PCX Module

Technical Guide

Technical Guide Revision History

Date	Revision Number	Description of Change	Affected Sections
July 2024	1	First release	-
August 2024	2	Add V1.2 firmware and hardware updates	All

Table of Contents

1. Introduction

This document contains a detailed guide of PCX module functionality, what all the channels mean, what expected values are, and a troubleshooting guide.

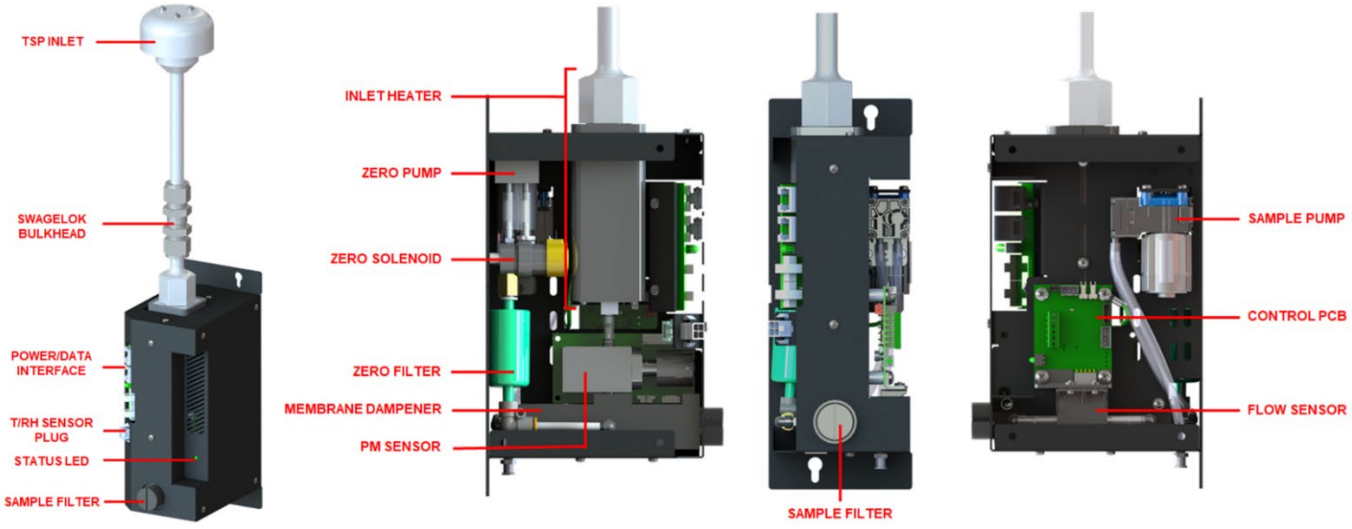
The PCX module firmware contains several distinct sub-modules which operate in parallel. This allows the module to report more diagnostic data, to contain more module settings, and to have more error states reported in the form of sensor aging and sensor failure flags.

A PCX module has the following available channels:

Mass Channels	Count Channels*	Diagnostic Channels	Environmental Channels
• PM1 • PM2.5 • PM4 • PM10 • TSP	• PC0.3 • PC0.5 • PC2.5 • PC5.0 • PC10	• Flow • Pump Speed • HTEMP	• AMB T • AMB RH

*Note: Count channels may not be enabled by default

1.1 PCX V1.0 Components



2. Diagnostic Data Channels

The PCX module can report a maximum of six data channels, referred to as DATA1 through DATA6. These are visible on Cloud via the *Diagnostics and Advanced* page > *Diagnostics* tab

2.1. Particle Mass Module Channels (PM_1, $PM_{2.5}$, PM_4, PM_{10}, TSP channels)

Time	TSP (µg/m³)	Raw (µg/m³)	Sensor Age (Hours)	Cumulative PM (mg)	Zero Status ()	Error Status ()	Inlet
11:42:55 AM	27.59	27.593	1765	2.315	30.000	0	Sample
11:42:50 AM	26.18	26.182	1765	2.315	30.000	0	Sample
11:42:45 AM	26.56	26.563	1765	2.315	30.000	0	Sample
11:42:40 AM	25.88	25.876	1765	2.315	30.000	0	Sample

DATA1 (PMx) – Measured particle mass with filtering and gain and offset applied.

- During a zero cycle or in the event of a sensor failure this channel is invalidated and appears blank.

DATA2 (Raw) – Raw particle mass without gain and offset applied.

- During a zero cycle or in the event the PM sensor is in a failure state this channel will report the current reading if available.

DATA3 (Sensor Age) – Running count of how many hours the sensor has been operating.

DATA4 (Cumulative PM) – Cumulative total PM mass measured by the sensor, in mg. Each PM fraction has a separate total.

