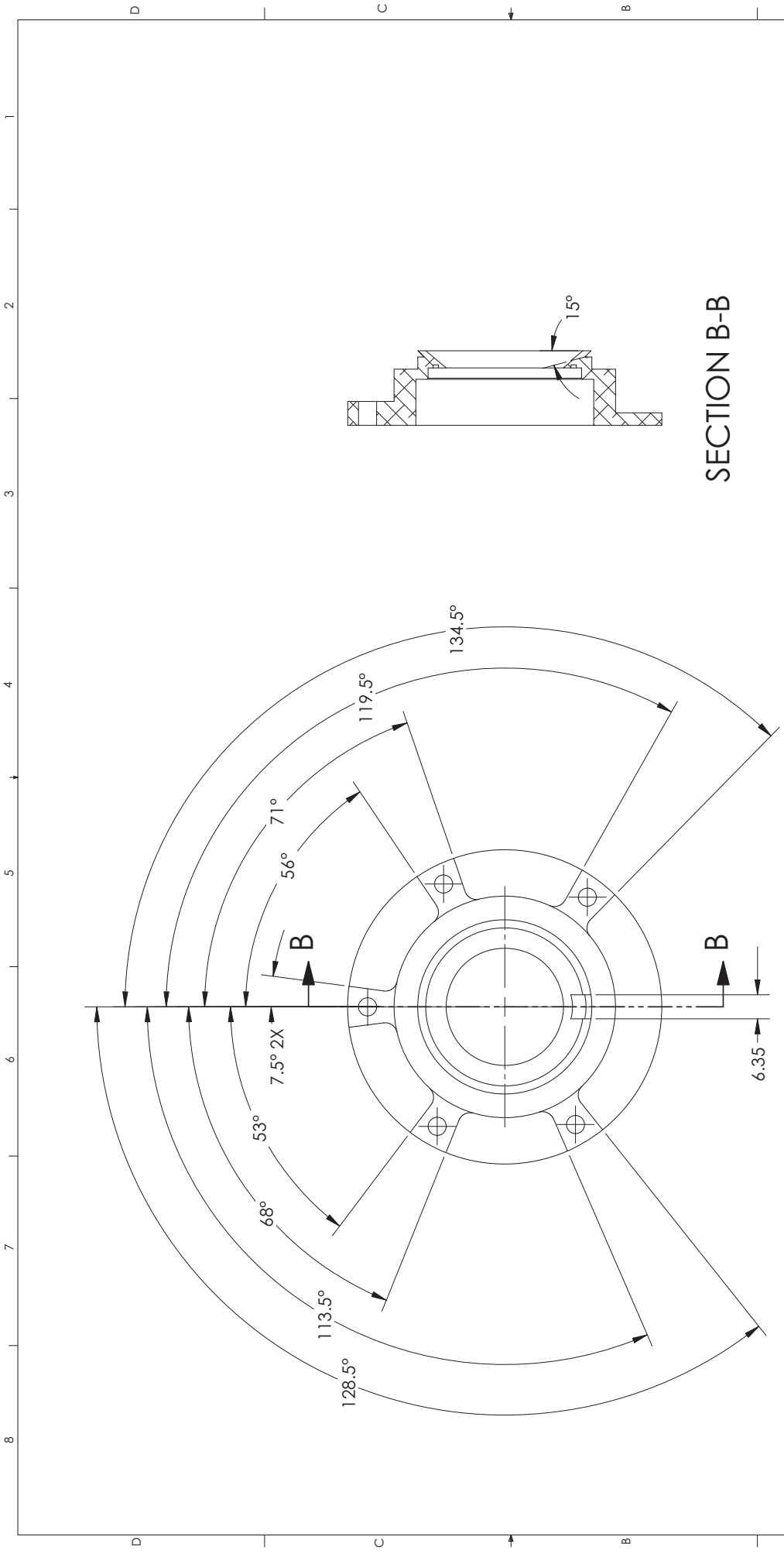
WINDOW INTERFACE DRAIN

| IDENTIFY WITH PART NUMBER & REV | | ENGLISH DIMENSIONS: INCHES | | DROPLET MEASUREMENT TECHNOLOGIES, INC. | |
|--|-----|--|------------------|--|--|
| MATERIAL | --- | TOLERANCES: | DECIMALS: ANGLES | 5710 B Flatirons Pkwy, Boulder, CO 80301 | |
| PROCESS | --- | X.X ±0.015 | X ° ±1 ° | TITLE BCPD | |
| THREAD DEPTH 2d UNLESS OTHERWISE SPECIFIED | --- | X.XX ±0.010 | X.X * ±0.1 * | CUSTOMER DIMS | |
| | | (UNLESS OTHERWISE SPECIFIED) | | PART NUMBER | |
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| | | | | DRAWN ROY NEWTON | |
| | | | | DATE 04/15/13 | |
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| | | | | SHEET 1 of 1 | |



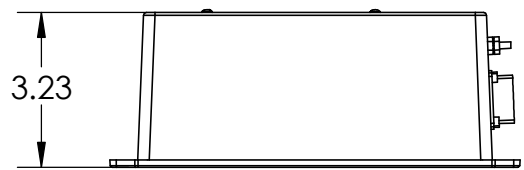
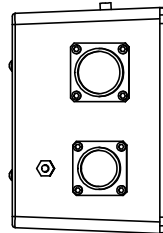
