



NO₂ Converter

Manual

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TABLE OF CONTENTS

1.	INTRODUCTION.....	1
1.1	Theory.....	1
1.2	Converter overview	2
2.	INSTALLATION AND USE.....	3
2.1	Electrical Connections.....	3
2.2	Plumbing connections.....	3
3.	CONVERSION EFFICIENCY CALCULATIONS	4
4.	PHYSICAL DIMENSIONS.....	5

1. INTRODUCTION

1.1 THEORY

The AQD photolytic NO₂ converter uses an array of ultraviolet light emitting diodes (UV-LED's) to photolyze NO₂ to NO and ozone per Reaction 1, which may be subsequently measured by chemiluminescence or another suitable method.

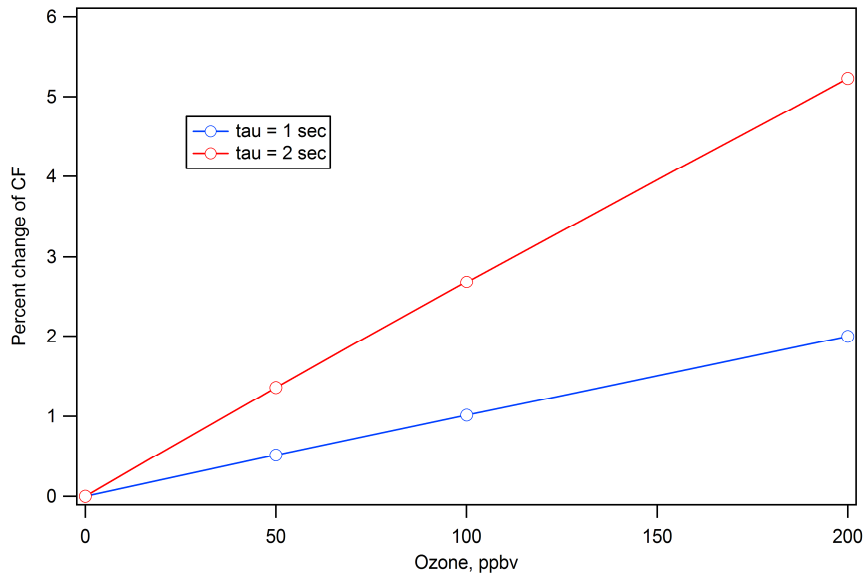
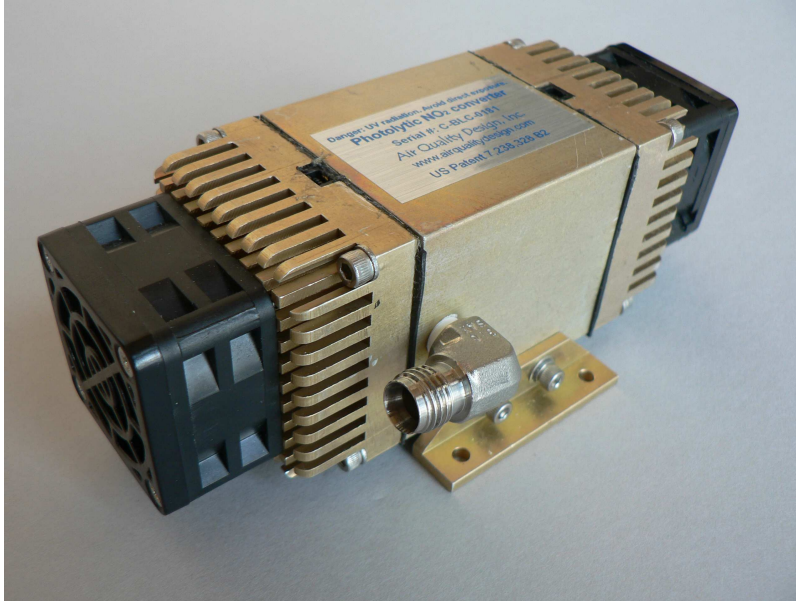


Figure 1-1. Percent change of the NO₂ conversion efficiency as a function of the ambient and produced ozone in the sample. For a residence time of 1 second the error introduced is less than 2%.