DATA5 (Zero Check Diagnostic) – V1.2 firmware only. This channel provides output from the most recent zero event. A value of > 0 indicates how long in seconds the most recent zero check took to reach the target threshold. A values of -1 indicates the zero check failed, and -2 indicates the last zero event was a zero calibration that failed. A value of zero indicates that the last event was a calibration that passed. Please see Section 4. for more description of the zero check and zero calibration process.

DATA6 Value	Meaning
>0	Time for last zero check to reach pass threshold.
0	The last zero event was a calibration that passed.
-1	The last zero event was a check that failed.
-2	The last zero event was a calibration that failed.

DATA6 (Error Status) – The PM sensor can report several error states. The error state will appear here in binary. A value of 0 indicates normal operation, while a value of 16 indicates a fouling error and 64 indicates laser failure. Values of 4 and 8 represent high temperature and low temperature alarms, respectively. Error state values can also be combined (e.g. a value of 20 indicates fouling error and high temperature error are both present).

2.2. Particle Count Channels (PC0.3, PC0.5, PC1, PC2.5, PC5, PC10)

Time	PC0.3 (/L)	Particle Count (raw) ()	Sensor Age (Hours)	Inlet
2:16 PM	4233	4233.080	7242.000	Sample
2:15 PM	4253	4252.920	7242.000	Sample
2:14 PM	4271	4271.420	7242.000	Sample
2:13 PM	4030	4030.500	7242.000	Sample

DATA1 (PCx) – Particle count with gain and offset applied.

- During a zero cycle or in the event of a sensor failure this channel is invalidated and appears blank.

DATA2 (Particle Count (raw)) – Raw particle count before gain and offset application.

- During a zero cycle or in the event the PM sensor is in a failure state this channel will report the current reading if available.

DATA3 (Sensor Age) – Sensor runtime in hours. This value is the same as the mass channel's sensor age.

2.3. Flow

The flow system can be configured to control to volumetric or standard flow by changing a module setting. If configured to volumetric flow it will use the pressure reported on the PCB along with the ambient temperature (AMB TEMP) by default. In the even the ambient temperature sensor is damaged or unavailable it will use the temperature measured on the PCX PCB.

Time	Flow (L/min)	PWM Value ()	Board Temperature (°C x 10)	Cumulative PM (mg)	Pressure (Pa)	Ambient Temperature (°C x 10)	Inlet
2:38 PM	1.000	451.996	275.000	2.499	100779.000	165.833	Sample
2:37 PM	0.999	452.411	275.000	2.499	100784.000	165.167	Sample
2:36 PM	1.002	452.196	274.833	2.499	100790.000	165.583	Sample

DATA1 (Flow) – The current measured flow rate in either standard or volumetric flow, depending on the configuration.

- The target flow rate for Flow is 1.0 +/- 0.01L/min
- During a zero calibration or check this value is invalidated and appears blank

DATA2 (PWM Value) – The current PWM value the pump is being driven at to achieve the target flow rate. A higher value indicates the pump is being driven harder.

- Typical PWM for a new pump is around 400-500
- Higher values may indicate that there is a leak or that the filters need to be changed

DATA3 (Board Temperature) – The temperature as measured on the PCB in the PCX module.

DATA4 (Cumulative PM) – The cumulative amount of TSP the filter in the PCX module (in front of the flow sensor) will have seen. This value can be reset independent of the Cumulative PM values of the PM channels. This channel can be a useful metric for determining when the sample filter in the PCX module needs to be replaced. Reset it by changing a module setting as described in Section 3.1.

DATA5 (Pressure) – Pressure as measured on the PCB of the PCX module.

DATA6 (Ambient Temperature) – Temperature as measured by the ambient temperature and humidity sensor.

2.4. Pump Speed

Time	Pump Speed (rpm)	Inlet
2:35 PM	14025	Sample
2:34 PM	13614	Sample
2:33 PM	13878	Sample

DATA1 (Pump Speed) – The output from the tachometer on the main sample pump. Reported as 6xRPM.

- Typical values are between 12-15k at 1L/min
- A high PWM value as reported in the Flow module and a low/zero Pump Speed may be indicative of a pump problem.

2.5. HTEMP

HTEMP is the submodule associated with control of the heater

Time	HTEMP (°C)	Setpoint (°C)	Inlet
2:37 PM	45.0	45.000	Sample
2:36 PM	45.0	45.000	Sample
2:35 PM	45.0	45.000	Sample

DATA1 (HTEMP) – The current temperature of the heater as reported by the heater's internal temperature measurement.

DATA2 (Setpoint) – The target temperature the heater is trying to achieve. In the event the heater is in a controlled mode this temperature will change over time to achieve its target.

