IECEx Certificate of Conformity

INTERNATIONAL ELECTROTECHNICAL COMMISSION
IEC Certification System for Explosive Atmospheres
for rules and details of the IECEx Scheme visit www.iecex.com

Certificate No.:	**IECEx KTL 19.0028X**	Page 1 of 3	Certificate history:
Status:	**Current**	Issue No: 0	
Date of Issue:	2019-11-19		
Applicant:	**Gastron Co., Ltd.** 23, Gunpocheomdansaneop 1-ro, Gunpo-si Gyeonggi-do 15881 **Korea, Republic of**		
Equipment:	**Portable Multi Gas Detector, G-Finder Multi GFM-400 Series**		
Optional accessory:			
Type of Protection:	**Intrinsic Safety "i"**		
Marking:	Ex ia IIC T4 Ga		

Approved for issue on behalf of the IECEx Certification Body:	**Park, Jong-koo**
Position:	**Certification Manager**
Signature: (for printed version)	
Date:	2019-11-19

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 www.iecex.com or use of this QR Code.

Certificate issued by:

Korea Testing Laboratory
87, Digital-ro, 26-gil, Guro-gu
Seoul
Korea, Republic of

IECEx Certificate of Conformity

Manufacturer: **Gastron Co., Ltd.**
23, Gunpocheomdansaneop 1-ro, Gunpo-si
Gyeonggi-do 15881
Korea, Republic of

Additional manufacturing locations:

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 equipment 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 60079-0:2017 Edition:7.0	Explosive atmospheres - Part 0: Equipment - General requirements
IEC 60079-11:2011 Edition:6.0	Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "i"

This Certificate **does not** indicate compliance with 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:

KR/KTL/ExTR19.0029/00

Quality Assessment Report:

NL/DEK/QAR19.0002/00

EQUIPMENT:
Equipment and systems covered by this Certificate are as follows:

The G-Finder Multi GFM-400 series are hand-held, battery operated multi gas detectors. The "G-Finder Multi" is a brand name and the main model name is "GFM-400". The detector is a personal safety device designed to continuously monitor the presence of oxygen(O_2), Carbon Monoxide (CO), Hydrogen Sulfide (H_2S) and one of methane (CH_4) or propane (C_3H_8). The detector samples the atmosphere in diffusion mode using an electrochemical sensors for O_2, a dual toxic electrochemical sensor for CO and H_2S, and an IECEx certified NDIR sensor for CH_4 or C_3H_8.

The detector alerts the user to potentially unsafe exposure with visual, vibrating and audible alarms when gas concentration exceeds user configurable set points, and readings are displayed on a LCD. The detector has IR communications for changing the alarm set point, the calibration range and etc. The IR communications shall only be used in safe area.

The detector is comprised of two printed circuit boards with a LCD, three gas sensors and two batteries in parallel, housed in a non-metallic enclosure which is constructed by double-shot injection molding with polycarbonate and thermoplastic elastomer alloy. The non-metallic enclosure consists of a front half (cover) and a back half (body). A wide LCD window of the front half of the enclosure is fully covered with an anti-static coating film. A metallic suspender clip is attached to the back half of the enclosure. The parts of the enclosure are secured by screws. The detector has no facilities for connection of external circuits.

Power is provided by non-user replaceable, two Lithium/Thionyl chloride ($Li/SOCl_2$) batteries (Tekcell, type SB-AA11 manufactured by VITZRO CELL, AA size, Nominal 3.6 V, Peak 3.9 V, 2.5 Ah) connected in parallel. The detector is intended to be a disposable unit. The ambient temperature range for the series is -20 °C ≤ T_a ≤ +50 °C.

The configuration for GFM-400 series is as follows;

GFM-400(-X)(-Y)

- GFM-400: Model name

- *X: Flammable gas type (blank(default sensor), MM2.5, MM100, MP1.5, MP2.5, PP1.5, PP2.5)

* : This option can be selected only if the user require a particular target gas, a particular calibration gas and a particular measurement range different from the default sensor to detect a flammable gas (CH_4 or C_3H_8).

- **Y: Housing body color (blank : orange(default), YE : yellow, GN : green, VT : violet, and etc.)

** : This option is not marked on the label and can only be used at an order if the user require a particular housing body color different from the default. The option does not affect intrinsic safety.

For the detailed information, see the instruction manual.

SPECIFIC CONDITIONS OF USE: YES as shown below:
The G-Finder Multi GFM-400 is provided with the anti-static coating film covering over the LCD window to avoid danger of ignition due to electrostatic charge. Periodic inspection of this coating film is required to ensure no degradation, delamination, abrasions or other deformities to this surface. Care must be taken to avoid exposure to excessive heat, harsh chemicals or solvents, sharp edges and abrasive surfaces. Clean only with a damp cloth.

IECEx Test Report Summary

INTERNATIONAL ELECTROTECHNICAL COMMISSION
IEC Certification System for Explosive Atmospheres

for rules and details of the IECEx Scheme visit www.iecex.com

ExTR Ref. No.:	**KR/KTL/ExTR19.0029/00**	Page 1 of 1
ExTR Free Ref. No.:	**PI181060**	Status: **Issued**
List of Standards Covered:	**IEC 60079-0:2017 Edition:7.0, IEC 60079-11:2011 Edition:6.0**	Date of issue: **2019-11-19**

Issuing ExTL: **KTL - Korea Testing Laboratory**

Endorsing ExCB: **KTL - Korea Testing Laboratory**

Manufacturer: **Gastron Co., Ltd.**
23, Gunpocheomdansaneop 1-ro, Gunpo-si
Gyeonggi-do 15881

Location of Manufacturer: **Korea, Republic of**

Ex Protection: **Intrinsic safety "i"**
Ex ia IIC T4 Ga

Ratings:
■ Battery Powered (Nominal 3.6 V, Peak 3.9 V, 2.5 Ah × 2) - Two Lithium/Thionyl chloride (Li/SOCl2) batteries in parallel, non-user replaceable, Tekcell, type SB-AA11 manufactured by VITZRO CELL
■ Ambient Temperature Range: -20 °C ≤ Ta ≤ +50 °C

Equipment: **Portable Multi Gas Detector, G-Finder Multi GFM-400 Series**

Model Reference:
GFM-400(-X)(-Y)
- GFM-400: Model name
- *X: Flammable gas type (blank(default sensor), MM2.5, MM100, MP1.5, MP2.5, PP1.5, PP2.5)
*** : This option can be selected only if the user require a particular target gas, a particular calibration gas and a particular measurement range different from the default sensor to detect a flammable gas (CH4 or C3H8).**
- **Y: Housing body color (blank : orange(default), YE : yellow, GN : green, VT : violet, and etc.)
**** : This option is not marked on the label and can only be used at an order if the user require a particular housing body color different from the default. The option does not affect intrinsic safety.**
For the detailed information, see the instruction manual.

Related IECEx Certificates:

IECEx KTL 19.0028X Issue 0

Comments:

IECEx TEST REPORT COVER

ExTR Reference Number:	KR/KTL/ExTR19.0029/00
ExTR Free Reference Number:	PI181060
Compiled by + signature (ExTL):	Choi, Yong-Won
Reviewed by + signature (ExTL):	Min, Yeong-Seung
Approved by + signature (ExCB):	Kim, Dong-Jin
Date of issue:	2019.11.19.
Ex Testing Laboratory (ExTL):	KTL(Korea Testing Laboratory)
Address:	87, Digital-ro 26-gil, Guro-gu, Seoul, Korea
Ex Certification Body (ExCB):	KTL(Korea Testing Laboratory)
Address:	87, Digital-ro 26-gil, Guro-gu, Seoul, Korea
Applicant's name:	GASTRON Co., Ltd.
Address:	23, Gunpocheomdansaneop 1-ro, Gunpo-si, Gyeonggi-do, 15881, Korea
Standards associated with this ExTR package:	IEC 60079-0:2017, IEC 60079-11:2011
Clauses considered:	All clauses considered
Test Report Form Number:	ExTR Cover_7 (released 2018-02)
Related Amendments, Corrigenda or ISHs:	N/A
Test item description:	Portable Multi Gas Detector
Model/type reference:	G-Finder Multi GFM-400 Series
Code (e.g. Ex __ II__ T__):	Ex ia IIC T4 Ga
Rating:	Nominal 3.6 V, Peak 3.9 V, 2.5 Ah × 2 (Two Lithium/Thionyl chloride ($Li/SOCl_2$) batteries in parallel, non-user replaceable)

ExTR Package Contents
Assembled ExTR documents and Additional reference material:
IECEx Test Report Cover
IECEx Test Report: IEC 60079-0, Edition 7
IECEx Test Report: IEC 60079-11, Edition 6

Manufacturer's name......................:	GASTRON Co., Ltd.
Address ....:	23, Gunpocheomdansaneop 1-ro, Gunpo-si, Gyeonggi-do, 15881, Korea
Trademark ....:	GASTRON
Certificate No. (optional).................:	IECEx KTL 19.0028X
QAR Reference No. (optional) ....:	NL/DEK/QAR19.0002/00

Particulars: Test item vs. Test requirements

Classification of installation and use .... : Hand-held

Ingress protection .... : IP20 or greater

Rated ambient temperature range (°C) .... : -20 °C ≤ T_a ≤ +50 °C

General remarks:

The test results presented in this ExTR package relate only to the item or product tested.

- "(See Attachment #)" refers to additional information appended to the ExTR package.
- "(See appended table)" refers to a table appended to the ExTR package.
- Throughout this ExTR package, a point is used as the decimal separator.
- *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.*
- *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.*

The technical content of this ExTR package shall not be reproduced except in full without the written approval of the Issuing ExCB and ExTL.

General product information:

The G-Finder Multi GFM-400 series are hand-held, battery operated multi gas detectors. The "G-Finder Multi" is a brand name and the main model name is "GFM-400". The detector is a personal safety device designed to continuously monitor the presence of oxygen(O_2), Carbon Monoxide (CO) , Hydrogen Sulfide (H_2S) and one of methane (CH_4) or propane (C_3H_8). The detector samples the atmosphere in diffusion mode using an electrochemical sensors for O_2, a dual toxic electrochemical sensor for CO and H_2S, and an IECEx certified NDIR sensor for CH_4 or C_3H_8.

The detector alerts the user to potentially unsafe exposure with visual, vibrating and audible alarms when gas concentration exceeds user configurable set points, and readings are displayed on a LCD. The detector has IR communications for changing the alarm set point, the calibration range and etc. The IR communications shall only be used in safe area.

The detector is comprised of two printed circuit boards with a LCD, three gas sensors and two batteries in parallel, housed in a non-metallic enclosure which is constructed by double-shot injection molding with polycarbonate and thermoplastic elastomer alloy. The non-metallic enclosure consists of a front half (cover) and a back half (body). A wide LCD window of the front half of the enclosure is fully covered with an anti-static coating film. A metallic suspender clip is attached to the back half of the enclosure. The parts of the enclosure are secured by screws. The detector has no facilities for connection of external circuits.

Power is provided by non-user replaceable, two Lithium/Thionyl chloride (Li/$SOCl_2$) batteries (Tekcell, type SB-AA11 manufactured by VITZRO CELL, AA size, Nominal 3.6 V, Peak 3.9 V, 2.5 Ah) connected in parallel. The detector is intended to be a disposable unit. The ambient temperature range for the series is -20 °C ≤ T_a ≤ +50 °C.

The configuration for GFM-400 series is as follows;

GFM-400(-X)(-Y)

- GFM-400: Model name

- *X: Flammable gas type (blank(default sensor), MM2.5, MM100, MP1.5, MP2.5, PP1.5, PP2.5)

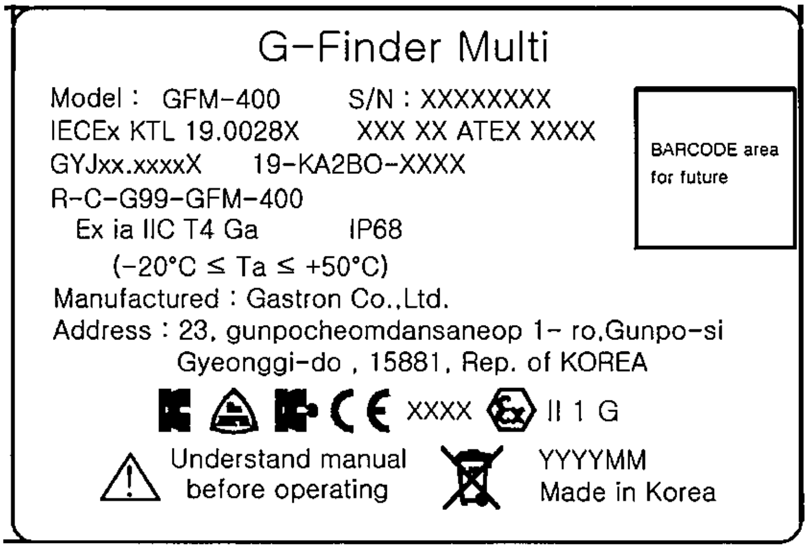
* : This option can be selected only if the user require a particular target gas, a particular calibration gas and a particular measurement range different from the default sensor to detect a flammable gas (CH_4 or C_3H_8).

- **Y: Housing body color (blank : orange(default), YE : yellow, GN : green, VT : violet, and etc.)

** : This option is not marked on the label and can only be used at an order if the user require a particular housing body color different from the default. The option does not affect intrinsic safety.

For the detailed information, see the instruction manual.

Copy of Marking Plate:



Details regarding 'trade agent' / 'local assembler' application in accordance with OD 203:

N/A

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" / "Schedule of Limitations":

The G-Finder Multi GFM-400 is provided with the anti-static coating film covering over the LCD window to avoid danger of ignition due to electrostatic charge. Periodic inspection of this coating film is required to ensure no degradation, delamination, abrasions or other deformities to this surface. Care must be taken to avoid exposure to excessive heat, harsh chemicals or solvents, sharp edges and abrasive surfaces. Clean only with a damp cloth.

