



# IECEX Certificate of Conformity

## INTERNATIONAL ELECTROTECHNICAL COMMISSION IEC Certification Scheme for Explosive Atmospheres

for rules and details of the IECEx Scheme visit [www.iecex.com](http://www.iecex.com)

Certificate No.: IECEx CSA 16.0038 Issue No: 1 Certificate history:  
Issue No. 1 (2017-12-07)  
Issue No. 0 (2016-12-19)

Status: Current Page 1 of 4

Date of Issue: 2017-12-07

Applicant: Gas Clip Technologies, Inc.  
610 Uptown Blvd. Suite 4100  
Cedar Hill, TX  
75104  
United States of America

Equipment: Portable Gas Detector MGC-S  
Optional accessory:

Type of Protection: Ex Ia

Marking: Ex ia IIC T4 Ga  
-20°C ≤ Ta ≤ +50°C

Approved for issue on behalf of the IECEx  
Certification Body:

Dorin Stochitoiu

Position:

Technical Advisor

Signature:  
(for printed version)

Date:

December 07, 2017

1. This certificate and schedule may only be reproduced in full.
2. This certificate is not transferable and remains the property of the issuing body.
3. The Status and authenticity of this certificate may be verified by visiting the [Official IECEx Website](http://www.iecex.com).

Certificate issued by:

CSA Group  
178 Rexdale Boulevard  
Toronto, Ontario M9W 1R3  
Canada





# IECEX Certificate of Conformity

Certificate No: IECEX CSA 16.0038

Issue No: 1

Date of Issue: 2017-12-07

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Manufacturer: **Precise Connections**  
1114 Explorer St.  
Duncanville, TX  
75137  
United States of America

Additional Manufacturing location(s):

This certificate is issued as verification that a sample(s), representative of production, was assessed and tested and found to comply with the IEC Standard list below and that the manufacturer's quality system, relating to the Ex products covered by this certificate, was assessed and found to comply with the IECEx Quality system requirements. This certificate is granted subject to the conditions as set out in IECEx Scheme Rules, IECEx 02 and Operational Documents as amended.

#### STANDARDS:

The electrical apparatus and any acceptable variations to it specified in the schedule of this certificate and the identified documents, was found to comply with the following standards:

IEC 60079-0 : 2011 Explosive atmospheres - Part 0: General requirements  
Edition:6.0

IEC 60079-11 : 2011 Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "i"  
Edition:6.0

*This Certificate does not indicate compliance with electrical safety and performance requirements other than those expressly included in the Standards listed above.*

#### TEST & ASSESSMENT REPORTS:

*A sample(s) of the equipment listed has successfully met the examination and test requirements as recorded in*

#### Test Report:

CA/CSA/ExTR16.0042/00 CA/CSA/ExTR16.0042/01

#### Quality Assessment Report:

GB/SIR/QAR15.0006/01



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## Schedule

### EQUIPMENT:

*Equipment and systems covered by this certificate are as follows:*

Gas Clip Technologies (GCT) Multi Gas Clip-Simple (MGC-S) and Multi Gas Clip-Simple plus (MGC-S plus) detectors are personal safety devices designed to detect the presence of specific toxic gases, Carbon Monoxide (CO), Hydrogen Sulfide (H<sub>2</sub>S), Oxygen (O<sub>2</sub>), and Combustible gases/Lower Explosive Limit (LEL).

The products are intrinsically safe and each is comprised of a main enclosure, display, two printed circuit boards, a non-rechargeable battery cell ER18505(Lithium Thionyl Chloride 3.6V; Capacity: 4 Ah ) P/N GC006-707, and three gas sensors. The printed circuit boards are secured to the front half of the enclosure with screws. There are no external connections on the equipment.

The only difference between MGC-S and MGC-S plus is about oxygen sensor with different life time but identical electrical rating.

**SPECIFIC CONDITIONS OF USE: NO**



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## DETAILS OF CERTIFICATE CHANGES (for Issues 1 and above):

### Issue 1:

- Addition of new model Multi Gas Clip-Simple Plus(MGC-S plus) which is for protection point of view is virtually identical to Multi Gas Clip-Simple.
- Addition of drawings to support the new model and updating exiting drawings to reflect the new addition.
- Changing on shape of a sensor filter on both models MGC-s and MGC-S plus to two separated part for EC sensors and combustible sensor and updating affected drawings.
- Replacment of an existing resistor with a lower power rated resistor having same resistance value
- Removal of "X" marking based on tests conducted.