2.6. AMB T, AMB RH

Time	AMB T (°C)	Inlet
2:40 PM	16.68	Sample
2:39 PM	16.64	Sample
2:38 PM	16.62	Sample

Time	AMB RH (%)	Inlet
2:41 PM	87.0	Sample
2:40 PM	87.1	Sample
2:39 PM	87.1	Sample

DATA1 (AMB T or AMB RH) – The ambient temperature and humidity values reported by the ambient temperature sensor.

3. Module Settings

3.1. Particle Mass Module Settings (PM1, PM2.5, PM4, PM10, TSP channels)

Module Setting	Default Value	Function
H0	N/A	Calibration coefficient
H1	N/A	Calibration coefficient
H2	N/A	Calibration coefficient
H3	N/A	Calibration coefficient
TIMA	N/A	Calibration coefficient
TIMR	N/A	Calibration coefficient
TEMA	0.0	Cumulative PM alert level - The PM sensor aging flag will come on if the cumulative PM measured for that channel exceeds this value. A value of 0 turns this alert off.
TEMR	0.0	Cumulative PM measurement reset flag - Set this value to a value greater than 0 to reset the cumulative PM for all PM channels
PWML	0.0	Factory offset

PWMH	1.0	Factory gain
HTR	0.0	User offset – This value may change after a zero calibration or can be manually updated to apply a zero offset
GAIN	1.0	User gain – this value will not change during a zero calibration

3.2. Particle Count Module Settings

V1.0 Particle Count Default Settings

Module Setting	Default Value	Function
H0	0.0	N/A
H1	0.12	Unused
H2	0.0	N/A
H3	0.0	N/A
TIMA	1440.0	Auto calibration cycle frequency (in minutes) – how often the zero calibration will run once it has started. Set this value to -1 to disable the auto zero calibration
TIMR	600.0	Zero calibration run time (in seconds) – how long a zero calibration runs for
TEMA	5.0	Startup zero calibration delay (in minutes) – once a unit is online and running it will run a zero calibration after this many minutes. Set this value to -1 to disable the startup zero.
TEMR	0.0	Cumulative PM measurement reset flag – Set this value to a value greater than 0 to reset the cumulative PM for all PM channels (Same function as PM channel TEMR)
PWML	60.0	Zero calibration restore time (seconds)
PWMH	0.0	N/A
HTR	0.0	N/A
GAIN	0.0	N/A

V1.2 Particle Count Default Settings

Module Setting	Default Value	Function
H0	0.0	Zero pump override. Enable or disable the zero pump during zero calibrations and checks, independent of the mode setting. This also opens the zero solenoid at the same time. • Turn zero pump on during zero cycles = 1 • Turn zero pump off during zero cycles = -1

		• Follow mode operation = 0
H1	0.12	Unused
H2	1.5	Zero check pass/fail threshold
H3	10.0	Zero calibration pass/fail threshold
TIMA	1440.0	Auto check cycle frequency (in minutes) – how often the zero check will run once it has started. Minimum value of 10 (or -1) required. Set this value to -1 to disable the auto zero check
TIMR	600.0	Zero calibration run time (in seconds) – how long a zero calibration runs for
TEMA	5.0	Startup zero check delay (in minutes) – once a unit is turned on and running it will run a zero check after this many minutes. Set this value to -1 to disable the startup zero check.
TEMR	0.0	Cumulative PM measurement reset flag – Set this value to a value greater than 0 to reset the cumulative PM for all PM channels (Same function as PM channel TEMR)
PWML	60.0	Unused
PWMH	0.0	Auto calibration cycle frequency (in minutes) – how often the zero calibration will run once it has started. Minimum value of 10 (or ≤0) required. Set this value to 1440 to enable daily auto zero calibration.
HTR	1.0	Mode configuration to work with old or new PCX hardware. Old hardware has the zero path going into the filter block. New hardware has the zero entering above the PM sensor. • 0 = Old hardware (V1.0 hardware) • 1 = New hardware (>V1.2 or upgraded hardware)
GAIN	0.0	N/A

3.3. Flow/Pump Speed Module Settings

The module settings for the Flow and Pump Speed submodules are linked. Changing one will automatically update the other.

Module Setting	Default Value	Function
H0	1.0	Target flow rate
H1	250.0	Flow sensor control parameter
H2	200.0	Lower limit used to trigger the pump aging flag – if the PWM required to hit the target flow rate goes below this, the flow sensor aging flag will come on.
H3	700.0	Upper limit used to trigger the pump aging flag – if the PWM required to hit the target flow rate goes above this, the flow sensor aging flag will come on.