Routine tests:

N/A

Technical Documents

Title:	Drawing No.:	Rev. Level:	Date:
GFM-400 INTRINSIC BLOCK DIAGRAM	Ex-GE-25S00	1	2019-08-14
GFM-400 MAIN SCHEMATIC	Ex-GE-25S01	1	2019-07-24
GFM-400 SENSOR SCHEMATIC	Ex-GE-25S02	1	2019-08-13

GFM-400 BLEUTOOTH SCHEMATIC	Ex-GE-25S03	1	2019-07-15
TOP LAYER / MAIN PCB	Ex-GE-25P00-1	0	2019-07-22
SILK SCREEN TOP + SOLDER MASK TOP LAYERS / MAIN PCB	Ex-GE-25P00-2	0	2019-07-22
BOTTOM LAYER / MAIN PCB	Ex-GE-25P00-3	0	2019-07-22
SILK SCREEN BOTTOM + SOLDER MASK BOTTOM LAYERS / MAIN PCB	Ex-GE-25P00-4	0	2019-07-22
GROUND PLANE / MAIN PCB	Ex-GE-25P00-5	0	2019-07-22
POWER PLANE / MAIN PCB	Ex-GE-25P00-6	0	2019-07-22
TOP LAYER DIMENSION / MAIN PCB	Ex-GE-25P00-7	0	2019-07-22
BOTTOM LAYER DIMENSION / MAIN PCB	Ex-GE-25P00-8	0	2019-07-22
GROUND PLANE DIMENSION / MAIN PCB	Ex-GE-25P00-9	0	2019-07-22
POWER PLANE DIMENSION / MAIN PCB	Ex-GE-25P00-10	0	2019-07-22
DRILL / MAIN PCB	Ex-GE-25P00-11	0	2019-07-22
TOP LAYER / SENSOR PCB	Ex-GE-25P01-1	0	2019-09-20
SILK SCREEN TOP + SOLDER MASK TOP LAYERS / SENSOR PCB	Ex-GE-25P01-2	0	2019-09-20
BOTTOM LAYER / SENSOR PCB	Ex-GE-25P01-3	0	2019-09-20
SILK SCREEN BOTTOM + SOLDER MASK BOTTOM LAYERS / SENSOR PCB	Ex-GE-25P01-4	0	2019-09-20
GROUND PLANE / SENSOR PCB	Ex-GE-25P01-5	0	2019-09-20
POWER PLANE / SENSOR PCB	Ex-GE-25P01-6	0	2019-09-20
TOP LAYER DIMENSION / SENSOR PCB	Ex-GE-25P01-7	0	2019-09-20
BOTTOM LAYER DIMENSION / SENSOR PCB	Ex-GE-25P01-8	0	2019-09-20
GROUND PLANE DIMENSION / SENSOR PCB	Ex-GE-25P01-9	0	2019-09-20
POWER PLANE DIMENSION / SENSOR PCB	Ex-GE-25P01-10	0	2019-09-20
DRILL / SENSOR PCB	Ex-GE-25P01-11	0	2019-09-20
TOP LAYER(SILK SCREEN TOP + SOLDER MASK TOP) LAYERS / BLUETOOTH PCB	Ex-GE-25P02-1	0.3	2019-07-19
BOTTOM(SILK SCREEN BOT + SOLDER MASK BOT) LAYERS / BLUETOOTH PCB	Ex-GE-25P02-2	0.3	2019-07-19
GROUND-1 PLANE / BLUETOOTH PCB	Ex-GE-25P02-3	0.3	2019-07-19
GROUND-2 PLANE / BLUETOOTH PCB	Ex-GE-25P02-4	0.3	2019-07-19
GFM-400 MAIN PART LIST	Ex-GE-25B00	1	2019-09-30
GFM-400 SENSOR PART LIST	Ex-GE-25B01	1	2019-08-14
GFM-400 BLUETOOTH PART LIST	Ex-GE-25B02	1	2019-07-24
GENERAL ASSEMBLY	Ex-A19060018	0	2019-07-29
GFM-400-IM(M)-COVER	Ex-A19060019	0	2019-07-29
GFM-400-IM(M)-BODY	Ex-A19060020	0	2019-07-29
GFM-400-IM(M)-LCD BKT	Ex-A19060021	0	2019-07-29
GFM-400-IM(M)-PCB BKT	Ex-A19060022	0	2019-07-29

PR(M)-SUSPENDER CLIP	Ex-A18120012	0	2019-07-29
GFM-400-PR(M)-SHIELDCASE	Ex-A19060023	0	2019-07-29
GFM-400-GA-SHIELDTAPE	Ex-A19060024	0	2019-07-29
GFM-400-RU-SENSOR CAP	Ex-A18120009	0	2019-07-29
GFM-400-MEMBRANE FILTER	Ex-A18120013	0	2019-07-29
GFM-400-MEMBRANE FILTER_B	Ex-A19060025	0	2019-07-29
GFM-400-GA-LCD CHUSION	Ex-A19060026	0	2019-07-29
GFM-400-GA-NDIR CHUSION	Ex-A19060027	0	2019-07-29
GFM-400-GA-LCD PROTECT FILM	Ex-A19060028	0	2019-07-29
GFM-400-GA-LCD BKT Sheet	Ex-A19060029	0	2019-07-29
GFM-400-GA-INSULATION SHEET	Ex-A19060030	0	2019-07-29
GFM-400-DE-LCD WINDOW	Ex-A19060031	0	2019-07-01
GFM-400-LA- CERTIFICATION LABEL	Ex-A19060032	0	2019-07-29
GFM-400-GA-PCB CUSHION	Ex-A19100005	0	2019-11-08
GFM-400_BATTERY(EX COMPONENT)	Ex-A19100004	0	2019-11-08
G-Finder Multi Instruction Manual	GT-07919072501	0.1	2019-07-25

IECEx TEST REPORT
IEC 60079-0
Explosive atmospheres – Part 0: Equipment – General requirements

ExTR Reference Number...............:	KR/KTL/ExTR19.0029/00
ExTR Free Reference Number ......:	PI181060
Compiled by + signature (ExTL) ....:	Choi, Yong-Won
Reviewed by + signature (ExTL)....:	Min, Yeong-Seung
Date of issue ....:	2019.11.19.
Ex Testing Laboratory (ExTL) ....:	KTL(Korea Testing Laboratory)
Address ....:	87, Digital-ro 26-gil, Guro-gu, Seoul, Korea
Applicant's name ....:	GASTRON Co., Ltd.
Address ....:	23, Gunpocheomdansaneop 1-ro, Gunpo-si, Gyeonggi-do, 15881, Korea
Standard...:	IEC 60079-0:2017, Edition 7.0
Test procedure ....:	IECEx System
Test Report Form Number ....:	ExTR60079-0_7B_DS (released 2018-01)
Related Amendments, Corrigenda or ISHs..	N/A

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 Ex Test Report relate only to the item or product tested.

- "(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.

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IEC 60079-0			
Clause	Requirement – Test	Result – Remark	Verdict

1	Scope		
2	Normative references		
3	Terms and definitions		
4	Equipment grouping		
4.1	General	The equipment is for Group IIC application.	Pass
4.2	Group I	The equipment is for Group IIC application.	N/A
4.3	Group II	The equipment is for Group IIC application.	Pass
4.4	Group III	The equipment is for Group IIC application.	N/A
4.5	Equipment for a particular explosive gas atmosphere	The equipment is for Group IIC application.	N/A
5 See also **DS 2015/011A**	Temperatures		
5.1	Environmental influences		
5.1.1	Ambient temperature	The ambient temperature for T4 class is -20 °C ≤ T_a ≤ +50 °C. Instead of applying 'X' marking, the upper information is included in the marking label on the equipment and the manual.	Pass
5.1.2	External source of heating or cooling	The equipment is a hand-held, battery powered device. Thus, there are no external sources of heating or cooling.	N/A

IEC 60079-0			
Clause	Requirement – Test	Result – Remark	Verdict
5.2	Service temperature	The equipment is not intended to be connected to a separate external source of heating or cooling. The maximum surface temperature rise of the non-metallic enclosure and internal PCB bracket of the equipment determined at worst fault conditions is negligible (less than 10 K). The service temperature is regarded as 60 °C at 50 °C ambient. Minimum thermal deformation temperature of the non-metallic enclosure and internal PCB bracket is 80 °C, which is higher than 60 °C. Highest continuous operating temperatures of adhesive materials used for attaching the marking label and the anti-static coating film to the enclosure are 145 °C and 180 °C respectively, which are higher than 60 °C. Thus, the service temperature does not adversely affect the type of protection, intrinsic safety.	Pass

5.3	Maximum surface temperature		
5.3.1	Determination of maximum surface temperature	The equipment is marked as T4.	Pass
5.3.2	Limitation of maximum surface temperature		
5.3.2.1	Group I electrical equipment	The equipment is for Group IIC application.	N/A
5.3.2.2	Group II electrical equipment	The equipment was assessed to satisfy the assigned temperature class T4 (135 °C) at 50 °C ambient. See Cl.5.3.3 for the details.	Pass
5.3.2.3	Group III electrical equipment		
5.3.2.3.1	Maximum surface temperature for EPL Da	The equipment is for Group IIC application.	N/A
5.3.2.3.2	Maximum surface temperature for EPL Db	The equipment is for Group IIC application.	N/A
5.3.2.3.3	Maximum surface temperature determined without a layer of dust for EPL Dc	The equipment is for Group IIC application.	N/A

IEC 60079-0			
Clause	Requirement – Test	Result – Remark	Verdict
5.3.3	Small component temperature for Group I or Group II electrical equipment	All the small components on the boards conform to Table 3 and Table 4. In case of small components having total surface area not less than 20 mm², maximum dissipation power in each component is less than 1.25 W required at T4 and 50 °C ambient as per Table 4 because maximum power supplied from the batteries to the boards after passing through the zener diodes, D1~D2, the internal resistance of the batteries and the current limiting resistors, R1, R2, R4, R5, R7, R8 and R10 on the main board, R8, R13, R20, R23, R25, R40, R43, R44 and R45 on the sensor board, is 0.130 W and maximum dissipation power of each current limiting resistor is 0.374 W. In case of small components having total surface area less than 20 mm², maximum surface temperature of the components does not exceed 275 °C as per Table 3. See Cl. 26.5.1.3 for the details. Therefore, considering the above, the equipment satisfies the assigned temperature class T4 at 50 °C ambient.	Pass
5.3.4	Component temperature of smooth surfaces for Group I or Group II electrical equipment	This clause is not applicable.	N/A

6	Requirements for all electrical equipment

6.1	General	To supplement IEC 60079-0:2017, IEC 60079-11:2011 was applied.	Pass
6.2	Mechanical strength of equipment	This clause is excluded as per Table 1 of IEC 60079-11 because Cl.6.1.2.3 a) of IEC 60079-11 is not applied for the assessment of the equipment.	**N/A**
6.3	Opening times	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
6.4	Circulating currents in enclosures (e.g. of large electric machines)	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
6.5	Gasket retention	This clause is excluded as per Table 1 of IEC 60079-11 because Cl.6.1.2.3 a) of IEC 60079-11 is not applied for the assessment of the equipment.	**N/A**

6.6	Electromagnetic and ultrasonic energy radiating equipment

IEC 60079-0			
Clause	Requirement – Test	Result – Remark	Verdict
6.6.1	General	The equipment contains two-way IR communications. Thus, the IR source, U3, shall be assessed as one of lasers or other non-divergent continuous wave optical sources. See Cl.6.6.4. The equipment also contains five LEDs, D1~D5 on the sensor board. However, the LEDs are used for indicating the operating condition and are excluded from the assessment of this clause as per the exception of the equipment detailed in Cl.1 of IEC 60079-28:2015 because the LEDs are considered to belong to non-array divergent LEDs used for example to show equipment status or backlight function.	Pass
6.6.2	Radio frequency sources	There are no radio frequency sources in the equipment.	N/A
6.6.3	Ultrasonic sources	There are no ultrasonic sources in the equipment.	N/A
6.6.4	Lasers, luminaires, and other non-divergent continuous wave optical sources	The IR source shall satisfy the requirements as per Cl.5.2.2 of IEC 60079-28:2015. The IR source is used for EPL Ga, Group IIC and temperature class T4. The maximum input power of the IR source is limited within 3.2 mW by the internal resistance of the battery and the current limiting resistors, R5 on the main board and R25 on the sensor board, under consideration of fault conditions in accordance with the over-power / energy fault protection criteria according to Cl.5.2.5 of IEC 60079-28:2015. The aforementioned value, 3.2 mW, does not exceed the safe optical radiated power limit, 35 mW, listed in Table 2 of IEC 60079-28:2015. Thus, the equipment conforms to the requirements of IEC 60079-28:2015.	Pass

7	Non-metallic enclosures and non-metallic parts of enclosures

7.1	General		
7.1.1	Applicability	This clause is excluded as per Table 1 of IEC 60079-11 because Cl.6.1.2.3 a) of IEC 60079-11 is not applied for the assessment of the equipment.	**N/A**
7.1.2	Specification of materials		
7.1.2.1	General	This clause is excluded as per Table 1 of IEC 60079-11 because Cl.6.1.2.3 a) of IEC 60079-11 is not applied for the assessment of the equipment.	**N/A**
7.1.2.2	Plastic materials	This clause is excluded as per Table 1 of IEC 60079-11 because Cl.6.1.2.3 a) of IEC 60079-11 is not applied for the assessment of the equipment.	**N/A**
7.1.2.3	Elastomers	This clause is excluded as per Table 1 of IEC 60079-11 because Cl.6.1.2.3 a) of IEC 60079-11 is not applied for the assessment of the equipment.	**N/A**
7.1.2.4	Materials used for cementing	This clause is excluded as per Table 1 of IEC 60079-11 because Cl.6.1.2.3 a) of IEC 60079-11 is not applied for the assessment of the equipment.	**N/A**

IEC 60079-0			
Clause	Requirement – Test	Result – Remark	Verdict

7.2	Thermal endurance		
7.2.1	Tests for thermal endurance	This clause is excluded as per Table 1 of IEC 60079-11 because Cl.6.1.2.3 a) of IEC 60079-11 is not applied for the assessment of the equipment.	**N/A**
7.2.2	Material selection	This clause is excluded as per Table 1 of IEC 60079-11 because Cl.6.1.2.3 a) of IEC 60079-11 is not applied for the assessment of the equipment.	**N/A**
7.2.3	Alternative qualification of elastomeric sealing O-rings	This clause is excluded as per Table 1 of IEC 60079-11 because Cl.6.1.2.3 a) of IEC 60079-11 is not applied for the assessment of the equipment.	**N/A**

7.3	Resistance to ultraviolet light	This clause is excluded as per Table 1 of IEC 60079-11 because Cl.6.1.2.3 a) of IEC 60079-11 is not applied for the assessment of the equipment.	**N/A**

7.4	Electrostatic charges on external non-metallic materials		
7.4.1	Applicability	The equipment has a non-metallic enclosure, which is made of polycarbonate, LUPOY PC 1201-15, and is covered with conductive thermoplastic elastomer alloy, RTP 2099 E X 100781, and an anti-static coating film, JB-SD10008, for ESD protection. A certification label sticker is attached on the surface covered by the conductive elastomer.	Pass

IEC 60079-0			
Clause	Requirement – Test	Result – Remark	Verdict
7.4.2	Avoidance of a build-up of electrostatic charge for Group I or Group II	The surface resistance of the conductive elastomer, RTP 2099 E X 100781, was tested as per Cl.26.13 and measured to be less than 3×10^8 Ω at (30 ± 5) % relative humidity. The surface resistance of the anti-static coating film, JB-SD10008, was tested as per Cl.26.13 and measured to be less than 2×10^7 Ω at (50 ± 5) % relative humidity. According to the construction of the enclosure, there are non-conductive parts made of polycarbonate, LUPOY PC 1301EP-30, which are accessible under normal condition of use, maintenance and cleaning in a hazardous location. The accessible parts are not covered by the conductive elastomer and the anti-static coating film as above. The surface areas of the accessible non-conductive parts exposed and unprotected are limited within the allowable size as per item b) of Cl.7.4.2. The maximum thickness of the certification label sticker as the non-metallic layer is 148 µm from the manufacturer's datasheet, which is limited within the allowable thickness, 0.2 mm, as per item c) of Cl.7.4.2. Thus, the non-metallic enclosure of the equipment is considered as suitable for avoidance of a build-up of electrostatic charge. Additionally, 'X' marking and the following specific condition of use are applied as per item d) of Cl.7.4.2 by provision of the anti-static coating film; "The G-Finder Multi GFM-400 is provided with the anti-static coating film covering over the LCD window to avoid danger of ignition due to electrostatic charge. Periodic inspection of this coating film is required to ensure no degradation, delamination, abrasions or other deformities to this surface. Care must be taken to avoid exposure to excessive heat, harsh chemicals or solvents, sharp edges and abrasive surfaces. Clean only with a damp cloth." The specific condition above was specified in the instruction manual. See the instruction manual.	Pass
7.4.3	Avoidance of a build-up of electrostatic charge for Group III	The equipment is for Group IIC application.	N/A
7.5	Attached external conductive parts	The equipment is portable or personal.	N/A
8	Metallic enclosures and metallic parts of enclosures		