## IECEX Technical Report: CA/CSA/ExTR16.0042/01 details

<b>ExTR :</b>	
ExTR Reference Number*: (automatic numbering)	CA/CSA/ExTR16.0042/01
Status*:	Issued
ExTR Free Reference Number*:	
Date of Issue*: (yyyy-mm-dd)	2017-12-07
Details of change*:	<p>Addition of new model Multi Gas Clip-Simple Plus(MGC-S plus) which is for protection point of view is virtually identical to Multi Gas Clip-Simple.</p> <p>Addition of drawings to support the new model and updating exiting drawings to reflect the new addition.</p> <p>Changing on shape of a sensor filter on both models MGC-s and MGC-S plus to two separated part for EC sensors and combustible sensor and updating affected drawings.</p> <p>Replacment of an existing resistor with a lower power rated resistor having same resistance value</p> <p>Removal of "X" marking based on tests conducted.</p>
List of Standards Covered*:	IEC 60079-0 (Ed.6.0); IEC 60079-11 (Ed.6.0)
Issuing ExTL*:	CSA - CSA Group
Endorsing ExCB*:	CSA - CSA Group
Manufacturer*:	Gas Clip Technologies, Inc. 610 Uptown Blvd. Suite 4100 Cedar Hill, TX 75104
Country of Manufacture*:	United States of America
Ex Protection*:	E ia
Ratings:	Ex ia IIC T4 Ga -20°C ≤ Ta ≤ +50°C Battery powered 3.6V; Nominal Capacity: 4 Ah
Equipment*:	Portable Gas Detector
Model Reference*:	MGC-S
Related IECEX Certificates:	<a href="#">IECEX CSA 16.0038 issue: 1 [Current]</a>
Comment:	
Attachment:	



Last modified: 12/12/2017 06:13:46 PM

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IECEX TEST REPORT COVER

ExTR Reference Number.....:	CA/CSA/ExTR16.0042/01
ExTR Free Reference Number .....	CA/CSA/2016/TR255950-70158987
Compiled by + signature (ExTL) .....	Zahra Amini 
Reviewed by + signature (ExTL).....:	Konstantin Rybalko 
Approved by + signature (ExCB) ....:	Dorin Stochitoiu
Date of issue .....	Dec 06,2017
Ex Testing Laboratory (ExTL) .....	CSA International
Address .....	178 Rexdale Boulevard, Toronto, ON, M9W 1R3
Ex Certification Body (ExCB) .....	CSA Group
Address .....	178 Rexdale Blvd., Toronto, ON, Canada
Applicant's name.....:	Gas Clip Technologies, Inc.
Address .....	610 Uptown Blvd. Suite 4100, Cedar Hill, TX 75104
Standards associated with this ExTR package.....:	IEC 60079-0:2011, 6th Edition; IEC 60079-11:2011, 6th Edition
Clauses considered.....:	Only specific clauses considered
Related Amendments, Corrigenda or ISHs .....	
Test item description .....	Gas Detector
Model/type reference .....	MGC-S and MGC-S Plus
Code (e.g. Ex _ II_ T_).....:	Ex ia IIC T4 Ga
Rating .....	Battery powered 3.6V; Nominal Capacity: 4 Ah

<b>ExTR Package Contents</b>
Assembled ExTR documents and Additional reference material:
IECEX Test Report Cover
IECEX Test Report: IEC 60079-0, Edition 6 <sup>th</sup>
IECEX Test Report: IEC 60079-11, Edition 6 <sup>th</sup>