TIMA	2.0	Flow sensor control parameter
TIMR	0.0	Flow sensor control parameter
TEMA	0.0	Flow sensor cumulative PM alert level - The flow sensor aging flag will come on if the cumulative PM associated with the flow sensor exceeds this value. A value of 0 turns this alert off.
TEMR	0.0	Flow sensor cumulative PM measurement reset flag - Set this value to a value greater than 0 to reset the cumulative PM for the flow sensor.
PWML	450.0	Initial PWM value – the startup PWM value used for the pump, and the default value used to run the pump in the event the flow sensor fails.
PWMH	-1.0	Automatic vs manual pump control trigger • Automatic flow control – set to -1 • Manual flow control – set to a value >200 to run the pump at that PWM level
HTR	-1.0	Flow control mode trigger • Standard flow control – set to -1 • Volumetric flow control – set to 0
GAIN	1.0	Flow sensor gain

3.4. HTEMP Module Settings

Module Setting	Default Value	Function
H0	45.0	Default heater temperature – the temperature the heater will operate in constant temperature mode, or in the even the ambient temperature/humidity sensor is unplugged.
H1	-0.44	Control coefficient
H2	4.639458	Control coefficient
H3	0.132161	Control coefficient
TIMA	25.03801	Control coefficient
TIMR	20.0	Control coefficient
TEMA	50.0	Maximum allowed heater temperature
TEMR	3.0	Control coefficient
PWML	0.0	N/A
PWMH	85.0	Control coefficient
HTR	0.0	Constant vs active heater control trigger. - Active heater control – set to 1 - Constant temperature – set to 0
GAIN	0.0	N/A

3.5. Service Actions - Quick Lookup

Below are some typical tasks you may want to do associated with a PCX module and what steps need to be taken to achieve it.

	Desired Behaviour	Action to Take
1	Reset flow sensor cumulative PM after filter change	Change [FLOW TEMR] from 0 to 1
2	Reset PM sensor cumulative PM after sensor replacement	Change a [PM TEMR] from 0 to 1
3	Adjust flow sensor gain	Update [FLOW GAIN] based on an external flow sensor reading
4	Disable auto zero calibration	FW V1.0 – Change [PC TIMA] to -1 FW >V1.2 – Change [PC PWMH] to 0 or below
5	Disable startup zero calibration	FW V1.0 – Change [PC TEMA] to -1 FW >V1.2 – N/A
6	Enable zero calibration	FW V1.0 – Change [PC TIMA] to time in minutes required FW >V1.2 – Change [PC PWMH] to time in minutes required
7	Disable startup zero check	FW V1.0 – N/A FW >V1.2 – Change [PC TEMA] to -1
8	Disable auto zero check	FW V1.0 – N/A FW >V1.2 – Change [PC TIMA] to -1
9	Switch between standard flow control and volumetric flow control	Change [FLOW HTR] from -1 to 0
10	Toggle heater control algorithm on and off	Change [HTEMP HTR] from 0 to 1

4. Zero Process

The zero process in the PCX module has been improved throughout the design lifecycle. V1.2 firmware adds the concept of a ‘zero check’ vs a ‘zero calibration’.

During a zero calibration the system takes current mass at the end of the zero-calibration cycle and calculates an offset based on the data reading. During a zero check the system checks to ensure the PM level drops low enough that the baseline is correct but does not apply an offset. A zero check is preferred in general as there should be no offset in the baseline of a particle-counter based instrument, and applying a zero calibration can only serve to reduce data quality. However, some regulation stipulates performing a zero calibration as it is required for instruments based on other technologies such as nephelometers. Therefor this operation is available in the PCX firmware.

In V1.0 the firmware can only complete a zero calibration. By default, this occurs at startup and at the automatic frequency as controlled in the module settings. In V1.2 firmware the zero calibration is disabled by default, in favour of running a zero check at startup and daily. The

zero calibration can be re-enabled as described in the module settings or executed manually via the button in Connect if required.

V1.2 firmware also introduces the concept of a ‘mode’ that is associated with a version of hardware. In V1.2 hardware (or upgraded V1.0 hardware) the zero-air path is changed from entering below the sensor and blowing upwards, to entering above the PM sensor, and blowing down through the sensor. This means that during a zero event with V1.2 hardware, the main sample pump is also turned on. This speeds up the zero process significantly.

4.1. Zero Calibration

During a zero calibration the PCX is recalculates the user offset values in the counts to mass algorithm.

Timing for when a zero calibration occurs and how long it runs for can be configured via Cloud/Connect by adjusting the relevant module parameter for any of the particle count sensor codes as described above.

When a zero calibration is triggered, the main sample pump turns off, the zero pump turns on, and the solenoid between the zero pump and the sensor opens. This results in filtered, particle free air being blown through the sensor.

The zero calibration can be triggered manually via the *Calibration and Service* page > *Zero Calibration* tab, or set to occur automatically at startup and at a designed interval as controlled by the appropriate module settings.