Since the reverse reaction (Reaction 2) occurs fairly quickly it is important that reaction 1 takes place in 1-2 seconds, followed shortly by measurement of the resulting product. Figure 1-1 shows the effect of the back titration of the produced NO on conversion efficiency as a function of the concentration of ambient and produced ozone.

1.2 CONVERTER OVERVIEW



The physical and performance characteristics of the AQD NO₂ converter include:

- High efficiency ($\geq 50\%$ NO₂ conversion/second)
- Highly specific for NO₂
- Negligible radiant heating of the sample gas
- Low volume (1 second residence time at STP, versions available for 0.5 and 1 slpm flow rate)
- Long light-source life (estimated >5,000 hours)
- Integrated lamp control circuit and remote on/off
- Power consumption: 30 W, 24 VDC; optional AC/DC or DC/DC power supply available
- Converter weight: 0.6 kg
- Converter size: 5 cm (w) x 5 cm (h) x 12 cm (l) (1 slpm version is 15 cm long)
- Patented Technology

Danger: UV radiation. Avoid direct exposure.
Photolytic NO₂ converter

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US Patent 7,238,328 B2

2. INSTALLATION AND USE

2.1 ELECTRICAL CONNECTIONS

The AQD NO₂ converter is shipped with two three-wire cables for connecting each of the two lamps to a user supplied power supply (optional 24 VDC power supply is available from AQD in either AC-DC or DC-DC configuration). Power for each lamp requires 24-28 VDC at 30 W. The cables may be wired in parallel and should be connected per Table 2-1.

Table 2-1. Electrical connections

Wire	Color	Connection
1	Red	+24 VDC
2	black	Power common
3	white	Remote on/off

The remote on/off turns the UV-LED's on by connecting the white wire to 5-30 VDC (typically a TTL digital output from a data system may be used). The converter cooling fans operate whenever power is applied.

2.2 PLUMBING CONNECTIONS

The plumbing connections for the converter are simply in and out with the two sides equivalent. To minimize post-photolysis back titration the converter should be either:

1. located in close proximity to the detector, or
2. for chemiluminescence detectors the flow control element (critical orifice or mass flow controller) should be located closely downstream of the converter.

Note that the converter is designed to operate at ambient pressure so the converter should not be installed downstream of the flow control element.

3. CONVERSION EFFICIENCY CALCULATIONS

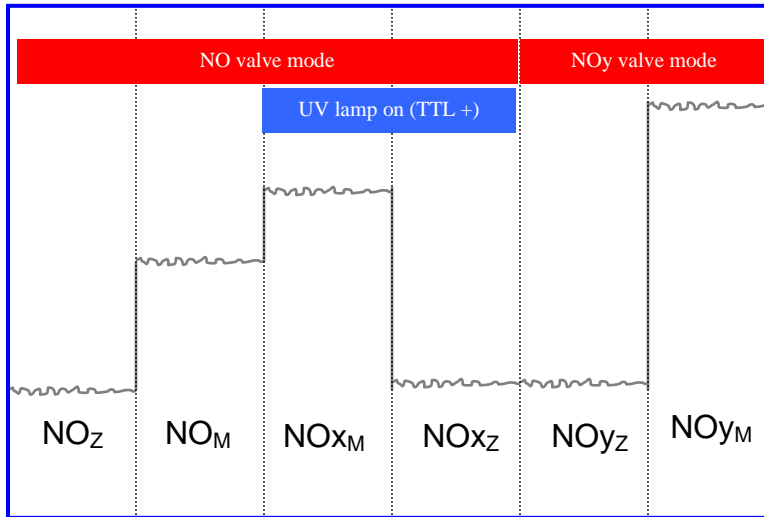


Figure 3-1. Example diagram of the sampling modes for a NO-NO₂-NO_y system.

1. $[NO] = (NO_M - NO_Z) / NO_{SENS}$

Where: NO_M = NO concentration in measure mode
 NO_Z = NO concentration in zero mode
 NO_{SENS} = NO response factor

2. $[NO_2] = ((NO_{xM} - NO_{xZ}) - (NO_M - NO_Z)) / NO_{2SENS}$

Where: NO_{xM} = NO_x concentration in measure mode
 NO_{xZ} = NO_x concentration in zero mode
 NO_{2SENS} = NO₂ response factor

3. $[NO_y] = (NO_{yM} - NO_{yZ}) / NO_{ySENS}$

Where: NO_{yM} = NO_y concentration in measure mode
 NO_{yZ} = NO_y concentration in zero mode
 NO_{ySENS} = NO_y response factor

¹ For systems using photon counting the response factors are calculated in units of counts per second per ppb (cps/ppb) in the form:

$$NO_{SENS} = (cal_counts - measure_counts) / cal_concentration.$$

In the TEI way of calibrating NO_{SENS} would be 1.0 +/- and would be multiplied instead of divided.