Manufacturer's name.....:	Precise Connections
Address .....	1114 Explorer St, Duncanville, TX 75137, USA
Trademark .....	
Certificate No. (optional).....:	
QAR Reference No. (optional) .....	GB/SIR/QAR15.0006/00
<b>Particulars: Test item vs. Test requirements</b>	
Classification of installation and use .....	Portable
Ingress protection .....	IP20
Rated ambient temperature range (°C).....:	-20°C ≤ Ta ≤ +50°C
Rated service temperature range (°C) for Ex Components .....	N/A
<b>General remarks:</b>	
The test results presented in this ExTR package relate only to the item or product tested.	
<ul style="list-style-type: none"> <li>▪ "(See Attachment #)" refers to additional information appended to the ExTR package.</li> <li>▪ "(See appended table)" refers to a table appended to the ExTR package.</li> <li>▪ Throughout this ExTR package, a point is used as the decimal separator.</li> <li>▪ <i>Where the term "N/A" appears in any part of an ExTR package, it indicates that the associated issue was considered "Not applicable" to the involved evaluation.</i></li> <li>▪ <i>In accordance with IECEx 02, a Receiving ExCB may request a sample of the Ex equipment and copies of the documentation referred to in an ExTR Cover.</i></li> </ul>	
The technical content of this ExTR package shall not be reproduced except in full without the written approval of the Issuing ExCB and ExTL.	
<b>General product information:</b>	
Gas Clip Technologies (GCT) Multi Gas Clip-Simple (MGC-S) and Multi Gas Clip-Simple plus (MGC-S plus) detectors are personal safety devices designed to detect the presence of specific toxic gases, Carbon Monoxide (CO), Hydrogen Sulfide (H <sub>2</sub> S), Oxygen (O <sub>2</sub> ), and Combustible gases/Lower Explosive Limit (LEL).	
The products are intrinsically safe and each is comprised of a main enclosure, display, two printed circuit boards, a non-rechargeable battery cell ER18505 (Lithium Thionyl Chloride 3.6V; Capacity: 4 Ah ) P/N GC006-707, and three gas sensors. The printed circuit boards are secured to the front half of the enclosure with screws. There are no external connections on the equipment.	
The only difference between MGC-S and MGC-S plus is about oxygen sensor with different life time but identical electrical rating.	
<b>Details of change (applicable only when revising an existing ExTR package):</b>	
This report is to assess the following Addition and modifications to certificate :	
<ol style="list-style-type: none"> <li>i. The introduction of a new model, Multi Gas Clip-Simple Plus (MGC-S +) was recognised. The requirements of safety protection, design, power, current and temperature rating of the MGC-S + are identical to the Multi Gas Clip-Simple (MGC-S) other than an Oxygen Sensor that has a longer lifetime. As a result, new drawings were introduced and previously certified drawings were amended.</li> <li>ii. The Sensor's filter has been separated to two part (for EC sensor and for combustibile sensor) on both MGC-S and MGC-S + models.</li> <li>iii. The power rating of the protective resistor R57 which is used in both the MGC-S and MGC-S + was changed from 22.1 Ohms @ 1 watt to 22.1 Ohms @ 1/4 watt.</li> <li>iv. As a result of this assessment, the Specific Condition Of Use relating to electrostatic charge was removed accordingly, the 'X' suffix was deleted from the certificate number.</li> </ol>	



<b>Copy of Marking Plate:</b>	
<b>GC006-009-LABEL-MODEL</b>	<b>GC006-023-LABEL-MODEL-Plus</b>
 <p><b>Multi Gas Clip - Simple</b></p> <p>CSA 16.70084100 C22.2 No.152, ISA S12.13              Intrinsically Safe / Sécurité Intrinsèque              Cl.I Gr.A,B,C,D; T4 / Cl Zone 0 AEx ia IIC T4 Ga              -20°C ≤ Ta ≤ +50°C, Ex ia IIC T4 Ga              SIRA 16ATEX2288 IECEx CSA 16 0038</p> <p>    </p> <p><b>WARNING/ADVERTISSEMENT/ATENÇÃO</b>  <small>SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY. DO NOT CHARGE IN A HAZARDOUS LOCATION.              SUBSTITUICÃO DE COMPONENTES PODE PREJUDICAR A SEGURANÇA INTRÍNSECA. NÃO CARREGUE EM UM LOCAL PERIGOSO.</small></p> <p><b>Understand Manual Before Use</b>  <small>Comprende le Manuel Avant Utilisation              Entenda o manual antes de usar</small></p> <p><b>gas clip</b> Gas Clip Technologies  <small>Assembled in USA              USA 75104</small></p>	 <p><b>Multi Gas Clip - Simple+</b></p> <p>CSA 16.70084100 C22.2 No.152, ISA S12.13              Intrinsically Safe / Sécurité Intrinsèque              Cl.I Gr.A,B,C,D; T4 / Cl Zone 0 AEx ia IIC T4 Ga              -20°C ≤ Ta ≤ +50°C, Ex ia IIC T4 Ga              SIRA 16ATEX2288 IECEx CSA 16 0038</p> <p>    </p> <p><b>WARNING/ADVERTISSEMENT/ATENÇÃO</b>  <small>SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY. DO NOT CHARGE IN A HAZARDOUS LOCATION.              SUBSTITUICÃO DE COMPONENTES PODE PREJUDICAR A SEGURANÇA INTRÍNSECA. NÃO CARREGUE EM UM LOCAL PERIGOSO.</small></p> <p><b>Understand Manual Before Use</b>  <small>Comprende le Manuel Avant Utilisation              Entenda o manual antes de usar</small></p> <p><b>gas clip</b> Gas Clip Technologies  <small>Assembled in USA              USA 75104</small></p>
<b>GC006-010-LABEL-SERIAL</b>	
<p>MODEL: {MODEL}      </p> <p>SN: {SERIAL}</p>	
Details regarding 'trade agent' / 'local assembler' application in accordance with OD 203: N/A	
In accordance with OD 024, testing not fully performed by ExTL staff at the above ExTL address: N/A	
National differences considered as part of this evaluation: N/A	
"Specific Conditions of Use": N/A	
<p><b>Conditions Of Manufacture</b></p> <ul style="list-style-type: none"> <li>The product covered by this certificates incorporates an IR sensor, MIPEX-04-1-12-3.1 made by Optosense LLC. The construction of this sensor was considered and approved as part of the overall assessment of the MGC-S Portable Gas Detector; therefore, Gas Clip Technologies shall ensure that the MIPEX-04-1-12-3.1 sensors used in their products have been manufactured in accordance with the Optosense LLC drawings that are listed in this certificate and report.</li> </ul>	
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Technical Documents				
No.	Title:	Drawing No.:	Rev. Level:	Date: yyyy/mm/dd
1*	GENERAL ASSEMBLY	GC006-000	1.2.0	2017/11/30