IEC 60079-0			
Clause	Requirement – Test	Result – Remark	Verdict
8.1	Material composition	The drawings in technical documents of this IECEx Test Report Cover and the manufacturer's datasheet specify the material.	Pass
8.2	Group I	The equipment is for Group IIC application.	N/A
8.3	Group II	The suspender clip secured to the back half of the enclosure is made of stainless steel (STS304). STS304 does not contain, by mass, more than the material limits of this clause for EPL Ga. Refer to the material datasheet for the details.	Pass
8.4	Group III	The equipment is for Group IIC application.	N/A
8.5	Copper Alloys	There are no parts of enclosures constructed of copper or copper alloys in the equipment.	N/A
9	Fasteners		
9.1	General	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
9.2	Special fasteners	See Cl.9.1.	**N/A**
9.3	Holes for special fasteners		
9.3.1	Thread engagement	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
9.3.2	Tolerance and clearance	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
9.4	Hexagon socket set screws	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
10	Interlocking devices	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
11	Bushings	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**

IEC 60079-0			
Clause	Requirement – Test	Result – Remark	Verdict
12	(Reserved for future use)		
13 See also **DS 2014/001**	Ex Components		
13.1	General	The equipment is not an EX component.	N/A
13.2	Mounting	See Cl.13.1.	N/A
13.3	Internal mounting	See Cl.13.1.	N/A
13.4	External mounting	See Cl.13.1.	N/A
13.5	Ex Component certificate	See Cl.13.1.	N/A
14	Connection facilities		
14.1	General	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
14.2	Type of protection	See Cl.14.1.	**N/A**
14.3	Creepage and clearance	See Cl.14.1.	**N/A**
15	Connection facilities for earthing or bonding conductors		
15.1	Equipment requiring earthing or bonding		
15.1.1	Internal earthing	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
15.1.2	External bonding	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
15.2	Equipment not requiring earthing	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
15.3	Size of protective earthing conductor connection	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**

IEC 60079-0			
Clause	Requirement – Test	Result – Remark	Verdict
15.4	Size of equipotential bonding conductor connection	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	N/A
15.5	Protection against corrosion	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	N/A
15.6	Secureness of electrical connections	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	N/A
15.7	Internal earth continuity plate	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	N/A
16	Entries into enclosures		
16.1	General	This clause is excluded as per Table 1 of IEC 60079-11 because Cl.6.1.2.3 a) of IEC 60079-11 is not applied for the assessment of the equipment.	N/A
16.2	Identification of entries	See Cl.16.1.	N/A
16.3	Cable glands	See Cl.16.1.	N/A
16.4	Blanking elements	See Cl.16.1.	N/A
16.5	Thread adapters	See Cl.16.1.	N/A
16.6	Temperature at branching point and entry point	See Cl.16.1.	N/A
16.7	Electrostatic charges of cable sheaths	See Cl.16.1.	N/A
17	Supplementary requirements for electric machines		
17.1	General	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	N/A

IEC 60079-0			
Clause	Requirement – Test	Result – Remark	Verdict
17.2	Ventilation		
17.2.1	Ventilation openings	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
17.2.2	Materials for external fans	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
17.2.3	Cooling fans of rotating electric machines	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
17.2.3.1	Fans and fan hoods	See Cl.17.2.3.	**N/A**
17.2.3.2	Construction and mounting of the ventilating systems	See Cl.17.2.3.	**N/A**
17.2.3.3	Clearances for the ventilating system	See Cl.17.2.3.	**N/A**
17.2.4	Auxiliary motor cooling fans	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
17.2.5	Room ventilating fans		
17.2.5.1	Applicability	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
17.2.5.2	General	See Cl.17.2.5.1.	**N/A**
17.2.5.3	Fan and fan hoods	See Cl.17.2.5.1.	**N/A**
17.2.5.4	Construction and mounting	See Cl.17.2.5.1.	**N/A**
17.2.5.5	Clearances for rotating parts	See Cl.17.2.5.1.	**N/A**
17.3	Bearings	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
18	Supplementary requirements for switchgear		
18.1	Flammable dielectric	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
18.2	Disconnectors	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
18.3	Group I – Provisions for locking	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**

IEC 60079-0			
Clause	Requirement – Test	Result – Remark	Verdict
18.4	Doors and covers	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
19	Reserved for future use		
20	Supplementary requirements for external plugs, socket outlets and connectors for field wiring connection		
20.1	General	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
20.2	Explosive gas atmospheres	See Cl.20.1.	**N/A**
20.3	Explosive dust atmospheres	See Cl.20.1.	**N/A**
20.4	Energized plugs	See Cl.20.1.	**N/A**
21	Supplementary requirements for luminaires		
21.1	General	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
21.2	Covers for luminaires of EPL Mb, EPL Gb, or EPL Db	See Cl.21.1.	**N/A**
21.3	Covers for luminaires of EPL Gc or EPL Dc	See Cl.21.1.	**N/A**
21.4	Sodium lamps	See Cl.21.1.	**N/A**
22	Supplementary requirements for caplights and handlights		
22.1	Group I caplights	The equipment is not a caplight nor a handlight.	N/A
22.2	Group II and Group III caplights and handlights	See Cl.22.1.	N/A
23	Equipment incorporating cells and batteries		

IEC 60079-0			
Clause	Requirement – Test	Result – Remark	Verdict
23.1	General	The equipment is battery operated.	Pass
23.2	Interconnection of cells to form batteries	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
23.3	Cell types	The batteries used in the equipment are Tekcell, type SB-AA11 manufactured by VITZRO CELL The battery consists of a Lithium/Thionyl chloride(Li/$SOCl_2$) cell. Table 13 (Primary Cells) includes Lithium/Thionyl chloride(Li/$SOCl_2$). According to the requirements of DS 2019/002, the battery was confirmed to comply with the requirements of UL 1642 by 3rd-party certification of the lithium battery from an IECEE NCB, UL.	Pass
23.4	Cells in a battery	The battery contains a single cell.	Pass
23.5	Ratings of batteries	The battery is used within the allowable limits defined by the battery manufacturer.	Pass
23.6	Interchangeability	Primary and secondary cells or batteries are not used inside the same equipment enclosure. The battery is not intended to be replaced by the user.	N/A
23.7	Charging of primary batteries	The equipment contains only two same primary batteries connected in parallel and has no other power sources nor connections for external circuits.	Pass
23.8	Leakage	Leakage of electrolyte did not occur during the test per Cl.10.5.2 of IEC 60079-11. See Cl.10.5.2 in ExTR of IEC 60079-11.	Pass
23.9	Connections	The battery is not intended to be replaced by the user. Making electrical connection to the batteries need not be considered by the user.	N/A
23.10	Orientation	The battery is not intended to be replaced by the user. The indication of battery orientation is not necessary.	N/A
23.11	Replacement of cells or batteries	The battery is not intended to be replaced by the user.	N/A

IEC 60079-0			
Clause	Requirement – Test	Result – Remark	Verdict
23.12	Replaceable battery pack	The battery is not intended to be replaced by the user.	N/A

24	Documentation	Documents submitted by the manufacturer provide details of the explosion safety aspects of the equipment necessary to determine compliance with Ex standards. See technical documents of the IECEx Test Report Cover.	Pass

25	Compliance of prototype or sample with documents	Compliance of prototype or sample with documents is secured.	Pass

26	Type tests

26.1	General	All the necessary tests were carried out.	Pass

26.2	Test configuration	Most unfavourable configurations were considered.	Pass

26.3	Tests in explosive test mixtures	All test mixtures have above 95% purity.	Pass

26.4	Tests of enclosures		
26.4.1	Order of tests		
26.4.1.1	Metallic enclosures, metallic parts of enclosures and glass parts of enclosures	This clause is excluded as per Table 1 of IEC 60079-11 because Cl.6.1.2.3 a) of IEC 60079-11 is not applied for the assessment of the equipment.	**N/A**
26.4.1.2	Non-metallic enclosures or non-metallic parts of enclosures		
26.4.1.2.1	General	This clause is excluded as per Table 1 of IEC 60079-11 because Cl.6.1.2.3 a) of IEC 60079-11 is not applied for the assessment of the equipment.	**N/A**
26.4.1.2.2	Group I equipment	See Cl.26.4.1.2.1.	**N/A**
26.4.1.2.3	Group II and Group III equipment	See Cl.26.4.1.2.1.	**N/A**
26.4.2	Resistance to impact	This clause is excluded as per Table 1 of IEC 60079-11 because Cl.6.1.2.3 a) of IEC 60079-11 is not applied for the assessment of the equipment.	**N/A**
26.4.3	Drop test	The equipment was dropped four times from a height of 1 m onto a horizontal concrete surface while at 5 K below the minimum ambient temperature of -20 °C.	Pass
26.4.4	Acceptance criteria	There was no ejection or separation of any component from the equipment and no damage to invalidate intrinsic safety of the equipment.	Pass
26.4.5 See also **DS 2012/003**	Degree of protection (IP) by enclosures		

IEC 60079-0			
Clause	Requirement – Test	Result – Remark	Verdict
26.4.5.1	Test procedure	IP Test was conducted according to IEC 60529.	Pass
26.4.5.2	Acceptance criteria	The equipment is considered to provide a degree of protection of at least IP20 by examination of drawings and test of a sample unit. (IP20 is required as minimum according to Cl.6.1.2.2 of IEC 60079-11).	Pass

26.5	Thermal tests		
26.5.1	Temperature measurement		
26.5.1.1	General	Surface temperature for the purpose of intrinsic safety was determined by evaluation or was measured by testing as this clause.	Pass
26.5.1.2	Service temperature	The maximum surface temperature rise of the non-metallic enclosures of the equipment determined at worst fault conditions is negligible (less than 10 K). The service temperature is regarded as 60 °C at 50 °C ambient.	Pass
26.5.1.3	Maximum surface temperature	In case of small components having total surface area less than 20 mm^2, maximum surface temperature of the components does not exceed 275 °C required at T4 and 50 °C ambient as per Table 3. In other words, their thermal coefficients, Rthj-a (Junction to Ambient) or Rthc-a (Case to Ambient), shall be less than (275 °C - 50 °C) / 0.130 W = 1 730 °C/W. Temperature tests were conducted on some small components to determine their thermal coefficients which are not obtained from the manufacturers. The results were determined as follows. 1) R31(100 Ω, 1/10 W) on the sensor board at 0.130 W : 41.3 °C at 24.7 °C ambient → Rthc-a = (41.3 °C – 24.7 °C) / 0.130 W = 127 °C/W. 2) R43(51 Ω, 1/4 W) on the sensor board at 0.130 W : 38.7 °C at 24.7 °C ambient → Rthc-a = (38.7 °C – 24.7 °C) / 0.132 W = 106 °C/W. The components smaller than 20 mm^2 were verified from the manufacturers' datasheets and the testing results above as having their thermal coefficients less than 1 730 °C/W. Therefore, considering the above, the equipment satisfies the assigned temperature class T4 at 50 °C ambient. Refer to Appendix A.3.1 and B.1 in ExTR of IEC 60079-11 for details.	Pass
26.5.2	Thermal shock test	This clause is excluded as per Table 1 of IEC 60079-11 because Cl.6.1.2.3 a) of IEC 60079-11 is not applied for the assessment of the equipment.	**N/A**
26.5.3	Small component ignition test (Group I and Group II)		
26.5.3.1	General	This clause is excluded because the small component ignition test is not necessary.	N/A
26.5.3.2	Procedure	See Cl.26.5.3.1.	N/A

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Clause	Requirement – Test	Result – Remark	Verdict
26.5.3.3	Acceptance criteria	See Cl.26.5.3.1.	N/A

26.6	Torque test for bushings		
26.6.1	Test procedure	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
26.6.2	Acceptance criteria	See Cl.26.6.1.	**N/A**

26.7	Non-metallic enclosures or non-metallic parts of enclosures		
26.7.1	General	This clause is excluded as per Table 1 of IEC 60079-11 because Cl.6.1.2.3 a) of IEC 60079-11 is not applied for the assessment of the equipment.	**N/A**
26.7.2	Test temperatures	See Cl.26.7.1.	**N/A**

26.8	Thermal endurance to heat	This clause is excluded as per Table 1 of IEC 60079-11 because Cl.6.1.2.3 a) of IEC 60079-11 is not applied for the assessment of the equipment.	**N/A**

26.9	Thermal endurance to cold	This clause is excluded as per Table 1 of IEC 60079-11 because Cl.6.1.2.3 a) of IEC 60079-11 is not applied for the assessment of the equipment.	**N/A**

26.10	Resistance to UV light		
26.10.1	General	This clause is excluded as per Table 1 of IEC 60079-11 because Cl.6.1.2.3 a) of IEC 60079-11 is not applied for the assessment of the equipment.	**N/A**
26.10.2	Light exposure	See Cl.26.10.1.	**N/A**
26.10.3	Acceptance criteria	See Cl.26.10.1.	**N/A**

26.11	Resistance to chemical agents for Group I equipment	This clause is excluded as per Table 1 of IEC 60079-11 because Cl.6.1.2.3 a) of IEC 60079-11 is not applied for the assessment of the equipment.	**N/A**

26.12	Earth continuity	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**

26.13	Surface resistance test of parts of enclosures of non-metallic materials	The surface resistance of the conductive elastomer, RTP 2099 E X 100781, was tested as per Cl.26.13 and measured to be less than $3 \times 10^8\ \Omega$ at (30 ± 5) % relative humidity. The surface resistance of the anti-static coating film, JB-SD10008, was tested as per Cl.26.13 and measured to be less than $2 \times 10^7\ \Omega$ at (50 ± 5) % relative humidity.	Pass

IEC 60079-0			
Clause	Requirement – Test	Result – Remark	Verdict
26.14	Measurement of capacitance		
26.14.1	General	See Cl.7.5.	N/A
26.14.2	Test procedure	See Cl.26.14.1.	N/A
26.15	Verification of ratings of ventilating fans	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
26.16	Alternative qualification of elastomeric sealing O-rings	This clause is excluded as per Table 1 of IEC 60079-11 because Cl.6.1.2.3 a) of IEC 60079-11 is not applied for the assessment of the equipment.	**N/A**
26.17	Transferred charge test		
26.17.1	Test equipment	See Cl.7.4.2.	N/A
26.17.2	Test sample	See Cl.7.4.2.	N/A
26.17.3	Test procedure	See Cl.7.4.2.	N/A
27	Routine tests	Routine tests are not considered necessary.	N/A
28	Manufacturer's responsibility		
28.1	Conformity with the documentation	Manufacturer's responsibility	Pass
28.2	Certificate	See Cl.28.1.	Pass
28.3	Responsibility for marking	By marking the product in accordance with Cl.29, the manufacturer is attesting on his own responsibility that the equipment has been constructed in accordance with the applicable requirements of the relevant standards in safety matters. Routine verifications per Cl.28.1 have been successfully completed and the product complies with the documentation.	Pass
29	Marking		
29.1	Applicability	Applicability of Ex marking is secured in the production process.	Pass
29.2	Location	See the label drawing (Ex-A19060032). The marking is located on the enclosure in a clear way.	Pass