¹ Similar to the NO_{sens} calculation, the NO_{2SENS} calc is presented in terms of cps/ppb as:

$$NO_{2SENS} = NO_{SENS} * NO_{2CE}$$

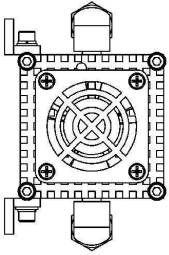
Where: NO_{2CE} = $((NO_{xT} - NO_{xTZ}) - (NO_T - NO_{TZ})) / ((NO_{xC} - NO_{xCZ}) - (NO_T - NO_{TZ}))$

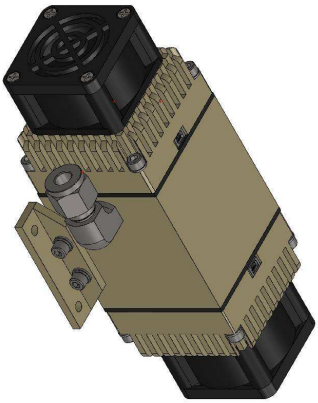
¹ For systems using photon counting the response factors are calculated in units of cps/ppb of NO_x in the form:

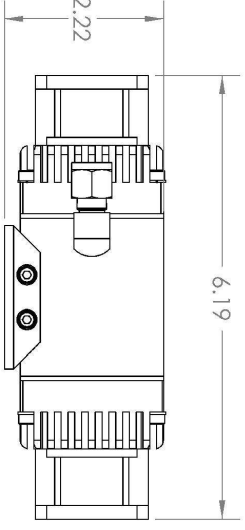
$$NO_{ySENS} = (cal_counts - measure_counts) / cal_concentration.$$

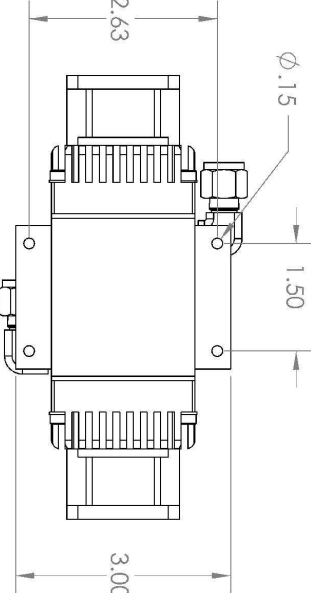
4. PHYSICAL DIMENSIONS

REV.	REVISIONS DESCRIPTION	DATE









5	4	3	2	1
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<p>UNLESS OTHERWISE SPECIFIED:</p> <p>DIMENSIONS ARE IN INCHES</p> <p>TOLERANCES:</p> <p>FRACTIONAL ±1/64</p> <p>ANGULAR: MACH ±1° BEND ±1°</p> <p>TWO PLACE DECIMAL ±0.01</p> <p>THREE PLACE DECIMAL ±0.005</p> <p>INTERPRT GEOMETRIC TOLERANCING PER: Q.A.</p> <p>MATERIAL: COMMENTS:</p> <p>FINISH:</p> <p>DO NOT SCALE DRAWING</p> <p>USED ON:</p> <p>NEXT ASSY:</p> <p>APPLICATION:</p>	<p>AIR QUALITY DESIGN, INC</p> <p>TITLE:</p> <p style="text-align: center;">Standard BLC Customer Dims</p> <p>NAME: D.M.M.T. DATE: 7/26/11</p> <p>DRAWN: CHECKED: ENG APPR. MFGS APPR.</p> <p>Q.A.</p> <p>SIZE: A PART NO. AS-001-0000 REV</p> <p>SCALE: 1:2 WEIGHT: SHEET 1 OF 1</p>
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