2	TOP CASE	GC006-001	1.0.0	2015/10/27
3	BOT CASE	GC006-002	1.0.0	2015/10/27
4	LCD BRACKET	GC006-003	1.0.0	2015/10/27
5	Reflector	GC006-004	1.0.0	2015/10/27
6	CUSHION PAD	GC006-005	1.0.0	2015/10/27
7	SENSOR PAD-A	GC006-006-A	1.0.0	2016/10/28
8	SENSOR PAD-B	GC006-006-B	1.1.0	2016/11/09
9-1*	ROUND-FILTER	GC006-020	1.0.0	17/01/20
9-2*	MIPEX-04-FILTER	GC006-021	1.0.0	15/10/27
10*	LABEL-MODEL	GC006-009	1.1.1	2017/11/30
11	LABEL-SERIAL	GC006-010	1.1.0	2016/10/24
12	CALIBRATION CAP	GC006-011	1.0.0	2015/10/27
13	SPACER	GC006-013	1.0.0	2015/10/27
14	AUXILIARY FILTER CAP	GC006-015	1.0.0	2015/10/27
15	AUXILIARY FILTER	GC006-016	1.0.0	2015/10/27
16	Battery Pad	GC006-018	1.0	2016/10/30
17	PCB-ASM	GC006-500	1.0.0	2015/10/27
18	LCD	GC006-704	1.1.0	2016/01/05
19	ZEBRA	GC006-705	1.0.0	2015/10/27
20	Battery Assembly	GC006-707	1.0.0	2015/10/27
21	MGC SIMPLE PCB	-	2.4	2016/06/13
22*	MGC Simple Schematic	GC006-100-234	2.3.6	2017/12/13
23*	MGC Simple BOM-Unit	00584	1.0.0c	2017/09/28
24*	MGC Simple BOM-FG	00585	1.0.0b	2017/09/01
25*	MGC Simple BOM-ASSY	00789	2.4.1e	2017/12/04
26*	MGC Simple plus BOM-Unit	00963	1.0.0	2017/09/01
27*	MGC Simple plus BOM-FG	00962	1.0.0	2017/09/28
28*	LABEL-MODEL-MGC-PLUS	GC006-023	1.0.1	2017/11/30

29	MIPEX-04--04-1-12-3.1-Drawings			
1	IR gas sensor MIPEX-04-X-XX-X.X	ESAT.100000.00.03 AD	03	-
2	Board of 12 Sensors. SLDDRW	ESAT.100001.00.03 AD	03	-
3	Board Assembly with OE	ESAT.100002.00.02 AD	02	-
4	Board Schematic with OE	ESAT.100002.00.04 E3	04	15/11/2016
5	SENSOR BOM	ESAT.100002.XX.07	07	15/11/2016
6	Gerbers-MIP04	-	-	1/11/206

*Note: An \* is included before the title of documents that are new or revised.*



IECEX TEST REPORT ADDENDUM

ExTR Reference Number.....: CA/CSA/ExTR16.0042/01
ExTR Free Reference Number .....: CA/CSA/2016/TR255950-70158987
Compiled by + signature (ExTL) ....: Zahra Amini
Reviewed by + signature (ExTL)....: Konstantin Rybalko
Date of issue .....:
Ex Testing Laboratory (ExTL) .....: CSA International
Address .....: 178 Rexdale Boulevard, Toronto, ON, M9W 1R3
Applicant's name.....: CSA Group
Address .....: 178 Rexdale Blvd., Toronto, ON, Canada
Standards.....: IEC 60079-0:2011, 6th Edition; IEC 60079-11:2011, 6th Edition
Test procedure .....: IECEx System
Test Report Form Number .....: ExTR Addendum\_2 (released 2010-08)

Instructions for Intended Use of ExTR Addendum:
An ExTR Addendum is to supplement a previously issued ExTR package. Only those clauses applicable to the supplemental issue being addressed are to be tabulated and remarked upon as part of this document. An ExTR of National Differences may also supplement this document. An ExTR Addendum is to be compiled and reviewed by the ExTL. The Issuing ExCB indicates final approval of the ExTR Addendum as part of the overall ExTR package on the associated ExTR Cover.