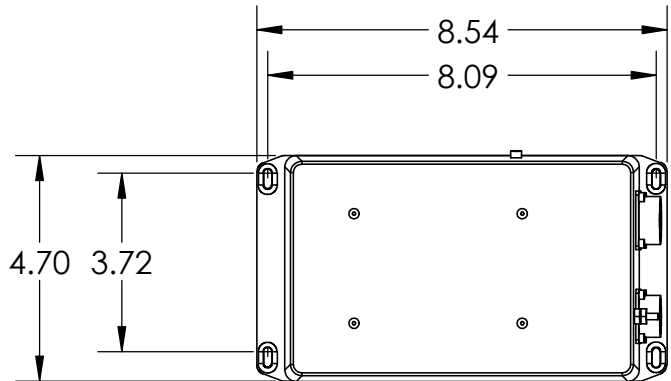
SECTION A-A

| | | | | | | |
|--|---|---|---|---|--|--------------|
| IDENTIFY WITH PART NUMBER & REV MATERIAL 6061-T6 Al PROCESS BLACK ANODIZE THREAD DEPTH 2d UNLESS OTHERWISE SPECIFIED | METRIC DIMENSIONS: millimeter TOLERANCES: DECIMALS: X.X ±0.1 X.XX ±0.01 X.XX ±0.1* ANGLES: X° ±1° X.X° ±0.1* (UNLESS OTHERWISE SPECIFIED) | CAD GENERATED DRAWING: ALL DIMENSIONS SHALL UNLESS OTHERWISE SPECIFIED DO NOT SCALE DRAWINGS ARE UNCONTROLLED 3RD ANGLE PROJECTION FEB 2014/14/2012 | DROPLET MEASUREMENT TECHNOLOGIES, INC. 5710 B FLATIRON PKWY, BOULDER, CO 80301 TITLE: BCP-D WINDOW INTERFACE | DRAWN: ROY NEWTON DATE: 09/13/12 SCALE: 1:1 PART NUMBER: MP-3413 PART REV: A | SIZE: B N:\BCPD\WindowInterface MP-3413-A.SLDPRT CAD FILE: | SHEET 1 of 2 |
| | | | | | | |