IEC 60079-0			
Clause	Requirement – Test	Result – Remark	Verdict
29.3	General	See the label drawing (Ex-A19060032). The marking includes the following: 1) the name of the manufacturer or his registered trade mark; 2) the manufacturer's type identification; 3) a serial number; 4) the name or mark of the certificate issuer and the certificate reference; 5) the symbol "X" placed after the certificate reference; 6) the specific Ex marking, See Cl.29.4; 7) any additional marking.	Pass
29.4	Ex marking for explosive gas atmospheres	Ex ia IIC T4 Ga	Pass
29.5	Ex marking for explosive dust atmospheres	The equipment is for Group IIC application.	N/A
29.6	Combined types (or levels) of protection	This clause is not applicable.	N/A
29.7	Multiple types of protection	This clause is not applicable.	N/A
29.8	Ga equipment using two independent Gb types (or levels) of protection	This clause is not applicable.	N/A
29.9	Boundary wall	This clause is not applicable.	N/A
29.10	Ex Components	The equipment is not an EX component.	N/A
29.11	Small Ex Equipment and small Ex Components	The equipment is not a small equipment.	N/A
29.12	Extremely small Ex Equipment and extremely small Ex Components	See Cl.29.11.	N/A
29.13	Warning markings	The equipment does not need any warning marking.	N/A
29.14	Cells and batteries	The battery is not intended to be replaced by the user.	N/A

IEC 60079-0			
Clause	Requirement – Test	Result – Remark	Verdict
29.15	Electric machines operated with a converter	The equipment is not an electric machine operated with a converter.	N/A
29.16	Examples of marking	See Cl.29.3.	Pass
30	Instructions		
30.1	General	Instruction manual complies with requirements of the standard.	Pass
30.2	Cells and batteries	The battery is not intended to be replaced by the user.	N/A
30.3	Electric machines	The equipment is not an electric machine.	N/A
30.4	Ventilating fans	The equipment is not a ventilating fan.	N/A
30.5	Cable glands	The equipment is not a cable gland.	N/A
Annex A (Normative)	Supplementary requirements for cable glands		
A.1	General	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
A.2	Constructional requirements		
A.2.1	Cable sealing	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
A.2.2	Filling compounds	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
A.2.3	Clamping		
A.2.3.1	General	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
A.2.3.2	Group II or III cable glands	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
A.2.4	Lead-in of cable		
A.2.4.1	Sharp edges	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
A.2.4.2	Point of entry	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**

IEC 60079-0			
Clause	Requirement – Test	Result – Remark	Verdict
A.2.5	Released by a tool	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
A.2.6	Fixing	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
A.2.7	Degree of protection	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
A.3	Type tests		
A.3.1	Tests of clamping of non-armoured and braided cables		
A.3.1.1	Cable glands with clamping by the sealing ring	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
A.3.1.2	Cable glands with clamping by filling compound	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
A.3.1.3	Cable glands with clamping by means of a clamping device	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
A.3.1.4	Clamping test	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
A.3.1.5	Mechanical strength	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
A.3.2	Tests of clamping of armoured cables		
A.3.2.1	Tests of clamping where the armourings are clamped by a device integral to the gland		
A.3.2.1.1	General	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
A.3.2.1.2	Clamping test	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
A.3.2.1.3	Mechanical strength	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
A.3.2.2	Tests of clamping where the armourings are not clamped by a device integral to the gland	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
A.3.3	Type test for resistance to impact	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
A.3.4	Test for degree of protection (IP) of cable glands	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
A.4	Marking		
A.4.1	Marking of cable glands	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**

IEC 60079-0			
Clause	Requirement – Test	Result – Remark	Verdict
A.4.2	Identification of cable-sealing rings	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**
A.5	Instructions	This clause is excluded as per Table 1 of IEC 60079-11 because the equipment is an intrinsically safe apparatus.	**N/A**

Annex B (Normative)	Requirements for Ex Components		
Table B.1	Applicability of clauses to Ex Components	The equipment is not an EX component.	N/A

Annex C (Informative)	Example of rig for resistance to impact test

Annex D (Informative)	Electric machines connected to converters

Annex E (Informative)	Temperature evaluation of electric machines

Annex F (Informative)	Guideline flowchart for tests of non-metallic enclosures or non-metallic parts of enclosures (26.4)

Annex G (Informative)	Guidance flowchart for tests of cable glands

Annex H (Informative)	Shaft voltages resulting in motor bearing or shaft brush sparking Discharge energy calculation

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

N/A

IECEx TEST REPORT
IEC 60079-11
Explosive atmospheres – Part 11: Equipment protection by intrinsic safety "i"

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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 Ex Test Report relate only to the item or product tested.

- "(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.

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IEC 60079-11			
Clause	Requirement – Test	Result – Remark	Verdict
1	Scope		
2 See also **DS 2010/006A**	Normative references		
3	Terms and definitions		
4	Grouping and classification of intrinsically safe apparatus and associated apparatus	Gas group : IIC Temperature class : T4	Pass
5	Levels of protection and ignition compliance requirements of electrical apparatus		
5.1	General	Level of protection is "ia".	Pass
5.2	Level of protection "ia"	Refer to Appendix A.1 for details.	Pass
5.3	Level of protection "ib"	Refer to Appendix A.1 for details.	N/A
5.4	Level of protection "ic"	Refer to Appendix A.1 for details.	N/A
5.5	Spark ignition compliance	Refer to Appendix A.2 for details.	Pass
5.6	Thermal ignition compliance		
5.6.1	General	Refer to Appendix A.3 for details.	Pass
5.6.2 See also **DS 2015/016 DS 2015/009**	Temperature for small components for Group I and Group II	Refer to Appendix A.3.1 for details.	Pass
5.6.3	Wiring within intrinsically safe apparatus for Group I and Group II	Refer to Appendix A.3.2 for details.	Pass
5.6.4	Tracks on printed circuit boards for Group I and Group II	Refer to Appendix A.3.3 for details.	Pass
5.6.5	Intrinsically safe apparatus and component temperature for Group III	The equipment is for Group IIC application.	N/A

IEC 60079-11			
Clause	Requirement – Test	Result – Remark	Verdict
5.7	Simple apparatus	The equipment is not considered as a simple apparatus.	N/A

6	Apparatus construction

6.1	Enclosures		
6.1.1	General	An enclosure is necessary for protection against contact with live parts and ingress of solid foreign bodies and liquids. The enclosure consists of 3 parts as the non-metallic front half (cover) and back half of the enclosure (body) and the metallic suspender clip. The non-metallic parts of the enclosure are made through double-shot injection moulding with polycarbonate, LUPOY PC 1201-15, manufactured from LG chem and conductive thermoplastic elastomer alloy, RTP 2099 E X 100781, manufactured from RTP. The parts of the enclosure are secured by screws. The metallic suspender clip is made of STS304. The clip is secured to the back half of the enclosure by a screw. The LCD window of the front half of the enclosure is fully covered with an anti-static coating film, JB-SD10008, manufactured from DAEHYUNSTJB. The designation of the surfaces which form the boundary of the enclosure is specified in technical documents of this IECEx Test Report Cover.	Pass
6.1.2	Enclosures for Group I or Group II apparatus		
6.1.2.1	General	The enclosure provides a degree of at least IP20 as the equipment relying on the separation requirements of Table 5. See Cl.26.4.5 in ExTR of IEC 60079-0.	Pass
6.1.2.2	Apparatus complying with Table 5	See Cl.6.1.2.1.	Pass
6.1.2.3	Apparatus complying with Annex F	See Cl.6.1.2.1.	N/A
6.1.3	Enclosures for Group III apparatus	The equipment is for Group IIC application.	N/A

6.2	Facilities for connection of external circuits		
6.2.1	Terminals	There are no terminals for external connections in the equipment.	N/A
6.2.2	Plugs and sockets	There are no plugs and sockets for external connections in the equipment.	N/A

IEC 60079-11			
Clause	Requirement – Test	Result – Remark	Verdict
6.2.3	Determination of maximum external inductance to resistance ratio (*Lo/Ro*) for resistance limited power source	The equipment is not a resistance limited power source. So, the L_o/R_o cannot be determined.	N/A
6.2.4	Permanently connected cable	The equipment is not supplied with permanently connected cables.	N/A
6.2.5	Requirements for connections and accessories for IS apparatus when located in the non-hazardous area	The equipment is not provided with connections and accessories that are restricted to use in a non-hazardous area.	N/A

6.3	Separation distances		
6.3.1	General	Annex F is not applied for the equipment.	Pass
6.3.2	Separation of conductive parts (continues in the next page)	Intrinsic safety depends on separation of conductive parts between circuits of the following blocks, between the infallible components/ assemblies and the surrounding circuits, and across the current limiting devices. Thus, the requirements of this clause were considered against the aforementioned separation. The circuits on the boards were classified into source power block (battery), block-A (Buzzer), block-B(Motor, LED), block-C(CPU, LCD, Electrochemical Sensor, IRDA and etc) and block-D(NDIR Sensor) according to the applied voltage and current levels. The voltage and current levels applied in each block were determined after the application of faults, as provided in Cl.5.2, except the segregation between the following blocks and the effect of the electrochemical cells for the detection of gases. **For power source block** U_{max} = 3.9 V (from a maximum open circuit voltage of one Lithium/Thionyl chloride (Li/$SOCl_2$) cell in the battery), U_n = 3.6 V (from a nominal voltage of one Lithium/Thionyl chloride (Li/$SOCl_2$) cell in the battery), I_{max} = U_{max} / (internal resistance of the batteries in parallel + R2||R5||R10 on the main board) = 3.9 V / (5.68 Ω + 7.26 Ω) = 0.30 A; **For block-A** U_{max} = 3.9 V × 3 = 11.7 V (from U3 with 3X charge pump in block-A), U_n = 3.6 V (from power source block), I_{max} = U_{max} from power source block / (internal resistance of the batteries in parallel + R2||(R1 + R10||(R5 + R4||R7||R8 on the main board ||R25 ||R8||R13||R20||R23||R40 on the sensor board))) = 3.9 V / 27.0 Ω = 0.144 A;	Pass

IEC 60079-11			
Clause	Requirement – Test	Result – Remark	Verdict
6.3.2	Separation of conductive parts (continues from the previous page)	**For block-B** U_{max} = 4.1 V (from D1 and D2 between block-A and block-C), U_n = 3.6 V (from power source block), I_{max} = U_{max} from power source block / (internal resistance of the batteries in parallel + R5) + U_{max} from D1 and D2 / (R4||R7||R8 on the main board ||R25||R8||R13||R20||R23||R40 on the sensor board) = 3.9 V / 27.46 Ω + 4.1 V / 241.44 Ω = 0.159 A; **For block-C** U_{max} = 4.1 V (from D1 and D2 between block-A and block-C), U_n = 3.6 V (from power source block), I_{max} = U_{max} from power source block / (internal resistance of the batteries in parallel + R10||(R5 + R4||R7||R8 on the main board ||R25||R8||R13 ||R20||R23||R40 on the sensor board)) + U_{max} from D1 and D2 / R1 on the main board = 3.9 V / (5.68 Ω + 20.12 Ω) + 4.1 V / (1 KΩ × 0.99) = 0.155 A; **For block-D** U_{max} = 4.1 V (from D1 and D2 between block-A and block-C), U_n = 3.6 V (from power source block), I_{max} = U_{max} / (R1||R10||(R5 + R4||R7||R8 on the main board ||R25||R8||R13||R20||R23||R40 on the sensor board) + R43||R44||R45 on the sensor board) = 4.1 V / ((19.91 Ω + 27.57 Ω) × 0.99) = 0.087 A; According to classification of the above blocks, the 10 V and 30 V lines in Table 5 were used to assess separation distances of conductive parts on the circuit board. The separation distances of conductive parts on the board, except the block-A including the 3X charge pump circuit for voltage increase, were assessed using 3.9 V or 4.1 V (10 V line). The separation distances of conductive parts in the block-A and between the block-A and the other blocks on the board were assessed using 11.7 V (30 V line). See the block diagram (Ex-GE-25S00) and the related circuit drawings for identification of the aforementioned blocks in detail. Manufacturing tolerances do not reduce the distances specified in the PCB layout drawings by more than 10 % or 1 mm, whichever is smaller. A PCB bracket including a battery container and a insulation sheet between the batteries and the main board are used for assembling and fixing internal parts each other, and considered as non-metallic insulating partitions.	Pass

IEC 60079-11			
Clause	Requirement – Test	Result – Remark	Verdict
6.3.2	Separation of conductive parts (continues from the previous page)	The non-metallic insulating partitions above have a thickness of at least 0.9 mm and appropriate CTI in accordance with Table 5 as the PCB bracket covering a part of the block-A using 11.7 V has the CTI of 100 or greater. The other requirements of this clause regarding the fault mode were applied when considering the application of faults, as provided in Cl.5.2, for the assessment of safety critical parts on which intrinsic safety depends.	Pass
6.3.2.1	Distances according to Table 5	The application of faults was considered using Table 5 according to the requirements of this clause for "ia" protection.	Pass
6.3.2.2	Distances according to Annex F	Annex F is not applied for the equipment.	N/A
6.3.3	Voltage between conductive parts	See Cl.6.3.2.	Pass
6.3.4	Clearance	The minimum clearance of critical separations between conductive parts assessed with 10 V conforms to at least 1.5 mm. The critical separations are applied to components and tracks except ground tracks on both sides of the circuit boards as follows: between two blocks except the block-A; between the current limiting resistors (R1, R2, R4, R5, R7, R8 and R10 on the main board, R8, R13, R20, R23, R25, R40, R43, R44 and R45 on the sensor board) and the surrounding parts; across the current limiting resistors. The minimum clearance of critical separations between conductive parts assessed with 30 V conforms to at least 2.0 mm. The critical separations are applied to components and tracks except ground tracks on both sides of the board as follows: between the block-A and the other blocks; between the assembly of the zener diodes (D1 and D2) and the surrounding parts. Thus, all the critical separations mentioned as above were considered as infallible separations. Intrinsic safety does not depend on all the other separation distances within each block except the safety components above, which were considered as non-countable short-circuit faults.	Pass
6.3.5	Separation distances through casting compound	Casting compound is not used.	N/A

IEC 60079-11			
Clause	Requirement – Test	Result – Remark	Verdict
6.3.6	Separation distances through solid insulation	The minimum distance of critical separations through solid insulation between conductive parts assessed with 10 V or 30 V conforms to at least 0.5 mm. The critical separations are applied to a battery pack containing two batteries connected in parallel and components/tracks except ground tracks on four layers of the circuit boards each, which were identically verified to the spaces specified in Cl.6.3.4. Thus, all the separation distances through solid insulation as above were considered as infallible separations. Intrinsic safety does not depend on all the other separation distances through solid insulation within each block, which were considered as non-countable short-circuit faults.	Pass
6.3.7	Composite separations	No composite separations are considered for the equipment.	N/A
6.3.8	Creepage distance	The minimum creepage distance of critical separations between conductive parts assessed with 10 V conforms to at least 1.5 mm. The critical separations are applied to components and tracks except ground tracks on both sides of the circuit boards as follows: between two blocks except the block-A; between the current limiting resistors (R1, R2, R4, R5, R7, R8 and R10 on the main board, R8, R13, R20, R23, R25, R40, R43, R44 and R45 on the sensor board) and the surrounding parts; across the current limiting resistors. The minimum creepage distance of critical separations between conductive parts assessed with 30 V conforms to at least 2.0 mm. The critical separations are applied to components and tracks except ground tracks on both sides of the board as follows: between the block-A and the other blocks; between the assembly of the zener diodes (D1 and D2) and the surrounding parts. Thus, all the critical separations mentioned as above were considered as infallible separations. Intrinsic safety does not depend on all the other separation distances within each block except the safety components above, which were considered as non-countable short-circuit faults.	Pass
6.3.9	Distance under coating	The part around J1 on bottom side of the sensor board is coated at least once by brushing. The coating material is PAS-7800 and is specified on the relevant PCB drawing (Ex-GE-25P01-3). The minimum distance under coating of conductive parts between the block-B and the block-C assessed with 10 V conforms to at least 0.5 mm, which was considered as an infallible separation.	Pass