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Possible test case verdicts:
- test case does not apply to the test item .....:N / A
- test item does meet the requirement .....:Pass

General remarks:
The test results presented in this ExTR Addendum relate only to the item or product tested, and are only valid when considered together with the related Ex Test Report that was previously issued, along with any previously issued ExTR Addendums for the same item or product.
Only clauses and manufacturer's documents impacted by this document are detailed.
- "(see Attachment #)" refers to additional information appended to this document.
- "(see appended table)" refers to a table appended to this document.
- Throughout this document, a point is used as the decimal separator.
The technical content of this ExTR Addendum shall not be reproduced except in full without the written approval of the Issuing ExCB and ExTL.

Standard and Clause	Requirement – Test	Result – Remark	Verdict
IEC 60079-0:2011 clause 5.3	Maximum surface temperature	See section 4	Pass
IEC 60079-0:2011 clause 7.5	Accessible metal parts	See section 5.1	Pass
IEC 60079-0:2011 clause 26.14	Measurement of capacitance	See section 5.1	Pass
IEC 60079-0:2011 clause 29.3 e)	Marking-General	See section 5.2	Pass
IEC 60079-11:2011 clause 5.6	Thermal ignition compliance	See section 4	Pass
IEC 60079-11:2011 clause 5.5	Resistive Spark ignition compliance	See section 4	Pass
IEC 60079-11:2011 clause 8.5	Resistors current-limiting resistors	See section 4	Pass
IEC 60079-11:2011 clause 7.1	Rating of safety components	See section 4	Pass
IEC 60079-11:2011 clause 6.3	Thermal ignition assessment	See section 4	Pass
IEC 60079-11:2011 clause 7.8	Electrochemical cells	See section 1	Pass

**Measurement Section, including Additional Narrative Remarks (as deemed applicable)**

**1. Adding new Model**

New model Multi Gas Clip-Simple plus (MGC-S plus) detector is a personal safety devices designed to detect the presence of specific toxic gases, Carbon Monoxide (CO), Hydrogen Sulfide (H<sub>2</sub>S), Oxygen (O<sub>2</sub>), and Combustible gases/Lower Explosive Limit (LEL).

Multi Gas Clip-Simple plus (MGC-S plus) is intrinsically safe comprised of a main enclosure, display, two printed circuit boards, a non-rechargeable battery cell ER18505(Lithium Thionyl Chloride 3.6V; Capacity: 4 Ah ) P/N GC006-707, and three gas sensors. The printed circuit boards are secured to the front half of the enclosure with screws. There are no external connections on the equipment.

The new model Multi Gas Clip-Simple Plus is identical to Multi Gas Clip-Simple with difference of an Oxygen sensor that has longer lifetime. See section 1.1.1.

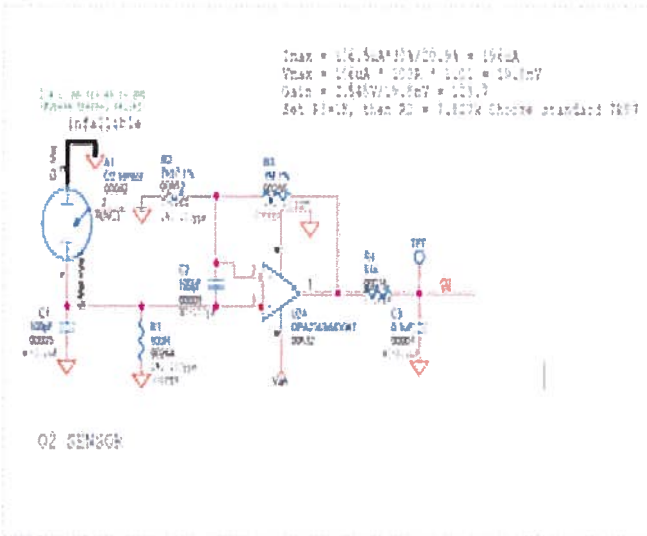
The requirement of safety protection, design, power, current, and temperature rating are identical to MGC-S that certified previously in last issue. Therefore the Intrinsically Safe assessment, evaluation and tests of MGC-S are representative for MGC-S plus.

**1.1 Electrochemical cell**

(EN 60079-11:2012 Clause 7.8)

The O<sub>2</sub> sensor circuit is connected directly to GND. Therefore the additional voltage of an electrochemical cell is in parallel with the battery pack and therefore cannot be considered as adding to the battery voltage for spark ignition purposes.