SECTION B-B

| | | | | | | | | | |
|--|--|--|--|--|--|--|--|--|--|
| IDENTIFY WITH PART NUMBER & REV MATERIAL 6061-T6 Al PROCESS BLACK ANODIZE THREAD DEPTH 2d UNLESS OTHERWISE SPECIFIED | | ENGLISH DIMENSIONS: INCHES TOLERANCES: DECIMALS: ANGLES X.X ±0.015 X° ±1° X.XX ±0.010 X° ±1° X.XXX ±0.005 X° ±0.1° (UNLESS OTHERWISE SPECIFIED) THIS DOCUMENT AND THE INFORMATION IT CONTAINS IS THE SOLE PROPERTY OF DMIL. IT IS TO BE USED ONLY FOR THE ENTIRETY OF THE WHOLE OR IN PART. IT IS THE INFORMATION TO BE RELAYED TO ANY OTHER PERSON OR ORGANIZATION WITHOUT THE WRITTEN PERMISSION FROM DMIL. ACCEPTANCE OF THIS DOCUMENT CONSTITUTES AGREEMENT TO THESE RESTRICTIONS. | | CAD GENERATED DRAWING: DO NOT SCALE DRAWINGS UNLESS SPECIFICALLY NOTED DO NOT SCALE DIMENSIONS UNLESS SPECIFICALLY NOTED 3RD ANGLE PROJECTION FIRST ANGLE PROJECTION FIRST ANGLE PROJECTION | | Droplet Measurement Technologies, Inc. 2545 Central Ave, Boulder, CO 80301 TITLE BCP-D WINDOW INTREFACE | | DRAWN: ROY NEWTON DATE: 09/13/12 SCALE: 1:1 PART NUMBER: MP-3413 PART REV: A | |
| | | SIZE: B N:\BCPD\WindowInterface MP-3413-A.SLDPRT | | CAD FILE: | | SHEET 2 of 2 | | | |



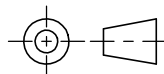
THREAD DEPTH 2d UNLESS OTHERWISE NOTED
IDENTIFY WITH PART NUMBER AND REV.

ENGLISH DIMENSIONS: INCHES
(UNLESS OTHERWISE SPECIFIED)

TOLERANCES:
 DECIMALS ANGLES
 X.X ±0.025
 X.XX ±0.010 X° ± 1°
 X.XXX ±0.005
 INSIDE CORNERS 0.010 R. MAX
 (UNLESS OTHERWISE STATED)

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 3RD ANGLE PROJECTION
 INTERPRET DRAWING
 PER ANSI Y14.5M, 1982



MATERIAL

PROCESS

DRAWN ROY NEWTON DATE 10/23/12

SCALE 1:4 FILE: N:\BCPD\ElectronicsBox\ElectronicsBox Dims.SLDPRT

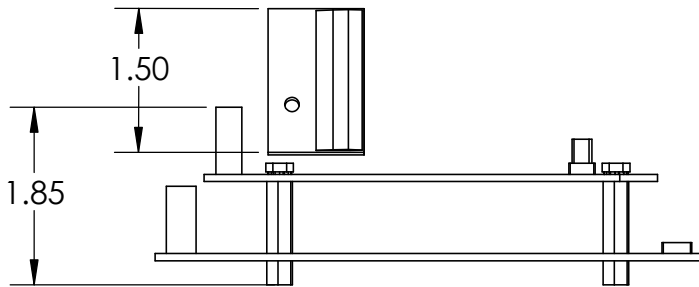
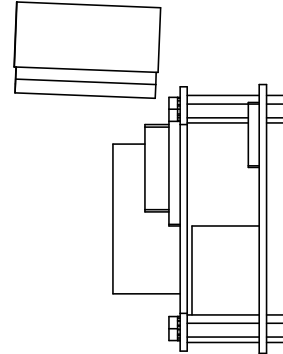
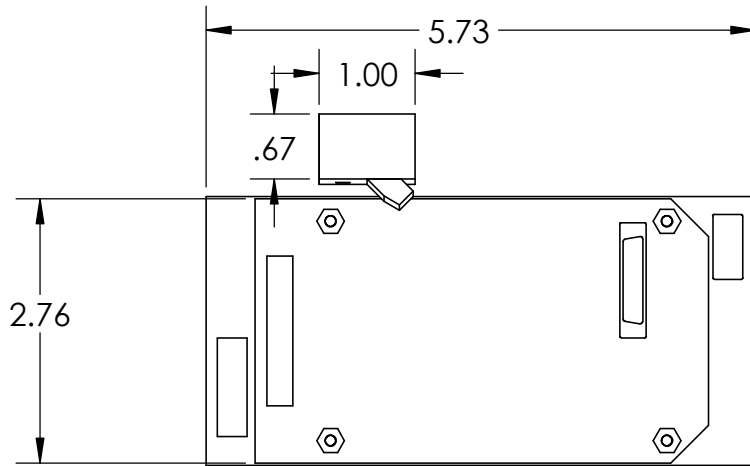
Droplet Measurement Technologies, Inc.