Once the zero calibration occurs, the mass values offset for each channel will be calculated and stored as the offset in the PM channel module setting HTR (user offset). This value will be used in the calculation of the mass measurement following the zero.

The particle count offset will also be calculated and stored in memory - it is not stored as a module setting. This value will be used to calculated the reported particle counts shown in the DATA1 channel for each measurement.

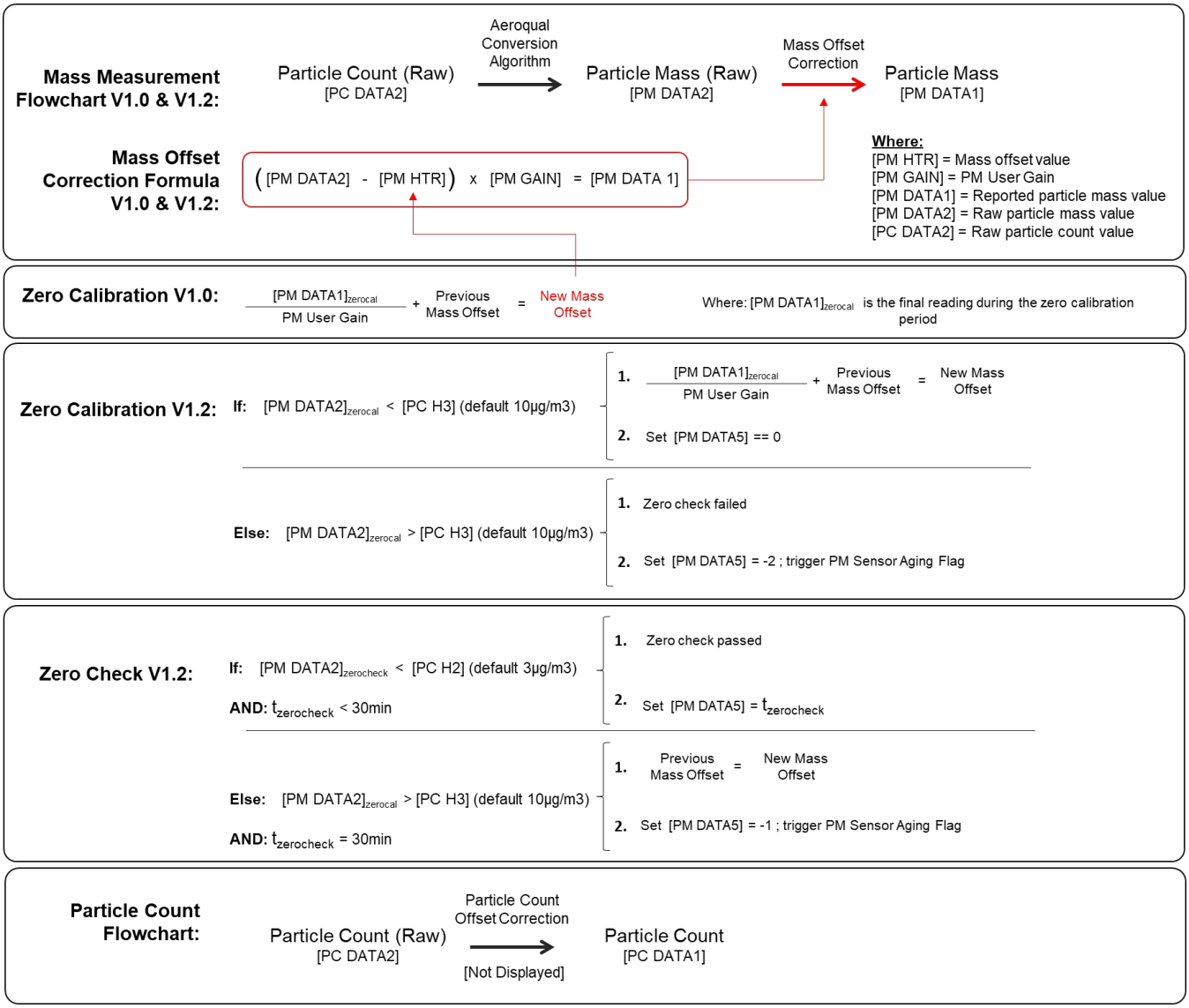
The RAW particle count value shown in DATA2 is the value used to calculate the mass measurement, NOT the corrected value shown in DATA1.

In V1.2 firmware the system also performs a check on the data to ensure that the zero calibration occurs correctly, in order to maximize data quality. If the value at the end of the zero is greater than the pass/fail threshold [PC H3] then the offset will not be applied and the zero data diagnostic [PM DATA5] set to -2. If the zero calibration passes it sets [PM DATA5] to 0.