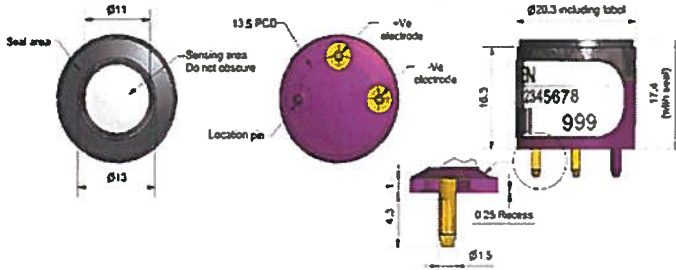
Therefore the difference of Oxygen sensor is not considered to affect the intrinsic safety properties of the equipment. See below



**1.1.1 O<sub>2</sub> sensor on MGC-S with 2 years of life time:**

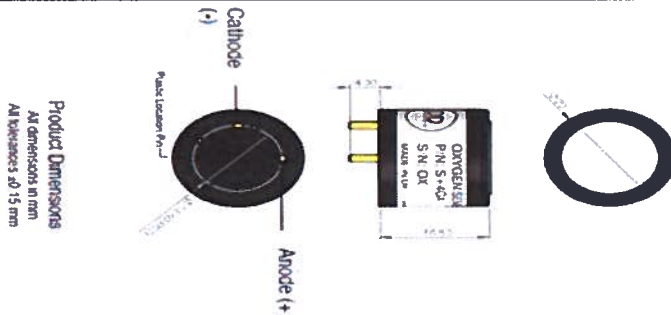
There are two alternative to use in the design of MGC-S refer to CA/CSA/ExTR16.0042/00 for evaluation:

Original O<sub>2</sub> sensor      Alpha sense P/N O2-A2      1.2V      0.1A



All dimensions in millimetres (± 0.15mm)

Alternative O<sub>2</sub> sensor      Scientific P/N S+4OX      0.9 V      0.01A

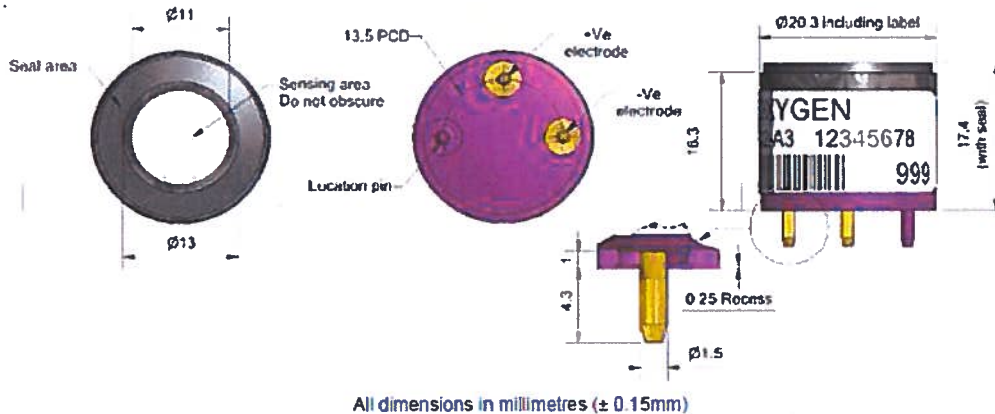


Life time Output drift % change in output @ 3 months < 1  
 Operating life months until 85% original output in 20.9% O2 > 24

**1.1.2 O2 sensor on MGC-S plus with 3 years of life time:**

O2 sensor Alpha sense P/N O2-A3 1.2V 0.1A

Life time Output drift % change in output @ 3 months < 2  
 Operating life months until 85% original output in 20.9% O2 > 36



Comparison shows the size, output voltage and current of sensors are identical. The life time difference is not considered to affect the intrinsic safety properties of the equipment.

All other aspect of intrinsically safe method of protection for both models are identical and covered under previous model MGC-S.

Therefore, no testing is deemed necessary.

**2. Drawings**

The following drawings are new and are considered to be used just for additional model MGC-S plus:

- MGC Simple plus BOM-Unit; Drawing # 00963; Version 1.0.0b ; date 9/1/2017
- MGC Simple plus BOM-FG; Drawing #00962; Version 1.0.0b ; date 9/1/2017
- LABE drawing for model MGC-S plus; Drawing # GC006-023; Version 1.1.0; date 09/25/17

Other drawings have shared use for both MGC-S and MGC-S plus models and there are some minor update on other drawings which are not considered to affect the intrinsic safety properties of the equipment

**3. Gas Filters**

The filter membrane of EC and MIPEX sensor which previously was one integrated part (the subject of drawing GC006-007-FILTER, divided to two part:

- For EC sensors GC006-020-ROUND-FILTER

- For MIPEX GC006-0210-MIPEX-04-FILTER

This change is not considered to affect the intrinsic safety properties of the equipment.