2545 Central Ave, Boulder, CO 80301

TITLE BCP-D
ELECTRONICS BOX DIMS.

| | | |
|------------------|--------------------|----------------------|
| SIZE A | PART NUMBER --- | PART REV A |
|------------------|--------------------|----------------------|

SHEET 1 of 2



THREAD DEPTH 2d UNLESS OTHERWISE NOTED
IDENTIFY WITH PART NUMBER AND REV.

ENGLISH DIMENSIONS: INCHES
(UNLESS OTHERWISE SPECIFIED)

TOLERANCES:

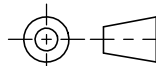
| | |
|--------------|---------|
| DECIMALS | ANGLES |
| X.X ±0.025 | |
| X.XX ±0.010 | X° ± 1° |
| X.XXX ±0.005 | |

INSIDE CORNERS 0.010 R. MAX

(UNLESS OTHERWISE STATED)

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3RD ANGLE PROJECTION
INTERPRET DRAWING
PER ANSI Y14.5M, 1982



MATERIAL

PROCESS

DRAWN
ROY NEWTON

DATE 10/23/12

SCALE 1:2

FILE: N:\BCPD\ElectronicsBox\ElectronicsBox Dims.SLDPR

Droplet Measurement Technologies, Inc.

2545 Central Ave, Boulder, CO 80301

TITLE BCP-D

ELECTRONICS BOX DIMS.