4.2. Zero Check

Zero check functionality was added as part of the V1.2 firmware release. The zero check monitors the particulate matter levels during a time either with particle free air being blown through the system, or with the pumps off. The system waits for the levels to drop below the

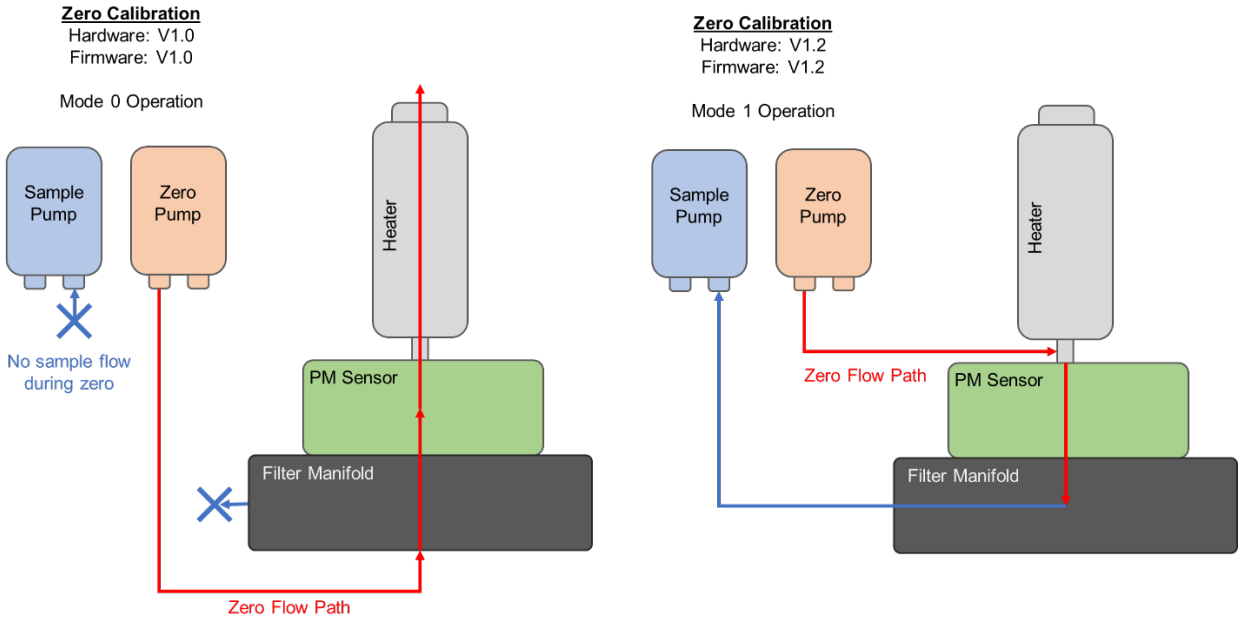
defined threshold defined in [PC H3]. Once it reaches this threshold it will continue to monitor levels for 3 minutes, and mark the check as a 'pass', setting the time required to reach the PM threshold as the [PM DATA5] diagnostic channel value. If the zero check does not reach the target value within 30 minutes, then it will mark the check as a fail and set [PM DATA5] to -1.



4.3. Zero Hardware Operation Modes

In firmware V1.2 and greater the PCX has an additional setting referred to as a 'mode'. The intent of this is to set the correct pump behaviour for the firmware running on V1.0 hardware vs when it's running on V1.2 hardware. Do to changes in the hardware design and zero flow path, the sample pump needs to be on while zeroing for the updated hardware as shown in the flow diagram below. This mode operation is controlled by the value in [PC HTR] as described in Section 3.2.

Mode 0 is to be used with V1.0 hardware where the zero flow path enters the filter manifold, and Mode 1 is to be used for V1.2 hardware (or older hardware that has been upgraded) where the zero flow enters between the heater and the PM sensor.



The table below here also shows the intended setting and expected behaviour for the firmware in either Mode 0 or Mode 1 configuration.

	V1.0 or V1.1 Firmware	V1.2 Firmware
V1.0 Hardware	**No Mode** • Zero calibration at startup • Automatic zero calibration as configured • No zero check	**Mode 0** • Zero check at startup (flow off) • Automatic zero check as scheduled • No zero calibration at startup • Automatic zero calibration can be configured • Manual zero calibration can be run
V1.2 Hardware	N/A	**Mode 1** • Zero check at startup (flow on) • Automatic zero check as scheduled (flow on) • No zero calibration at startup • Automatic zero calibration can be configured • Manual zero calibration can be run

5. Heater Control

Regulation of the heater's temperature is performed by the controller on the heater itself. The heater can be set to operate at a constant temperature or to operate in a controlled mode. This control algorithm is controlled based on the ambient temperature and humidity and sets the heater to a temperature that is sufficient to dry the air for an accurate measurement.