IEC 60079-11			
Clause	Requirement – Test	Result – Remark	Verdict
6.3.10	Requirements for assembled printed circuit boards	There are no additional requirements.	N/A
6.3.11	Separation by earthed screens	Earthed screen is not used.	N/A
6.3.12	Internal wiring	Internal wiring is used for connection between the battery pack containing two batteries connected in parallel and the main board. The separations of conductors are determined by the radial thicknesses of extruded insulation on the wires. It conforms to at least 0.5 mm from the 30 V line in Table 5. All the separations of conductors through extruded insulation on the wires were considered as infallible separations.	Pass
6.3.13	Dielectric strength requirement	The equipment is a hand-held, battery powered device and does not require dielectric strength tests.	N/A
6.3.14	Relays	The equipment does not contain any relays.	N/A

6.4	Protection against polarity reversal	Polarity reversal is not possible since the batteries in parallel are connected to the circuit board at the manufacturer's facility and are not intended to be replaced by the user. Thus, protection against polarity reversal is not required.	N/A

6.5	Earth conductors, connections and terminals	Earth conductors, connections and terminals are not required to maintain intrinsic safety.	N/A

6.6	Encapsulation		
6.6.1	General	The equipment has no encapsulation.	N/A
6.6.2	Encapsulation used for the exclusion of explosive atmospheres	See Cl.6.6.1.	N/A

7	Components on which intrinsic safety depends

IEC 60079-11			
Clause	Requirement – Test	Result – Remark	Verdict
7.1 See also **DS 2004/003**	Rating of components	Safety components on which intrinsic safety depends are as follows: 1) Zener diodes D1 and D2 to prevent 11.7 V level of the block-A, made by the 3X charge pump circuit for voltage increase, from being introduced elsewhere on the circuit boards except the block-A and ensure that 4.1 V level from the block-A is applied to all the other blocks; 2) Resistors, R1, R2, R4, R5, R7, R8 and R10 on the main board, R8, R13, R20, R23, R25, R40, R43, R44 and R45 on the sensor board, to limit currents and powers supplied to circuits in the blocks and segregate each block from being adversely affected by capacitors and inductors in the other blocks; The zener diodes and the resistors do not operate at more than 2/3 of their maximum ratings. Refer to Appendix A.4 for details.	Pass

7.2	Connectors for internal connections, plug-in cards and components	The equipment contains five internal connections on the circuit boards for the sensor assemblies (two electrochemical sensors and one NDIR sensor), the LCD and the vibration motor, four pairs of internal plugs and sockets to connect between the main board and the sensor board, and one internal connector to connect from the battery pack to the main board. By structural features of internal connections above, all the connections within the equipment are conducted only in a designated way so that incorrect connection or interchangeability with other connector is not possible. The failure to open circuits of the connections does not affect intrinsic safety adversely.	Pass

7.3	Fuses	The equipment does not contain any fuses.	N/A

7.4	Primary and secondary cells and batteries

IEC 60079-11			
Clause	Requirement – Test	Result – Remark	Verdict
7.4.1	General	The equipment is powered by two Lithium/ Thionyl Chloride (Li/$SOCl_2$) batteries in parallel (Tekcell, type SB-AA11 manufactured by VITZRO CELL, IEC 60086-1 type E). The batteries in parallel are connected to the circuit board at the manufacturer's facility and are not intended to be replaced by the user. According to the requirements of DS 2019/002, the battery was confirmed to comply with the requirements of UL 1642 by 3rd-party certification of the lithium battery from an IECEE NCB, UL. Thus, the battery is considered as being safe against explosion risk of some lithium type batteries. The battery is also used within its condition of acceptability and the manufacturer's instruction. Therefore, the equipment need not be marked with a warning marking as specified in item a) of Table 11.	Pass
7.4.2 See also **DS2010/003**	Battery construction	The battery was tested for spark ignition and temperature rise under short circuit condition as per Cl.10.5.3. See Cl.10.5.3. The battery does not require addition of electrolyte, and has a sealed metallic enclosure.	Pass
7.4.3	Electrolyte leakage and ventilation	Ten samples of the Tekcell, type SB-AA11 battery were tested in accordance with Cl.10.5.2, with acceptable results. There was no spillage of electrolyte. See Cl.10.5.2.	Pass
7.4.4	Cell voltages	The cell type used in the equipment is Lithium/Thionyl Chloride(Li/$SOCl_2$). According to the table 13 of IEC 60079-0, a maximum open-circuit (peak) voltage is 3.9 V and a nominal voltage is 3.6 V (for IEC 60086-1 type E cell).	Pass
7.4.5	Internal resistance of cell or battery	The internal resistance of the battery pack containing two batteries connected in parallel was determined in accordance with Cl.10.5.3 as 5.68 Ω. See Cl.10.5.3.	Pass
7.4.6	Batteries in equipment protected by other types of protection	The equipment is not protected by flameproof (or other technique).	N/A
7.4.7	Batteries used and replaced in explosive atmospheres	The batteries in parallel are connected to the circuit board at the manufacturer's facility and are not intended to be replaced by the user.	N/A

IEC 60079-11			
Clause	Requirement – Test	Result – Remark	Verdict
7.4.8	Batteries used but not replaced in explosive atmospheres	The batteries in parallel are connected to the circuit board at the manufacturer's facility and are not replaced in a hazardous area. The battery does not require current limiting devices to ensure the safety of the battery itself because internal resistance of the battery is big enough. The batteries are housed in the enclosure secured with screws, and the batteries are installed without reducing the intrinsic safety of the equipment by the mechanical shape of the enclosure and the battery compartment, and the structural features of the battery pack. The drop test in accordance with Cl.26.4.3 of IEC 60079-0 did not result in the ejection or separation of the battery pack from the equipment in such a way as to invalidate intrinsic safety. Therefore, the equipment need not be marked with a warning marking as specified in item b) or d) of Table 11.	Pass
7.4.9	External contacts for charging batteries	The equipment contains primary batteries and does not contain any external contacts for charging batteries.	N/A

7.5 See also **DS 2015/007**	Semiconductors		
7.5.1	Transient effects	The equipment is battery powered and intrinsically safe. Transients effects generated within the intrinsically safe equipment were ignored.	N/A
7.5.2	Shunt voltage limiters	For "ia" protection, the zener diodes, D1 and D2, are rated to withstand at least 1.5 times the maximum dissipation power in the zener mode and at least 1.5 times the maximum possible short-circuit current in the forward direction. Refer to Appendix A.4.2 for details.	Pass
7.5.3	Series current limiters	The equipment does not contain any series current limiters using semiconductors.	N/A

7.6 See also **DS 2016/002** **DS2012/009**	Failure of components, connections and separations	Failure of components, connections and separation distances were assessed in this report as being not capable of causing an ignition in a hazardous area.	Pass

IEC 60079-11			
Clause	Requirement – Test	Result – Remark	Verdict
7.7	Piezo-electric devices	The equipment contains a piezo-electric buzzer and was tested in accordance with Cl.10.7. The piezo-electric buzzer is part no. CBE1440BP-L, manufactured by Daeyoung Electric. The maximum energy stored by the capacitance of the buzzer at the maximum measured voltage does not exceed 50 μJ for group IIC apparatus. See Cl.10.7 for details.	Pass
7.8	Electrochemical cells for the detection of gases	The equipment contains two electrochemical sensors for the detection of oxygen and toxic gases. Sensor types are shown on part list (Ex-GE-25B01). According to manufacturer's specifications, All the electrochemical sensors do not generate more than 1.3 V and 1.5 A at worst fault condition by two sensors connected in parallel. They were considered for their addition to voltages and currents which may affect spark ignition assessment and testing as per Cl.10.1. See Cl.10.1.	Pass
8	Infallible components, infallible assemblies of components and infallible connections on which intrinsic safety depends		
8.1	Level of Protection “ic”	Level of protection for the equipment is “ia”.	N/A
8.2	Mains transformers		
8.2.1	General	The equipment does not contain any transformers.	N/A
8.2.2	Protective measures	See Cl.8.2.1.	N/A
8.2.3	Transformer construction	See Cl.8.2.1.	N/A
8.2.4	Transformer type tests	See Cl.8.2.1.	N/A
8.2.5	Routine test of mains transformers	See Cl.8.2.1.	N/A
8.3	Transformers other than mains transformers	The equipment does not contain any transformers.	N/A
8.4	Infallible windings		
8.4.1	Damping windings	The equipment does not contain any Infallible damping windings.	N/A
8.4.2	Inductors made by insulated conductors	The equipment does not contain any Infallible Inductors made by insulated conductors.	N/A

IEC 60079-11			
Clause	Requirement – Test	Result – Remark	Verdict
8.5	Current-limiting resistors	Resistors, R1, R2, R4, R5, R7, R8 and R10 on the main board, R8, R13, R20, R23, R25, R40, R43, R44 and R45 on the sensor board are used as the current-limiting resistors. All the aforementioned resistors are film type. The resistors are rated to withstand at least 1.5 times the maximum voltage and to dissipate at least 1.5 times the maximum power after the application of faults, as provided in Cl.5.2. The resistors are not invalidated after the application of faults as well. Refer to Appendix A.4.1 for details.	Pass

8.6 See also DS 2003/003	Capacitors		
8.6.1	Blocking capacitors	The equipment does not contain any blocking capacitors.	N/A
8.6.2	Filter capacitors	The equipment does not contain any filter capacitors.	N/A

8.7	Shunt safety assemblies		
8.7.1	General	The zener diodes, D1 and D2, on the circuit board are used as shunt components in an infallible shunt safety assembly. The zener diodes are duplicated in the assembly and rated properly for "ia" protection as per Cl.7.5.2. The zener diodes are not invalidated after the application of faults, as provided in Cl.5.2, as well. Refer to Appendix A.4.2 for details.	Pass
8.7.2	Safety shunts	The shunt safety assembly is considered as a safety shunt that can be used to limit voltage to capacitors in the block-B/C/D.	Pass
8.7.3	Shunt voltage limiters	The shunt safety assembly is considered as a shunt voltage limiter to ensure that defined voltage level, 4.1 V, is applied to intrinsically safe circuits. The analysis of transients for the assembly is not required because the assembly is fed from batteries in accordance with Cl.7.4.	Pass

8.8	Wiring, printed circuit board tracks, and connections	The followings were considered as infallible against open circuit failure: 1) The zener diodes, D1 and D2, on the circuit board are infallibly connected to ground with at least 2 mm wide, 35 µm thick track. 2) The connections to the board of the zener diodes above are infallibly soldered as a soldered joint of the surface mount component mounted in accordance with the component manufacturer's recommendation.	Pass

IEC 60079-11			
Clause	Requirement – Test	Result – Remark	Verdict
8.9	Galvanically separating components		
8.9.1	General	The equipment does not contain any galvanically separating components.	N/A
8.9.2	Isolating components between intrinsically safe and non-intrinsically safe circuits	See Cl.8.9.1.	N/A
8.9.3	Isolating components between separate intrinsically safe circuits	See Cl.8.9.1.	N/A
9	Supplementary requirements for specific apparatus		
9.1	Diode safety barriers		
9.1.1	General	The equipment is not a standalone diode safety barrier.	N/A
9.1.2	Construction		
9.1.2.1	Mounting	See Cl.9.1.1.	N/A
9.1.2.2	Facilities for connection to earth	See Cl.9.1.1.	N/A
9.1.2.3	Protection of components	See Cl.9.1.1.	N/A
9.2	FISCO apparatus	The equipment is not a FISCO apparatus.	N/A
9.3	Handlights and caplights	The equipment is not a Handlight nor a caplight.	N/A
10	Type verifications and type tests		
10.1 See also **DS 2013/002**	Spark ignition test		
10.1.1	General	Spark ignition tests were not considered necessary because the circuits in the equipment were exempted from type tests by the methods described in Annex A. Refer to Appendix A.2 for details.	Pass
10.1.2	Spark test apparatus	Tests were not conducted.	N/A
10.1.3	Test gas mixtures and spark test apparatus calibration current		
10.1.3.1	Explosive test mixtures suitable for tests with a safety factor of 1.0 and calibration current of the spark test apparatus	Tests were not conducted.	N/A
10.1.3.2	Explosive test mixtures suitable for tests with a safety factor of 1.5 and calibration current of the spark test apparatus	Tests were not conducted.	N/A

IEC 60079-11			
Clause	Requirement – Test	Result – Remark	Verdict
10.1.4	Tests with the spark test apparatus		
10.1.4.1	Circuit test	Tests were not conducted.	N/A
10.1.4.2	Safety factors	When using the methods described in Annex A for assessment, a safety factors of 1.5 was considered.	Pass
10.1.5	Testing considerations		
10.1.5.1	General	Tests were not conducted.	N/A
10.1.5.2	Circuits with both inductance and capacitance	The sum of all the capacitances or all the inductances in each block on the circuit boards is less than 1 % of the allowable limit. The circuits were considered acceptable without further testing. Refer to Appendix A.2.4 for details.	Pass
10.1.5.3	Circuits using shunt short-circuit (crowbar) protection	Circuits do not use crowbar protection. Refer to Appendix A.2.5 for details.	N/A
10.1.5.4	Results of spark test	Tests were not conducted.	N/A

10.2	Temperature tests (continues in the next page)	In case of small components having total surface area not less than 20 mm², maximum dissipation power in each component is less than 1.25 W required at T4 and 50 °C ambient as per Table 4 of IEC 60079-0 because maximum power supplied from the batteries to the boards after passing through the zener diodes, D1~D2, the internal resistance of the batteries and the current limiting resistors, R1, R2, R4, R5, R7, R8 and R10 on the main board, R8, R13, R20, R23, R25, R40, R43, R44 and R45 on the sensor board, is 0.130 W and maximum dissipation power of each current limiting resistor is 0.374 W. In case of small components having total surface area less than 20 mm², maximum surface temperature of the components does not exceed 275 °C required at T4 and 50 °C ambient as per Table 3 of IEC 60079-0. In other words, their thermal coefficients, Rthj-a (Junction to Ambient) or Rthc-a (Case to Ambient), shall be less than (275 °C - 50 °C) / 0.130 W = 1 730 °C/W. Temperature tests were conducted on some small components to determine their thermal coefficients which are not obtained from the manufacturers. The results were determined as follows. 1) R31(100 Ω, 1/10 W) on the sensor board at 0.130 W : 41.3 °C at 24.7 °C ambient → Rthc-a = (41.3 °C – 24.7 °C) / 0.130 W = 127 °C/W. 2) R43(51 Ω, 1/4 W) on the sensor board at 0.130 W : 38.7 °C at 24.7 °C ambient → Rthc-a = (38.7 °C – 24.7 °C) / 0.132 W = 106 °C/W.	Pass