SIZE
A

PART NUMBER

PART REV

A

SHEET 2 of 2

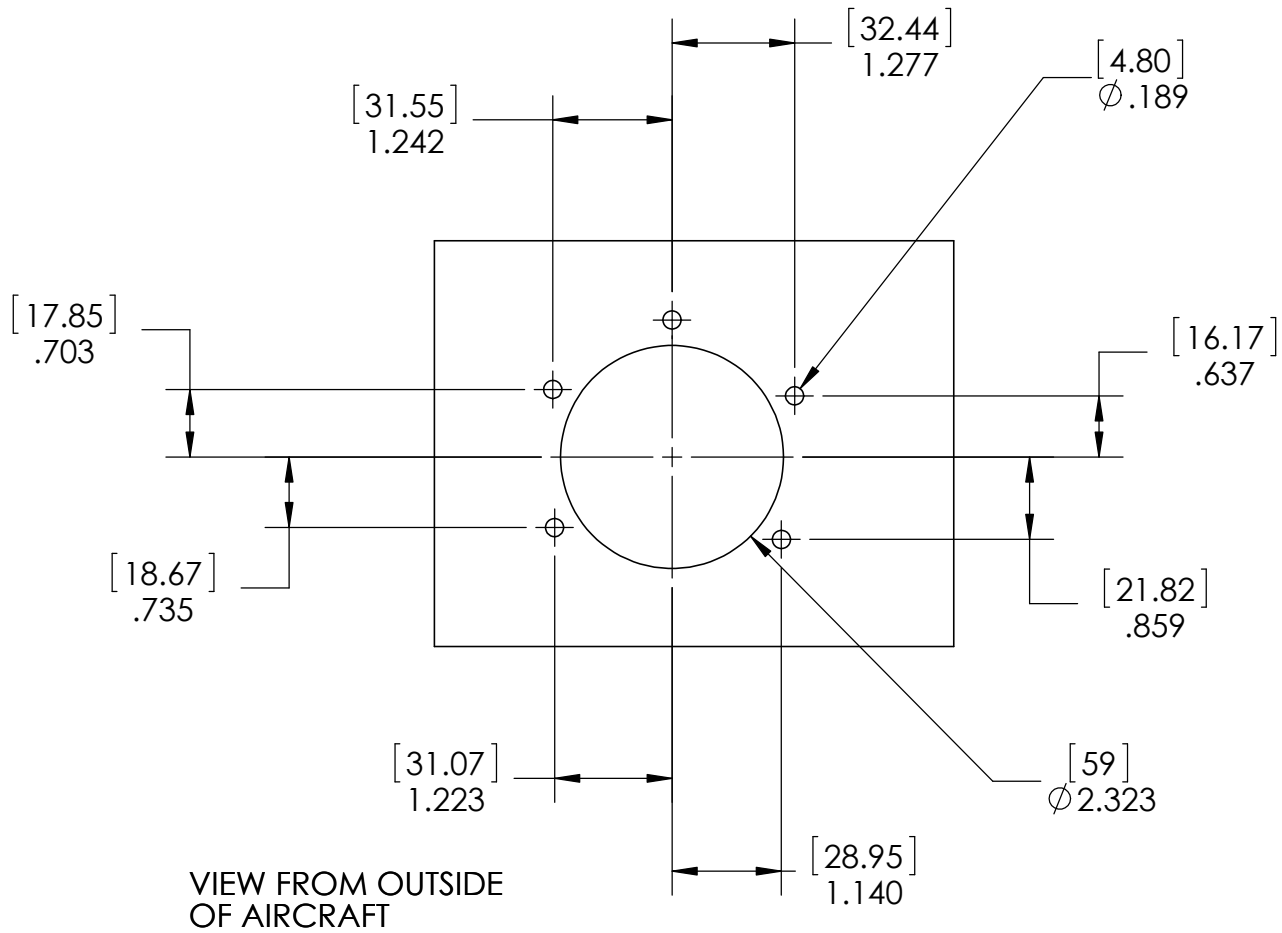
Appendix C: Mounting Bolt Pattern

Information about the mounting bolt pattern can be found on the following page.

REVISIONS

| ECN | REV. | DESCRIPTION | DATE | APPROVED |
|-----|------|-------------|------|----------|
|-----|------|-------------|------|----------|

AIR FLOW DIRECTION



VIEW FROM OUTSIDE OF AIRCRAFT

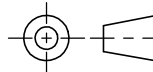
STANDARDS AND COMPLIANCE NOTES:

1. COMPONENT MUST BE COMPLIANT WITH RoHS DIRECTIVE 2011/65/EU. SOURCE MATERIALS AND CONTROL PROCESSES TO ENSURE COMPLIANCE.
2. INTERPRET IN ACCORDANCE WITH DMT SHOP STANDARDS DOCUMENT DOC-0376.

TOLERANCES: DECIMALS ANGLES
 X.X ±0.015
 X.XX ±0.010 X° ± 1°
 X.XXX ±0.005 X.X° ±0.1°

DIMENSIONS ARE IN INCHES
 (UNLESS OTHERWISE SPECIFIED)

CAD GENERATED DRAWING; DO NOT MANUALLY UPDATE;
 ALL PRINTED DRAWINGS ARE UNCONTROLLED
 DO NOT SCALE
 3RD ANGLE PROJECTION
 INTERPRET DRAWING
 PER ASME Y14.5M- 1994



Droplet Measurement Technologies, Inc.

2545 Central Avenue, Boulder, CO 80301

TITLE

BCPD

MOUNTING BOLT PATTERN

SCALE

DRAWING NUMBER

REV

1:2

TBD

A

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MATERIAL

N/A

FINISH

N/A
 N/A

DRAWN

R NEWTON

DATE

02/12/14

SIZE

A

CAD FILE

N:\BCPD\BoltPattern

SHEET 1 of 1