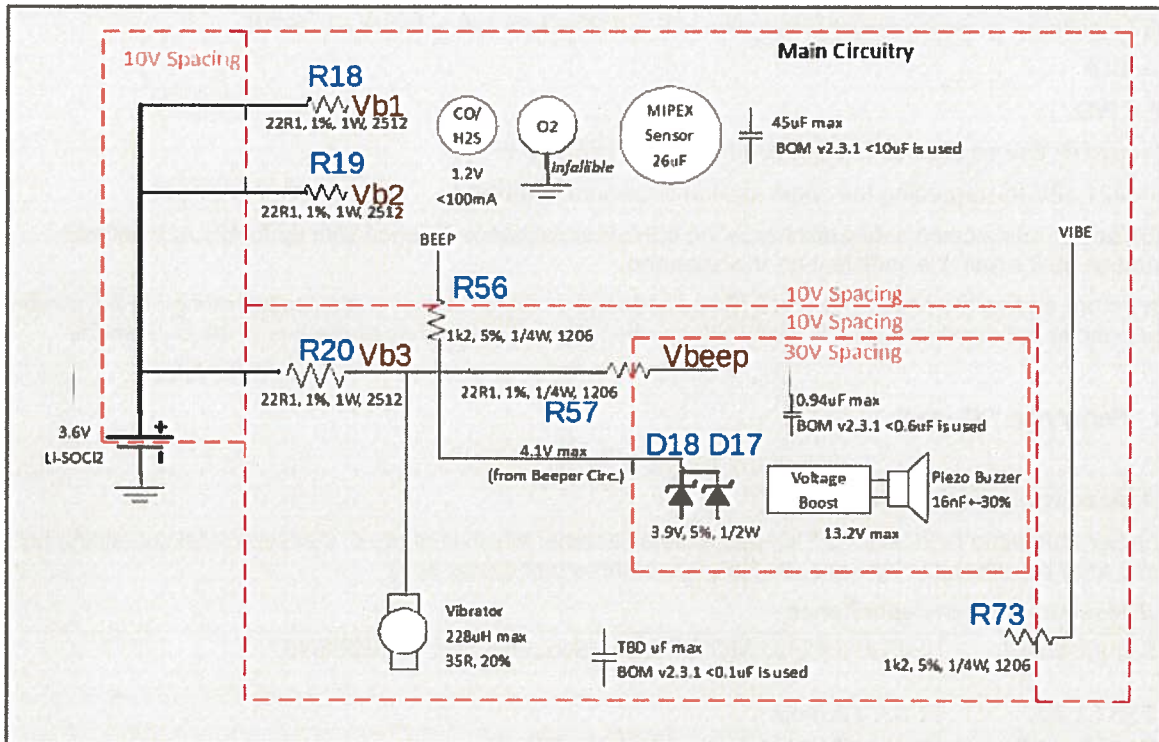
#### 4. New Rating of R57

Changing the power rating of a protective resistor ( R57) that is listed as 22.1 Ohms @ 1 watt to 22.1 Ohms @ 1/4 watt on both model.

##### 4.1 R57 as 22.1 Ohms @ 1/4 watt rating.

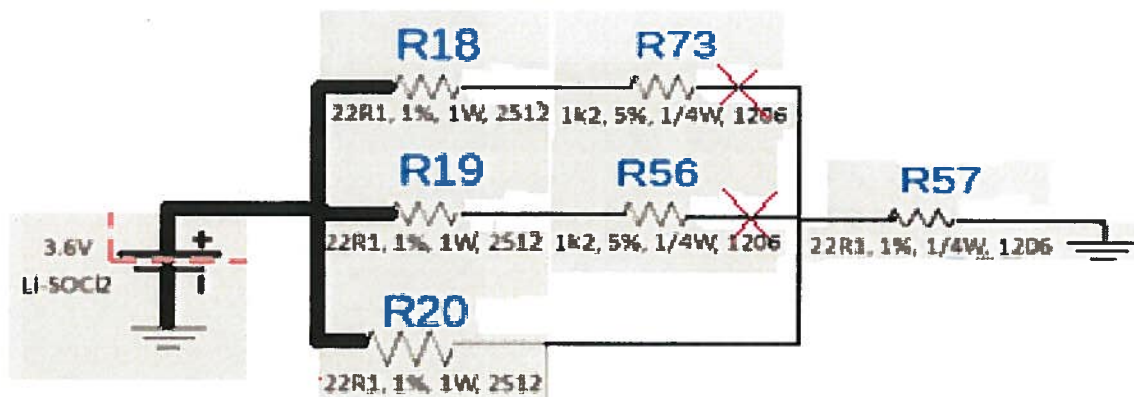
The presence of R20 (current-limiting resistor can only fail to open-circuit) limits the current that can flow through R57 in worst case condition to acceptable level.

R18, R19, R20, R56, R57 and R73 can only fail to open circuit and their identified spacing border meets Table 5 requirements.