IEC 60079-11			
Clause	Requirement – Test	Result – Remark	Verdict
10.2	Temperature tests (continues from the previous page)	The components smaller than 20 mm² were verified from the manufacturers' datasheets and the testing results above as having their thermal coefficients less than 1 730 °C/W. Therefore, considering the above, the equipment satisfies the assigned temperature class T4 at 50 °C ambient. The maximum surface temperature rise of the enclosure of the equipment determined at worst fault conditions is negligible (less than 10 K). The service temperature is regarded as 60 °C at 50 °C ambient. Refer to Appendix A.3.1 and B.1 for details.	Pass
10.3	Dielectric strength tests	The equipment is a hand-held, battery powered device and does not require dielectric strength tests.	N/A
10.4	Determination of parameters of loosely specified components	Ten samples of the vibration motor, M1 (Z6SH1B0060711), manufactured by JINLONG MACHINERY & ELECTRONIC CO., LTD., were measured at room temperature, 20 °C, to determine the maximum inductance. The motor has the maximum measured inductance of 127 μH.	Pass
10.5	Tests for cells and batteries		
10.5.1	General	The battery pack containing two batteries connected in parallel is not rechargeable and was tested as such.	Pass
10.5.2	Electrolyte leakage test for cells and batteries	Ten test samples of the battery pack were subjected to short circuit until discharged. For 12 hours after the test, there was no visible sign of electrolyte from the test samples.	Pass
10.5.3	Spark ignition and surface temperature of cells and batteries	The equipment contains batteries that are not changed in a hazardous area. The battery delivers a peak open-circuit voltage of 3.9 V, less than 4.5 V. Thus, the consideration of the spark ignition discharge at the terminals is not necessary. The internal resistance of the battery pack was determined from a test of ten samples as required by this clause. Its minimum value is 5.68 Ω. Ten samples of the battery pack were also tested for temperature rise under short circuit condition as required by this clause. The maximum surface temperature of the battery pack determined from the tests was 126.6 °C at 50 °C ambient, which does not exceed 135 °C (T4), considering safety margin.	Pass

IEC 60079-11			
Clause	Requirement – Test	Result – Remark	Verdict
10.5.4	Battery container pressure tests	This test is not required. See Cl.7.4.2 for details.	N/A

10.6	Mechanical tests		
10.6.1	Casting compound	There is no unprotected or exposed surface of the casting compound which forms part of the enclosure. Thus, this test was not conducted.	N/A
10.6.2	Determination of the acceptability of fuses requiring encapsulation	The equipment does not contain any fuses.	N/A
10.6.3	Partitions	The equipment does not use non-metallic insulating partitions of lesser thickness than 0.9 mm on which intrinsic safety depends.	N/A

10.7	Tests for intrinsically safe apparatus containing piezoelectric devices	The maximum capacitance of the piezo-electric buzzer is 19.5 nF at 120 Hz from the manufacturer's specification. The voltage appearing across the buzzer was tested as required by this clause and the maximum measured value was 17.5 V. The maximum energy stored by the capacitance of the buzzer at the maximum measured voltage was calculated using the following formula; $E = 1/2 \times CV^2 = 2.99$ µJ, which does not exceed 50 µJ for group IIC apparatus.	Pass

10.8	Type tests for diode safety barriers and safety shunts	The equipment is not a standalone diode safety barrier.	N/A

10.9	Cable pull test	The equipment is not supplied with permanently connected cables.	N/A

10.10	Transformer tests	The equipment does not contain any transformers.	N/A

10.11	Optical isolators tests		
10.11.1	General	The equipment does not contain any optical isolators.	N/A
10.11.2	Thermal conditioning, dielectric and carbonisation test	See Cl.10.11.1.	N/A
10.11.2.1	Overload test at the receiver side	See Cl.10.11.1.	N/A
10.11.2.2	Overload test at the transmitter side	See Cl.10.11.1.	N/A
10.11.2.3	Thermal conditioning and dielectric strength test	See Cl.10.11.1.	N/A
10.11.2.4	Carbonisation test		
10.11.2.4.1	Receiver side	See Cl.10.11.1.	N/A

IEC 60079-11			
Clause	Requirement – Test	Result – Remark	Verdict
10.11.2.4.2	Transmitter side	See Cl.10.11.1.	N/A
10.11.3	Dielectric and short-circuit test	See Cl.10.11.1.	N/A
10.11.3.1	General	See Cl.10.11.1.	N/A
10.11.3.2	Pre-test dielectric	See Cl.10.11.1.	N/A
10.11.3.3	Short-circuit current test	See Cl.10.11.1.	N/A
10.11.3.4	Current limited short-circuit current test	See Cl.10.11.1.	N/A
10.11.3.5	Dielectric strength test	See Cl.10.11.1.	N/A

10.12	Current carrying capacity of infallible printed circuit board connections	This clause is not applicable. See Cl.8.8.	N/A

11	Routine verifications and tests

11.1	Routine tests for diode safety barriers		
11.1.1	Completed barriers	See Cl.9.1.1.	N/A
11.1.2	Diodes for 2-diode "ia" barriers	See Cl.9.1.1.	N/A

11.2	Routine tests for infallible transformers	See Cl.8.2.5.	N/A

12	Marking

12.1	General	See the label drawing (Ex-A19060032). The equipment is marked with the necessary requirements in Cl.29 of IEC 60079-0 on adhesive label.	Pass
12.2	Marking of connection facilities	Additional identification marking of connection facilities is not necessary because connection facilities are not used for the external connections of the equipment.	N/A
12.3	Warning markings	No warnings are required to be present on the equipment. See Cl.7.4.	N/A
12.4	Examples of marking	See Cl.12.1.	Pass

13	Documentation	Documentation includes the relevant safety information.	Pass

Annex A (Normative)	Assessment of intrinsically safe circuits

IEC 60079-11			
Clause	Requirement – Test	Result – Remark	Verdict
A.1	Basic criteria	Intrinsically safe circuits in the equipment satisfy three basic criteria which are no spark ignition, the temperature classification and the adequate separation from other circuits.	Pass
A.2	Assessment using reference curves and tables	The structure and electrical parameters of the circuits in the equipment were sufficiently well defined for its safety to be deduced from the methods described in Annex A. Thus, the safety of the circuits was assessed using the reference tables, Tables A.1~A.2, and the reference curve, Figure A.6.	Pass
A.3	Examples of simple circuits	See Cl.A.2.	Pass
A.4	Permitted reduction of effective capacitance when protected by a series resistance	No reduction of effective capacitance is used.	N/A

Annex B (Normative)	Spark test apparatus for intrinsically safe circuits		
B.1	Test methods for spark ignition		
B.1.1	Principle	Tests were not conducted.	N/A
B.1.2	Apparatus	Tests were not conducted.	N/A
B.1.3	Calibration of spark test apparatus	Tests were not conducted.	N/A
B.1.4	Preparation and cleaning of tungsten wires	Tests were not conducted.	N/A
B.1.5	Conditioning a new cadmium disc	Tests were not conducted.	N/A
B.1.6	Limitations of the apparatus	Tests were not conducted.	N/A
B.1.7	Modifications of test apparatus for use at higher currents	Tests were not conducted.	N/A

Annex C (Informative)	Measurement of creepage distances, clearances and separation distances through casting compound and through solid insulation

Annex D (Normative)	Encapsulation		
D.1	Adherence	See Cl.6.6.	N/A
D.2	Temperature	See Cl.6.6.	N/A

Annex E (Informative)	Transient energy test

Annex F (Normative)	Alternative separation distances for assembled printed circuit boards and separation of components		
F.1	General	The equipment is not assessed with Annex F.	N/A
F.2	Control of pollution access	The equipment is not assessed with Annex F.	N/A

IEC 60079-11			
Clause	Requirement – Test	Result – Remark	Verdict
F.3	Distances for printed circuit boards and separation of components		
F.3.1	Level of protection “ia” and “ib”	The equipment is not assessed with Annex F.	N/A
F.3.2	Level of protection “ic”	The equipment is not assessed with Annex F.	N/A

Annex G (Normative)	Fieldbus intrinsically safe concept (FISCO) – Apparatus requirements		
G.1	Overview	The equipment is not FISCO.	N/A
G.2	Apparatus requirements		
G.2.1	General	The equipment is not FISCO.	N/A
G.2.2	FISCO power supplies		
G.2.2.1	General	The equipment is not FISCO.	N/A
G.2.2.2	Additional requirements of ‘ia’ and ‘ib’ FISCO power supplies	The equipment is not FISCO.	N/A
G.2.2.3	Additional requirements of ‘ic’ FISCO power supplies	The equipment is not FISCO.	N/A
G.3	FISCO field devices		
G.3.1	General	The equipment is not FISCO.	N/A
G.3.2	Additional requirements of ‘ia’ and ‘ib’ FISCO field devices	The equipment is not FISCO.	N/A
G.3.3	Additional requirement of ‘ic’ FISCO field devices	The equipment is not FISCO.	N/A
G.3.4	Terminator	The equipment is not FISCO.	N/A
G.3.5	Simple apparatus	The equipment is not FISCO.	N/A
G.4	Marking	The equipment is not FISCO.	N/A
G.4.1	Examples of marking	The equipment is not FISCO.	N/A

Annex H (Informative)	Ignition testing of semiconductor limiting power supply circuits

Measurement Section, including Additional Narrative Remarks

APPENDIX A: Description of product

A.1 General overview

A.1.1 Scope

This report provides the basis for the certification of the G-Finder Multi GFM-400 series Portable Multi Gas Detectors as intrinsically safe electrical apparatus as defined in the standards IEC 60079-0:2017 and IEC 60079-11:2011 to Level of protection "ia", Group IIC and Temperature Class T4 in an ambient temperature -20 °C ~ +50 °C. The equipment provides a degree of protection of at least IP20. The tests and assessments in this report are limited to the aforementioned standards.

A.1.2 Equipment

The G-Finder Multi GFM-400 series are hand-held, battery operated multi gas detectors. The "G-Finder Multi" is a brand name and the main model name is "GFM-400". The detector is a personal safety device designed to continuously monitor the presence of oxygen(O_2), Carbon Monoxide (CO) , Hydrogen Sulfide (H_2S) and one of methane (CH_4) or propane (C_3H_8). The detector samples the atmosphere in diffusion mode using an electrochemical sensors for O_2, a dual toxic electrochemical sensor for CO and H_2S, and an IECEx certified NDIR sensor for CH_4 or C_3H_8.

The detector alerts the user to potentially unsafe exposure with visual, vibrating and audible alarms when gas concentration exceeds user configurable set points, and readings are displayed on a LCD. The detector has IR communications for changing the alarm set point, the calibration range and etc. The IR communications shall only be used in safe area.

The detector is comprised of two printed circuit boards with a LCD, three gas sensors and two batteries in parallel, housed in a non-metallic enclosure which is constructed by double-shot injection molding with polycarbonate and thermoplastic elastomer alloy. The non-metallic enclosure consists of a front half (cover) and a back half (body). A wide LCD window of the front half of the enclosure is fully covered with an anti-static coating film. A metallic suspender clip is attached to the back half of the enclosure. The parts of the enclosure are secured by screws. The detector has no facilities for connection of external circuits.

Power is provided by non-user replaceable, two Lithium/Thionyl chloride (Li/$SOCl_2$) batteries (Tekcell, type SB-AA11 manufactured by VITZRO CELL, AA size, Nominal 3.6 V, Peak 3.9 V, 2.5 Ah) connected in parallel. The detector is intended to be a disposable unit.

The configuration for GFM-400 series is as follows;
GFM-400(-X)(-Y)
- GFM-400: Model name
- *X: Flammable gas type (blank(default sensor), MM2.5, MM100, MP1.5, MP2.5, PP1.5, PP2.5)
* : This option can be selected only if the user require a particular target gas, a particular calibration gas and a particular measurement range different from the default sensor to detect a flammable gas (CH_4 or C_3H_8).
- **Y: Housing body color (blank : orange(default), YE : yellow, GN : green, VT : violet, and etc.)
** : This option is not marked on the label and can only be used at an order if the user require a particular housing body color different from the default. The option does not affect intrinsic safety.
For the detailed information, see the instruction manual.

A.2 Spark ignition considerations

Spark ignition tests were not necessary for the equipment because the structure and electrical parameters of the circuits in the equipment were sufficiently well defined for its safety to be deduced from the methods described in Annex A. The safety of the circuits was assessed using the reference tables, Tables A.1~A.2, and the reference curve, Figure A.6.
The circuits on the boards were classified into source power block (battery), block-A (Buzzer), block-B(Motor, LED), block-C(CPU, LCD, Electrochemical Sensor, IRDA and etc) and block-D(NDIR Sensor) according to the applied voltage and current levels. The blocks were segregated each other through the

zener diodes, D1~D2, and the resistors, R1, R2, R4, R5, R7, R8 and R10 on the main board, R8, R13, R20, R23, R25, R40, R43, R44 and R45 on the sensor board. See the block diagram (Ex-GE-25S00) and the related circuit drawings for identification of the aforementioned blocks and safety components in detail. Intrinsic safety depends on separation of conductive parts between circuits of the blocks, between the infallible components/assemblies and the surrounding circuits, and across the current limiting devices mentioned as above. The separations did not invalidate the classification of the blocks and the safety components when considering the application of faults, as provided in Cl.5.2.

Thus, the voltage and current levels applied in each block were determined, except the effect of the electrochemical cells for the detection of gases, as follows.

For power source block
- U_{max} = 3.9 V (from a maximum open circuit voltage of one Lithium/Thionyl chloride (Li/$SOCl_2$) cell in the battery),
- U_n = 3.6 V (from a nominal voltage of one Lithium/Thionyl chloride (Li/$SOCl_2$) cell in the battery),
- I_{max} = U_{max} / (internal resistance of the batteries in parallel + R2||R5||R10 on the main board) = 3.9 V / (5.68 Ω + 7.26 Ω) = 0.30 A;

For block-A
- U_{max} = 3.9 V × 3 = 11.7 V (from U3 with 3X charge pump in block-A),
- U_n = 3.6 V (from power source block),
- I_{max} = U_{max} from power source block / (internal resistance of the batteries in parallel + R2||(R1 + R10||(R5 + R4||R7||R8 on the main board ||R25 ||R8||R13||R20||R23||R40 on the sensor board))) = 3.9 V / 27.0 Ω = 0.144 A;

For block-B
- U_{max} = 4.1 V (from D1 and D2 between block-A and block-C),
- U_n = 3.6 V (from power source block),
- I_{max} = U_{max} from power source block / (internal resistance of the batteries in parallel + R5) + U_{max} from D1 and D2 / (R4||R7||R8 on the main board ||R25||R8||R13||R20||R23||R40 on the sensor board) = 3.9 V / 27.46 Ω + 4.1 V / 241.44 Ω = 0.159 A;

For block-C
- U_{max} = 4.1 V (from D1 and D2 between block-A and block-C),
- U_n = 3.6 V (from power source block),
- I_{max} = U_{max} from power source block / (internal resistance of the batteries in parallel + R10||(R5 + R4||R7||R8 on the main board ||R25||R8||R13 ||R20||R23||R40 on the sensor board)) + U_{max} from D1 and D2 / R1 on the main board = 3.9 V / (5.68 Ω + 20.12 Ω) + 4.1 V / (1 KΩ × 0.99) = 0.155 A;

For block-D
- U_{max} = 4.1 V (from D1 and D2 between block-A and block-C),
- U_n = 3.6 V (from power source block),
- I_{max} = U_{max} / (R1||R10||(R5 + R4||R7||R8 on the main board ||R25||R8||R13||R20||R23||R40 on the sensor board) + R43||R44||R45 on the sensor board) = 4.1 V / ((19.91 Ω + 27.57 Ω) × 0.99) = 0.087 A;

The current limiting resistors, R1, R2, R4, R5, R7, R8 and R10 on the main board, R8, R13, R20, R23, R25, R40, R43, R44 and R45 on the sensor board, segregate each block from being adversely affected by capacitors and inductors in the other blocks. Thus, according to the classification of the above blocks, effective capacitance and inductance of each block per the applied voltage and current levels were considered separately as follows.