If the ambient conditions reach a condition where it is possible/likely for fog to occur it will turn the heater on full in order to mitigate any fog that may eventuate.

If the heater is configured to run using the control algorithm, and there is no ambient temperature and humidity sensor present, it will default to operating at the default constant temperature.

6. Flow and Pump Control

The PCX module can be configured to control to standard flow or volumetric flow as described in the previous section. If configured to control to volumetric flow, the system will use the temperature from the ambient temperature sensor for its calculations. If this sensor is not present and it is configured to control to volumetric flow it will default to using the temperature

Aeroqual uses a standard temperature and pressure of 20°C and 1atm for standard to volumetric flow conversions.

$$Volumetric\ Flow = Q\ * \left(\frac{Tm}{Tstd}\right)\left(\frac{Pstd}{Pm}\right)$$

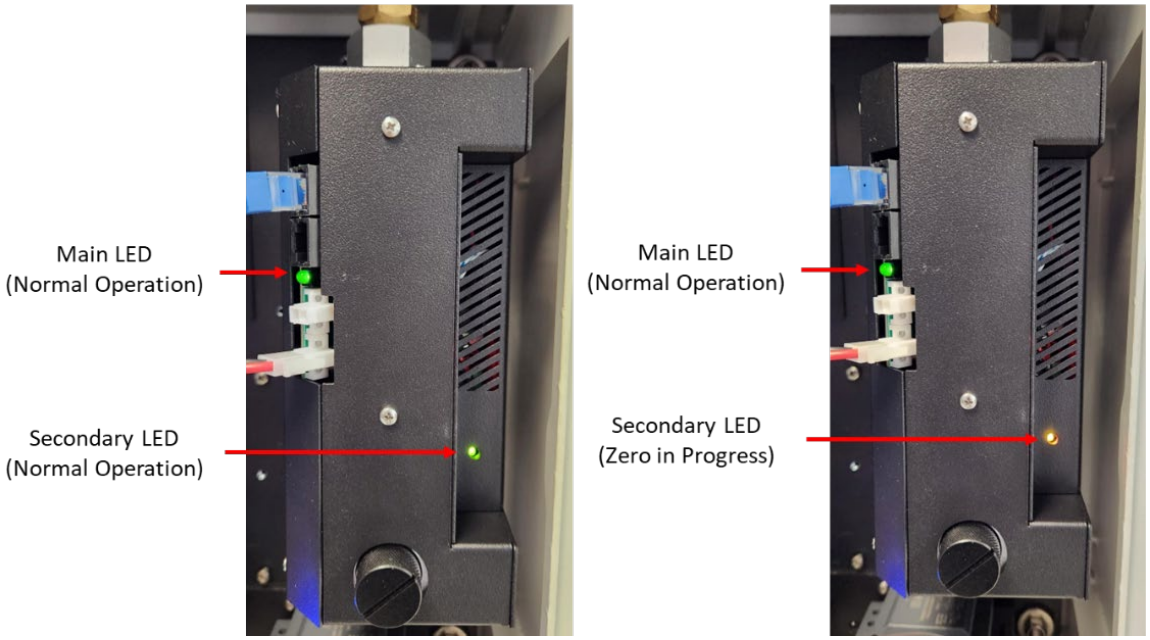
Where: Q = Standard Flow (in SLPM)
T = temperature (in Kelvin)
P = pressure (in kPa)

Broken down with the data channels as described in Section 2.3, converting them to the appropriate units that works out to:

$$Volumetric\ Flow = Q\ * \left(\frac{\frac{Flow_{[DATA6]}}{10} + 273.15}{293.15K}\right)\left(\frac{101.3kPa}{\frac{Flow_{[DATA5]}}{1000}}\right)$$

7. PCX Status LED

The PCX module contains two LED which indicate module status. The main LED, which is present on all Aeroqual modules, and a secondary LED which can indicate additional states unique to the PCX module.



MAIN LED

- Normal operation
- Device warming up (slow)
- Sensor failure error (fast)

SECONDARY LED

- Normal operation
- Device warming up
- Zero calibration in progress
- Zero check in progress (V1.2)
- Sensor failure error
- Comms error with EPC

8. Troubleshooting

8.1. PCX Error States

The PCX module can provide more detailed error states than previous Aeroqual modules, however these are limited to being encoded using two status flags – a 'Sensor Failure' flag, and a 'Sensor Aging' flag. When the sensor failure flag is active, data for the failed sensor channel is invalidated and will not appear or be used in calculation or triggering alerts.

The table below summarizes which error states the module may present, the possible cause, and the recommend action the user should take.