##### 4.2 R57 stress scenario A:

Right side of R57 is shorted to GND



After applying 2 fault as above ( or in middle of resistors), the only way that let current flow to R57 is R20.  
 Current through R20 in series with R57 =  $3.6V / (R20+R57) = 3.6V / (21.88+21.88) = 43.76 = 0.083A$   
 Power dissipated in R57 =  $I^2 R57_{max} = (0.083A^2) * 22.321 = 0.154W$   
 R57 power rating to handle 1.5 times max power =  $0.154W * 1.5 = 0.231W$   
 Since R57 is rated at 0.250W, therefore meets the requirement.

**4.3 R57 stress scenario B:**

Left side of R57 is shorted to GND

All the capacitance on right side must discharge through R57.

R57 and the capacitor of circuit are connected in series. To protect the discharge from the capacitor, R57 may be considered to dissipate power in watts numerically equal to  $CU^2$ .

Audio Circuit maximum capacitance is  $C = 0.94\mu F$

R57 maximum accepted power dissipation is  $P = 0.25w / 1.50$  safety factor =  $0.167W$

$P = CU^2$

$U^2 = P/C$

$U = \text{sqrt}(P/C) = \text{sqrt}(0.167W / 0.00000094F) = \text{sqrt}(177659.5745)$

$U = 421.42V$  (disregarding the spark ignition maximum potential.)

R57 power rating could safely discharge the 0.94uF capacitance charged with up to 421.42V without damage so it's rating is sufficient for this scenario.

Therefore and as the assessment in 2 stress scenario indicate the power dissipation rating of R57 can be changed to not considered to 1/4 watt with no effect the intrinsic safety properties of the equipment.

**5. Removing "X" mark**

**5.1 Accessible metal parts**

The portable hand held MGC-S Plus has a metal fastener which is made of stainless steel containing no more than the allowable light alloys= 3pF(Two of three test shows 3pF)

**5.2 Measurement of capacitance**

Sample tested:	Full assembled MGC-S Plus - Serial Number D4SH390497.	
TEST LAB	CSA Toronto	
Test report # :	Accessible metal part-70158986-WO#3	
Date	30 Nov, 2017	
Temperature	23°C	
Standard reference:	CSA C22.2 60079-0, Cl. 7.5 and 26.14.1, 2	
Test custom sample picture		



<p>Test procedure:</p>	<p>The test was conducted on a fully assembled sample of the electrical equipment. The test was conducted on sample as received. The sample was conditioned in a climatic conditioning chamber for at least 1 h at a temperature of <math>(20 \pm 2) ^\circ\text{C}</math> and a relative humidity of <math>(50 \pm 5) \% \text{RH}</math>. The sample under test was placed on an unearthed metal plate that significantly exceeds the area of the test sample. Connection leads were as short as possible. The positions of the samples was face down on the unearthed metal plate with the metal clip facing upward.</p> <p>The capacitance between each exposed metallic part on the test sample and the metal plate was measured. Connect the negative measurement lead of the capacitance meter to the unearthed metal plate. The positive measurement lead of the capacitance meter was kept as far as possible from the metal plate.</p>																													
<p>Test result summary:</p>	<table border="1"> <thead> <tr> <th data-bbox="446 504 730 625">Location</th> <th data-bbox="730 504 852 625">Test no. 1</th> <th data-bbox="852 504 982 625">Test no .2</th> <th data-bbox="982 504 1096 625">Test 3</th> <th data-bbox="1096 504 1226 625">Average</th> <th data-bbox="1226 504 1396 625">Difference between stray and measured</th> </tr> </thead> <tbody> <tr> <td data-bbox="446 625 730 657">Stray capacitance</td> <td data-bbox="730 625 852 657">14pF</td> <td data-bbox="852 625 982 657">15pF</td> <td data-bbox="982 625 1096 657">14pF</td> <td data-bbox="1096 625 1226 657">14.3pF</td> <td data-bbox="1226 625 1396 657">--</td> </tr> <tr> <td data-bbox="446 657 730 716">Metal Clip measured capacitance</td> <td data-bbox="730 657 852 716">17 pF</td> <td data-bbox="852 657 982 716">18pF</td> <td data-bbox="982 657 1096 716">18 pF</td> <td data-bbox="1096 657 1226 716">17.66 pF</td> <td data-bbox="1226 657 1396 716">Two time 3 pF</td> </tr> <tr> <td colspan="6" data-bbox="446 716 1396 751"> <p>Measured capacitance is equal to 3 pF in average and therefore is acceptable</p> </td> </tr> </tbody> </table>						Location	Test no. 1	Test no .2	Test 3	Average	Difference between stray and measured	Stray capacitance	14pF	15pF	14pF	14.3pF	--	Metal Clip measured capacitance	17 pF	18pF	18 pF	17.66 pF	Two time 3 pF	<p>Measured capacitance is equal to 3 pF in average and therefore is acceptable</p>					
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End of report