For power source block
- Total effective maximum capacitance connected to the maximum voltage (3.9 V) = negligible,
- Total effective maximum inductance = negligible;

For block-A
- Total effective maximum capacitance connected to the maximum input voltage (3.9 V) = C11 + C12 + C15 + C16 + BZ1 on the main board = (1 μF × 1.1) + (0.1 μF × 1.1 x 3) + (15 nF × 1.3) = 1.45 μF,
- Total effective maximum capacitance connected to the maximum charge pumped voltage (11.7 V) = C11 + C12 + C16 + BZ1 on the main board = (0.1 μF × 1.1 x 3) + (15 nF × 1.3) = 0.35 μF,
- Total effective maximum inductance = negligible;

For block-B
- Total effective maximum capacitance connected to the maximum voltage (4.1 V) = C17 on the main board = 0.11 μF,
- Total effective maximum inductance = maximum inductance of the vibration motor, M1 on the main board = 127 μH;

For block-C
- Total effective maximum capacitance connected to the maximum voltage (4.1 V) = (C1 + C2 + ... + C26 on the main board) + (C1 + C2 + ... + C55 on the Bluetooth module, U4) + (C1 + C3 + ... + C25 + CF1 + ... + CF12 on the sensor board) = 29.15 μF,
- Total effective maximum inductance = L1 + L8 + L9 + L11 + L46 on the Bluetooth module, U4 = 54.8 nH;

For block-D
- Total effective maximum capacitance connected to the maximum voltage (4.1 V) = (C13 + C20 + C23 + C224 on the sensor board) + C_i of NDIR Sensor = (10 μF × 1.2 × 2) + (68 pF × 1.05 x 2) + 26 μF = 50 μF,
- Total effective maximum inductance = L1 on the sensor board + L_i of NDIR Sensor = (2.2 μH × 1.1) + 0 = 2.42 μH;

In addition, influences by voltages and currents generated from two electrochemical sensors on the circuits were considered for the separation assessment of conductive parts and the spark ignition assessment. When the maximum voltage, 1.3 V, generated from the sensors is added to the voltages in the blocks above, it does not adversely affect the previous separation assessment in Cl.6.3 because the assessment using the 10 V and 30 V lines in Table 5 is still maintained. And the maximum voltage and the maximum current generated at worst fault condition by two sensors connected in parallel, 1.3 V and 1.5 A, were also taken into account during the spark ignition assessment of the block-C/D below.

A.2.1 Resistive spark ignition

In case of the block-C/D, the maximum voltage and the maximum current in the circuits were determined by addition of the voltage, 1.3 V, and the current, 1.5 A, generated from the electrochemical sensors to the voltage and the current applied in the block-C/D.

In case of the other blocks, the maximum voltage and the maximum current in each circuit were determined as the voltage and the current applied in each block.

1) 0.30 A at 3.9 V < 3.33 A at 12.1 V for Group IIC and a safety factor of 1.5.
2) 0.144 A at 11.7 V < 3.33 A at 12.1 V for Group IIC and a safety factor of 1.5.
3) 0.159 A at 4.1 V < 3.33 A at 12.1 V for Group IIC and a safety factor of 1.5.
4) 1.655 A at 5.4 V < 3.33 A at 12.1 V for Group IIC and a safety factor of 1.5.

The circuits in the equipment were assessed as intrinsically safe in regard to resistive spark ignition.

A.2.2 Inductive spark ignition

The maximum current and the inductance value shall be compared to the values given in Figure A.6. However, the points of the values to be compared are located beyond Figure A.6. So, the possibility of inductive spark ignition was assessed on the calculation of spark ignition energy considering a safety factor of 1.5.
The following is the assessment result based on the calculation of spark ignition energy.

- block-B : Vibration motor, M1
Maximum flowing current to the motor = U_{max} from power source block / (internal resistance of the batteries in parallel + R5 + resistance of the motor) + U_{max} from D1 and D2 / (R4||R7||R8 on the main board ||R25||R8||R13||R20||R23||R40 on the sensor board + resistance of the motor) = 3.9 V / 54.46 Ω + 4.1 V / 268.44 Ω = 0.087 A
E = $1/2 \times L_{max} \times (I_{max} \times \text{safety factor})^2$ = 0.5 × 127 μH × (0.087 A × 1.5)^2 = 1.08 μJ < 40 μJ for Group IIC.

- block-C : Bluetooth module, U4
Maximum flowing current to the Bluetooth module = maximum current of block-C + maximum current of two electrochemical sensors = 0.155 A + 1.5 A = 1.655 A
E = $1/2 \times L_{max} \times (I_{max} \times \text{safety factor})^2$ = 0.5 × 54.8 nH × (1.655 A × 1.5)^2 = 0.17 μJ < 40 μJ for Group IIC.

- block-D : L1 on the sensor board
Maximum flowing current to block-D = U_{max} from block-C by addition of the maximum voltage, 1.3 V, generated from the electrochemical sensors / (R43||R44||R45 on the sensor board) = 5.4 V / (27.57 Ω × 0.99) = 0.198 A
$E = 1/2 \times L_{max} \times (I_{max} \times \text{safety factor})^2 = 0.5 \times 2.42\ \mu H \times (0.198\ A \times 1.5)^2 = 0.11\ \mu J < 40\ \mu J$ for Group IIC.

The circuits in the equipment were assessed as intrinsically safe in regard to inductive spark ignition.

A.2.3 Capacitive spark ignition

In case of the block-C/D, the maximum voltages in the circuits were determined by addition of the maximum voltage, 1.3 V, generated from the electrochemical sensors to the voltages applied in the block-C/D. In case of the other blocks, the maximum voltage in each circuit was determined as the voltage applied in each block.

The maximum voltage of each block and the maximum effective capacitance connected to the voltage were compared to the values given in Table A.2 as follows.

- block-A
1.45 μF at 3.9 V < 100 μF at 5.0 V for Group IIC and a safety factor of 1.5.
0.35 μF at 11.7 V < 1.54 μF at 11.7 V for Group IIC and a safety factor of 1.5.

- block-B
0.11 μF at 4.1 V < 100 μF at 5.0 V for Group IIC and a safety factor of 1.5.

- block-C
29.15 μF at 5.4 V < 65 μF at 5.4 V for Group IIC and a safety factor of 1.5.

- block-D
50 μF at 5.4 V < 65 μF at 5.4 V for Group IIC and a safety factor of 1.5.

The circuits in the equipment were assessed as intrinsically safe in regard to capacitive spark ignition.

A.2.4 Combination of inductive and capacitive spark ignition

The sum of all the capacitances or all the inductances in each block on the circuit boards is less than 1 % of the allowable limit as follows. The circuits were considered acceptable without further testing.

- block-B
0.11 μF at 4.1 V < 100 μF at 5.0 V for Group IIC and a safety factor of 1.5. → 0.11 % of the allowable capacitance limit

- block-C
$E = 1/2 \times L_{max} \times (I_{max} \times \text{safety factor})^2 = 0.5 \times 54.8\ nH \times (1.655\ A \times 1.5)^2 = 0.17\ \mu J < 40\ \mu J$ for Group IIC. → 0.43 % of the allowable inductance limit

- block-D
$E = 1/2 \times L_{max} \times (I_{max} \times \text{safety factor})^2 = 0.5 \times 2.42\ \mu H \times (0.198\ A \times 1.5)^2 = 0.11\ \mu J < 40\ \mu J$ for Group IIC. → 0.28 % of the allowable inductance limit

The circuits in the equipment were assessed as intrinsically safe in regard to combination of inductive and capacitive spark ignition.

A.2.5 Shunt short-circuit (crowbar) spark ignition

The equipment does not contain any crowbar circuits. The assessment of this section isn't necessary.

A.2.6 Other spark ignition considerations

<Piezo-electric buzzer, BZ1, on the main board>

The equipment contains a piezo-electric buzzer, part no. CBE1440BP-L, manufactured by Daeyoung Electric and was tested in accordance with Cl.10.7 (see Appendix B.4). The maximum capacitance of the buzzer is 19.5 nF at 120 Hz from the manufacturer's specification. The maximum voltage appearing across the buzzer was 17.5 V from the test.

According to Cl.10.7, for Group IIC apparatus, the calculated energy resulting from the test shall not exceed 50 μJ. The calculation of the worst case energy is as follows;
$E = 1/2 \times C \times V^2 = 0.5 \times 19.5\ nF \times (17.5\ V)^2 = 2.99\ \mu J < 50\ \mu J$

Therefore, the piezo-electric buzzer was considered acceptable for use.

<NDIR Sensor, MIPEX-04-X-XX-3.1, on the main board>

The equipment contains an IECEx certified (Certificate No. IECEx ITS 19.0005U) NDIR sensor, part no. MIPEX-04-X-XX-3.1, manufactured by Optosense LLC.

The applicable types of the NDIR sensor are as follows;
MIPEX-04-a-bb-3.1
- MIPEX-04: MIPEX model number
- a: Target gas; 1 - CH_4, 2 - C_3H_8
- bb: Application; if a = 1, 01, 11, 21, 02, 12, 22, 61, 71, 62, 72
  If a = 2, 61, 71, 62, 72

The applicable NDIR sensors have the following electrical parameters for intrinsic safety.
$U_i = 5.5$ V, $I_i = 200$ mA, $P_i = 0.13$ W, Ci = 26 μF, Li = 0

The NDIR sensor is used in the block-D. Maximum electrical parameters applied in the block-D are determined after considering the maximum voltage generated from the electrochemical sensors in the block-C, 1.3 V, as follows;
- $U_{max} = 4.1\ V + 1.3\ V = 5.4\ V < U_i = 5.5\ V$
- $I_{max} = U_{max}$ / (R43||R44||R45 on the sensor board) = 5.4 V / (27.57 Ω × 0.99) = 198 mA < I_i = 200 mA

Therefore, the NDIR sensor was considered acceptable for use in regard to spark ignition.

A.3 Thermal ignition consideration

A.3.1 Temperature for small components for Group I and Group II

Maximum power dissipated in the circuits after passing through the zener diodes, D1~D2, the internal resistance of the batteries and the current limiting resistors, R1, R2, R4, R5, R7, R8 and R10 on the main board, R8, R13, R20, R23, R25, R40, R43, R44 and R45 on the sensor board, is 130 mW based on the calculation shown below.

$P_{block\text{-}A} = V^2/4R$ = (U_n from a nominal voltage of the cell)^2 / (4 × (internal resistance of the batteries in parallel + R2||(R1 + R10||(R5 + R4||R7||R8 on the main board ||R25||R8||R13||R20||R23||R40 on the sensor board))) = (3.6 V)^2 / (4 × 27.0 Ω) = 120 mW
$P_{block\text{-}B} = V^2/4R$ = (U_n from a nominal voltage of the cell)^2 / (4 × (internal resistance of the batteries in parallel + R5||(R10 + R4||R7||R8 on the main board ||R25||R8||R13||R20||R23||R40 on the sensor board))) + U_{max} from D1 and D2 / (4 × (R1 + R4||R7||R8 on the main board ||R25||R8||R13||R20||R23||R40 on the sensor board)) = (3.6 V)^2 / (4 × 25.8 Ω) + (4.1 V)^2 / (4 × 1241.44 Ω) = 129 mW
$P_{block\text{-}c} = V^2/4R$ = (U_n from a nominal voltage of the cell)^2 / (4 × (internal resistance of the batteries in parallel + R10||(R5 + R4||R7||R8 on the main board ||R25||R8||R13||R20||R23||R40 on the sensor board))) + U_{max} from D1 and D2 / (4 × R1) = (3.6 V)^2 / (4 × 25.8 Ω) + (4.1 V)^2 / (4 × 990 Ω) = 130 mW
$P_{block\text{-}D} = V^2/4R$ = (U_n from a nominal voltage of the cell)^2 / (4 × (internal resistance of the batteries in parallel + R10||(R5 + R4||R7||R8 on the main board ||R25||R8||R13||R20||R23||R40) + R43||R44||R45 on the sensor board)) + U_{max} from D1 and D2 / (4 × (R1 + R43||R44||R45) = (3.6 V)^2 / (4 × 53.37 Ω) + (4.1 V)^2 / (4 × 1 017.57 Ω) = 64.8 mW

The maximum dissipation power of each current limiting resistor is 374 mW based on the calculation shown below.

$P_{R2,R5,R10\_max}$ = R×I² = R2 × (U_n / (internal resistance of the batteries in parallel + R2))² = (22 Ω × 0.99) × (3.6 V / (5.68 Ω + 22 Ω × 0.99))² = 374 mW for R2, R5 and R10 on the main board
P_{R1_max} = R×I² = R1 × (U_{max} from D1 and D2 / R1)² = (1 KΩ × 0.99) × (4.1 V / (1 KΩ × 0.99))² = 17 mW for R1 on the main board
$P_{R8\ on\ the\ main\ board\_max}$ = R×I² = R8 × (U_n / (internal resistance of the batteries in parallel + R5 + R8))² = (330 Ω × 0.99) × (3.6 V / (5.68 Ω + 22 Ω × 0.99 + 330 Ω × 0.99))² = 34 mW for R8 on the main board
P_{R25_max} = R×I² = R25 × (U_n / (internal resistance of the batteries in parallel + R5 + R25))² = (1 KΩ × 0.99) × (3.6 V / (5.68 Ω + 22 Ω × 0.99 + 1 KΩ × 0.99))² = 12 mW for R25 on the sensor board
$P_{R4,R7,R8\ on\ the\ sensor\ board,R13,R20,R23,R40\_max}$ = R×I² = R4 × (U_n / (internal resistance of the batteries in parallel + R5 + R4))² = (100 KΩ × 0.99) × (3.6 V / (5.68 Ω + 22 Ω × 0.99 + 100 KΩ × 0.99))² = 0.13 mW for R4, R7 on the main board, R8, R13, R20, R23, R40 on the sensor board
$P_{R43,R44,R45\_max} \leq P_{block\text{-}c}$ = 130 mW

The maximum dissipation power of each zener diode in the Zener mode is 120 mW based on the calculation shown below.
$I_{D1,D2\_Zener\_max}$ = V/R = U_n / (internal resistance of the batteries in parallel + R2||(R1 + R10||(R5 + R4||R7||R8 on the main board ||R25||R8||R13||R20||R23||R40 on the sensor board))) = 3.6 V / 27.0 Ω = 0.133 A
$P_{D1,D2\_Zener\_max}$ = V×I/4 = U_n × $I_{D1,D2\_Zener\_max}$ / 4 = 3.6 V × 0.133 A / 4 = 120 mW

In case of small components having total surface area not less than 20 mm², maximum dissipation power in each component is less than 1.25 W required at T4 and 50 °C ambient as per Table 4 of IEC 60079-0 because maximum power supplied from the batteries to the boards after passing through the zener diodes, D1~D2, the internal resistance of the batteries and the current limiting resistors, R1, R2, R4, R5, R7, R8 and R10 on the main board, R8, R13, R20, R23, R25, R40, R43, R44 and R45 on the sensor board, is 0.130 W and maximum dissipation power of each current limiting resistor is 0.374 W.