Measurement Channel	Error State	Possible Cause	Recommended Action
Particle Mass	Sensor due for replacement	PM Sensor cumulative PM exceeded or Zero calibration or zero check failed	• Check PM sensor connection. • Return module to service center for PM sensor replacement. • Check PM DATA5 diagnostic
	Sensor Failure	PM sensor comms error or PM sensor reporting an error	• Check PM sensor to see if data is present. If no data, check cable. If data present, return to service center for PM sensor replacement
Particle Counts	Sensor due for replacement	Zero calibration or zero check failed	• Check PM DATA5 diagnostic
	Sensor Failure	PM sensor comms error or PM sensor reporting an error	• Check PM sensor to see if data is present. If no data, check cable. If data present, return to service center for PM sensor replacement.
Flow	Sensor due for replacement	Cumulative PM for flow sensor channel exceeded.	• Replace primary filter. • Reset cumulative particulate measurement as described in Section 3.3.
	Sensor Failure	No new data from flow sensor.	• Check flow sensor connection. • Manually set flow rate as described in Section 3.3.
Pump Speed	Sensor due for replacement	Pump PWM outside of expected range	• Check system for leaks • Replace pump.
	Sensor Failure	Pump PWM is non-zero, but pump speed (tacho) reads zero	• Check pump cable connection • Replace pump
HTEMP	Sensor Failure	No new data from inlet heater	• Check connection to heater • Replace heater
AMB TEMP or AMB RH	Sensor Failure	No new data from T/RH sensor	• Check connection to T/RH sensor • Replace sensor

8.2. Troubleshooting Examples

	Example Fault	Troubleshooting Suggestion
1	PM and PC channels display (unexpected) very high levels	• This may occur if debris (seed pods, spiders, etc.) make their way into the optical chamber. Generally large obstructions will be detected and result in the PM sensor channels reporting 'Sensor Failure'.
2	PM and PC channels reporting sensor aging	• Check the DATA5 channel for any of the PM channels. A value of anything other than 0 indicates a fault with the sensor as described in Section 2.1
3	Negative offset following zero calibration	• A negative offset (or offset higher than expected) stored in the PM channel HTR module setting can result from an unsuccessful zero calibration where there was still dust present in the optical chamber at the end of the cycle. • Try running another manual zero calibration to see if this resolves the issue. • If it does, and the environment is particularly dirty, the length of the zero cycle can be increased by changing the value PC TIMR module setting as described in Section 3.2.
4	Flow rate doesn't reach 1.0L/min as reported by the Flow sensor channel	• Ensure the pump is in automatic flow control mode (Flow PWMH set to -1) • Check whether the pump is running at max speed Flow DATA2 PWM Value showing 1000) • If the pump is running at full speed and still not achieving 1L/min, inspect the membrane dampener in the flow manifold for leaks.
5	Flow rate at the inlet doesn't reach 1L/min	• Check the flow meter you're using is configured to the same settings as the flow meter in the PCX module (e.g. volumetric vs standard flow, and STP conditions • Complete a vacuum test and check for leaks in the system • If the system is leak tight you may need to apply a gain to calibrate the flow sensor as described the user guide.
6	Flow rate takes a long time to reach 1L/min when measured with an external flow meter	• Contact Aeroqual to upgrade the PCX module's firmware to a version >V1.1. Early versions of firmware were slow to respond when perturbed by a small pressure drop like the addition of a flowmeter.
7	Zero calibration has failed (PM DATA 5 = -2)	• Check raw PM data to see what levels were like during the zero calibration. • Increase the length of the zero calibration • Follow the sensor cleaning procedure to remove any foreign debris

8	Zero check has failed (PM DATA5 = -1)	• Check raw PM data to see what levels were like during the zero check • Follow the sensor cleaning procedure to remove any foreign debris

9. Firmware Revision Notes

Release Date	Version	Changes
August 2023	V1.0	• Initial release of PCX firmware.
July 2024	V1.1	• Improved flow control and speed of flow adjustment. • Improved heater control algorithm. • Resolved errors around 'Sensor Failure' reporting when the sensors hadn't failed. • Updated to report alarm state from PM sensor in PM DATA5.
August 2024	V1.2	• Add zero check to firmware • Enable zero check on startup, remove zero calibration on startup • Introduce hardware 'mode' control [PC HTR] • Add zero diagnostic channel [PM DATA5] **Module Setting Changes** • Add PC H0 – zero pump override (default 0) • Add PC H2 - zero check pass/fail threshold (default 3) • Add PC H3 – zero calibration pass/fail threshold (default 10) • Change PC TIMA from auto calibration frequency to auto check frequency • Change PC TEMA from startup zero calibration to startup zero check delay • Add PC PWMH – auto calibration cycle frequency (default 0) • Add PC HTR – Hardware mode control