In case of small components having total surface area less than 20 mm², maximum surface temperature of the components does not exceed 275 °C required at T4 and 50 °C ambient as per Table 3 of IEC 60079-0. In other words, their thermal coefficients, Rthj-a (Junction to Ambient) or Rthc-a (Case to Ambient), shall be less than (275 °C - 50 °C) / 0.130 W = 1 730 °C/W. The thermal coefficients were obtained from the test results or the manufacturer's specifications below.

•R31(100 Ω, 1/10 W) on the sensor board at 130 mW : 41.3 °C at 24.7 °C ambient → Rthc-a = (41.3 °C – 24.7 °C) / 0.130 W = 127 °C/W from test results
•R43(51 Ω, 1/4 W) on the sensor board at 0.130 W : 38.7 °C at 24.7 °C ambient → Rthc-a = (38.7 °C – 24.7 °C) / 0.132 W = 106 °C/W from test results
•D1(BZT52C3V9) on the main board : Rthj-a = 338 °C/W from the manufacturer's specification
•Q1(DDC123JU) on the main board : Rthj-a = 625 °C/W from the manufacturer's specification
•Q3(NTGS3441 or NVGS3441) on the main board : Rthj-a = 244 °C/W from the manufacturer's specification
•U5(AT25DF512C-MAHN-T) on the main board : Rthj-a = 64.58 °C/W from the manufacturer's specification
•Q2(SST177) on the sensor board : Rthj-a = 357 °C/W from the manufacturer's specification
•U1(TSU111) on the sensor board : Rthj-a = 205 °C/W from the manufacturer's specification
•U2(TSU112) on the sensor board : Rthj-a = 57 °C/W from the manufacturer's specification
•U6(SN74AUP1G07) on the sensor board : Rthj-a = 252 °C/W from the manufacturer's specification
•U7(SN74AUP1T50) on the sensor board : Rthj-a = 259 °C/W from the manufacturer's specification
•U5(MAX17220) on the sensor board : Rthj-a = 223.6 °C/W from the manufacturer's specification

The highest thermal coefficient obtained was 625 °C/W, which is less than 1 730 °C/W.

Therefore, the equipment satisfies the assigned temperature class T4 at 50 °C ambient.

A.3.2 Wiring within intrinsically safe apparatus for Group I and Group II

The internal wiring is used for connection between the battery pack containing two batteries connected in parallel and the main board, which belongs to the block-A. According to the dissipated power calculation of the block-A in A.3.1, the maximum dissipation power of internal wires is 0.120 W which is less than 1.25 W required at T4 and 50 °C ambient as per Table 2 and Table 4 of IEC 60079-0. Therefore, the wires satisfy Table 2.

A.3.3 Tracks on printed circuit boards for Group I and Group II

Minimum Track width on PCB : 0.2 mm
Factor(Refer to the Table 3)
- Copper thickness : 33 μm (Factor : 1)
- Printed board thickness : 1.6 mm (Factor : 1)
- track layer on board : Four (Factor : ÷ 2)
- Tracks passing under component dissipating 0.25 W or more. : None (Factor : ÷ 1)
- Component dissipating 0.25 W or more & 1.00mm along the conductor : Yes (Factor : ÷ 2)
- Ambient temperature : 50 °C (Factor : ÷ 1.2)

The PCB tracks (with minimum track width of 0.2 mm and copper of 33 μm thickness on multilayer of a PCB of 1.6 mm thickness) are considered suitable for a maximum current of 375 mA dc for a temperature classification of T4 in an ambient temperature of 50 °C. The maximum current in the equipment is U_n / (internal resistance of the batteries in parallel + R2||R5||R10 on the main board) = 3.6 V / (5.68 Ω + 7.26 Ω) = 278 mA from the power source block. Therefore, the PCB tracks satisfy Table 3.

A.3.4 Intrinsically safe apparatus and component temperature for Group III

This section is not applicable.

A.3.5 Temperature for the battery pack

Ten samples of the battery pack containing two batteries connected in parallel were tested for temperature rise under short circuit condition as per Cl.10.5.3. The maximum surface temperature of the battery pack determined from the tests was 126.6 °C at 50 °C ambient, which does not exceed 135 °C (T4), considering safety margin.
Therefore, the battery pack satisfies the assigned temperature class T4 at 50 °C ambient.

A.4 Rating of components

A.4.1 Resistors

Component designation	Value	Maximum rating (W1)	Rating used* (W2)	W1/W2	Calculation
R2,R5,R10	22 Ω ±1%	1 000 mW	374 mW	2.67	Refer to Appendix A.3.1.
R1	1 KΩ ±1%	250 mW	17 mW	14.7	Refer to Appendix A.3.1.
R8(main)	330 Ω ±1%	250 mW	34 mW	7.35	Refer to Appendix A.3.1.
R25	1 KΩ ±1%	250 mW	12 mW	20.8	Refer to Appendix A.3.1.
R4,R7,R8(sensor), R13,R20,R23,R40	100 KΩ ±1%	250 mW	0.13 mW	1 923	Refer to Appendix A.3.1.
R43	51 Ω ±1%	250 mW	130 mW	1.92	Refer to Appendix A.3.1.
R44,R45	120 Ω ±1%	250 mW	130 mW	1.92	Refer to Appendix A.3.1.

(*"Rating used" is a term used to describe the maximum voltage, current and/or power which the component may be subjected to when applying the number of faults as prescribed in the Standards.)
(All the components are rated at 50 °C ambient.)

A.4.2 Shunt voltage limiters

The maximum dissipation power of each zener diode in the Zener mode was described in Appendix A.3.1.
The maximum dissipation power of each zener diode in the forward direction is calculated as below;
$I_{D1,D2\_forward\_max}$ = 0 (The current of D1 and D2 in forward direction does not occur after the application of faults, as provided in Cl.5.2.)

Component designation	Value	Maximum rating (W1)	Rating used* (W2)	W1/W2	Calculation
D1,D2(BZT52C 3V9) in Zener mode	3.9 V ±5%	300 mW	130 mW	2.31	Refer to Appendix A.3.1.

(*"Rating used" is a term used to describe the maximum voltage, current and/or power which the component may be subjected to when applying the number of faults as prescribed in the Standards.)
(All the components are rated at 50 °C ambient.)

A.4.3 Series current limiter

The equipment does not contain any semiconductor series current limiting devices.

APPENDIX B: Tests

Option 2: If tests records are not provided as an attachment, please complete the following table:

B.1 Temperature tests

Equipment Tested:	Components on the circuit board in the equipment
Date of Test (yyyy/mm/dd):	2019/11/15
Clause and Standards:	Cl.26.5 of IEC 60079-0 and Cl.10.2 of IEC 60079-11

B.1.1 Test procedures

Samples of selected components used in the intrinsically safe circuits were in turn connected across a source of supply. At the approximate powers or currents indicated, the temperatures of the components and the exact powers dissipated across them were recorded. The components were mounted as intended, i.e. on an equivalent sample to the manufacturer's circuit board, in their worst case mounting configuration. The temperatures were measured using a thermal image scanner (Ti25 of Fluke).

B.1.2 Results

Temperature tests were conducted on some small components to determine their thermal coefficients which are not obtained from the manufacturers.

Component		Test method*	Test conditions		Test result		Calculated maximum temperature			Verdict
Ref.	Part No.		Condition desired**	Actual condition	Max. temp. measured	Ambient temp.	Max. ambient temp. (for T4)	Max. temp. corrected (for T4)	Safety margin (for T4)	T.Class (for T4)
R31	100Ω±1%,1/10W	TI	130 mW	130 mW	41.3 °C	24.7 °C	50 °C	66.6 °C	5K	Pass
R43	51 Ω ±1%,1/4W	TI	130 mW	132 mW	38.7 °C	24.7 °C	50 °C	64.0 °C	5K	Pass

(*"Test method": TC-Thermocouple, TI-Thermal image scanner)
(**"Condition desired" is a term used to describe the maximum voltage, current and/or power which the component may be subjected to when applying the number of faults as prescribed in the Standards.)

The thermal coefficients were determined from the test results as follows.

1) R31(100 Ω, 1/10 W) on the sensor board at 0.130 W : 41.3 °C at 24.7 °C ambient → Rthc-a = (41.3 °C – 24.7 °C) / 0.130 W = 127 °C/W.
2) R43(51 Ω, 1/4 W) on the sensor board at 0.130 W : 38.7 °C at 24.7 °C ambient → Rthc-a = (38.7 °C – 24.7 °C) / 0.132 W = 106 °C/W.

The components smaller than 20 mm² above were verified as having their thermal coefficients less than 1 730 °C/W. Therefore, the components satisfy the assigned temperature class T4 at 50 °C ambient.

The maximum surface temperature rise of the enclosure of the equipment determined at worst fault conditions is negligible (less than 10 K). The service temperature is regarded as 60 °C at 50 °C ambient.

B.2 Determination of parameters of loosely specified components

Equipment Tested:	10 samples of the vibration motor, M1 (Z6SH1B0060711)
Date of Test (yyyy/mm/dd):	2019/02/21
Clause and Standards:	Cl.10.4 of IEC 60079-11

B.2.1 Test procedures

Ten unused samples of each component above were obtained from the manufacturer of the equipment. Their relevant parameters were measured using suitable instruments (such as E4980AL Precision LCR Meter of KEYSIGHT).

B.2.2 Results

Parameters of ten unused samples of the vibration motor, M1 (Z6SH1B0060711), manufactured by JINLONG MACHINERY & ELECTRONIC CO., LTD., were measured using 1 kHz and 1 V conditions at room temperature, 20 °C to determine the maximum inductance. The results are as follows.

Component	Vibration motor, M1 (Z6SC0B0150081)									
Parameters	Sample No.									
	1	2	3	4	5	6	7	8	9	10
Inductance (μH)	**127**	125	121	118	111	108	113	118	114	119

The motor was determined as having the maximum measured inductance of 127 μH.

B.3 Determination of internal resistance of cells and batteries

Equipment Tested:	10 samples of the battery pack containing two batteries (Tekcell, type SB-AA11) connected in parallel
Date of Test (yyyy/mm/dd):	2019/04/16
Clause and Standards:	Cl.7.4.4, Cl.10.4, Cl.10.5.1 and Cl.10.5.3 of IEC 60079-11

B.3.1 Test procedures

Ten representative samples of the battery for use in the intrinsically safe equipment were obtained from the manufacturer of the battery.
The internal resistance of the battery was determined from the open circuit voltage and short circuit current and measured at room temperature using suitable instruments (such as HIOKI 3555 Battery HiTESTER). The short circuit was configured using a link with a maximum resistance of 3 mΩ or a voltage drop across it not exceeding 200 mV or 15 % of the cell e.m.f.

B.3.2 Results

Internal resistances of ten samples of the battery pack containing two batteries (Tekcell, type SB-AA11) connected in parallel manufactured by VITZRO CELL were measured as follows.

Component	Battery pack containing two batteries (Tekcell, type SB-AA11) connected in parallel									
Parameters	Sample No.									
	1	2	3	4	5	6	7	8	9	10
Internal Resistance (Ω)	6.80	8.65	5.85	6.61	**5.68**	8.26	7.18	6.02	6.71	7.34

The battery pack was determined as having the minimum internal resistance of 5.68 Ω.

B.4 Surface temperature and Electrolyte leakage test of cells and batteries

Equipment Tested:	10 samples of the battery pack containing two batteries (Tekcell, type SB-AA11) connected in parallel
Date of Test (yyyy/mm/dd):	2019/04/16~23
Clause and Standards:	Cl.10.5.2 and Cl.10.5.3 of IEC 60079-11

B.4.1 Test procedures

Ten representative samples of the battery for use in the intrinsically safe equipment were obtained from the manufacturer of the battery.
All current limiting devices external to the cell were short circuited and each cell was in turn short circuited until discharged using a short-circuit link with a maximum resistance of 3 mΩ (excluding the connections to the cell). The cells were arranged in a way as to simulate the thermal effects of their intended position in the complete equipment. The temperatures were measured at the interface of the sheath and the metal surface of each cell because the external sheath was fitted. The temperature was determined on the hottest surface of the cell that may be exposed to the explosive atmosphere and the maximum figure taken. The temperatures of the cells short-circuited were recorded with respect to time at room temperature.
The temperatures were measured using T-type thermocouples connected to a temperature-indicating device (μR10000 recorder of Yokogawa). The thermocouples were secured by tape.

After the application of the above tests, the test samples were placed with any case discontinuities, e.g. seals, facing downward over a piece of blotting paper for a period of at least 12 h.

B.4.2 Results

The test results were as follows.

Component	*Test method	Test conditions	Test result		Calculated maximum temperature			Verdict	Leaked Electrolyte for a period of at least 12 hours (Y/N)
			Max temp. measured	Ambient temp.	Max ambient temp (for T4)	Max temp corrected (for T4)	Safety margin (for T4)	T.Class (for T4)	
Tekcell, type SB-AA11 #1	TC	Short-circuited	98.4 °C	21.8 °C	50 °C	126.6 °C	5K	Pass	No leakage
Tekcell, type SB-AA11 #2	TC	Short-circuited	93.2 °C	21.6 °C	50 °C	121.6 °C	5K	Pass	No leakage
Tekcell, type SB-AA11 #3	TC	Short-circuited	96.5 °C	21.2 °C	50 °C	125.3 °C	5K	Pass	No leakage
Tekcell, type SB-AA11 #4	TC	Short-circuited	91.0 °C	21.8 °C	50 °C	119.2 °C	5K	Pass	No leakage
Tekcell, type SB-AA11 #5	TC	Short-circuited	90.1 °C	21.2 °C	50 °C	118.9 °C	5K	Pass	No leakage
Tekcell, type SB-AA11 #6	TC	Short-circuited	90.2 °C	19.4 °C	50 °C	120.8 °C	5K	Pass	No leakage
Tekcell, type SB-AA11 #7	TC	Short-circuited	93.6 °C	21.2 °C	50 °C	122.4 °C	5K	Pass	No leakage
Tekcell, type SB-AA11 #8	TC	Short-circuited	95.0 °C	21.0 °C	50 °C	124.0 °C	5K	Pass	No leakage
Tekcell, type SB-AA11 #9	TC	Short-circuited	93.1 °C	21.0 °C	50 °C	122.1 °C	5K	Pass	No leakage
Tekcell, type SB-AA11 #10	TC	Short-circuited	92.8 °C	20.8 °C	50 °C	122.0 °C	5K	Pass	No leakage

(*"Test method": TC-Thermocouple, TI-Thermal image scanner)

The maximum surface temperature of the battery pack determined from the tests was 126.6 °C at 50 °C ambient, which does not exceed 135 °C (T4), considering safety margin. Therefore, the battery pack satisfies the assigned temperature class T4 at 50 °C ambient.

For 12 hours after the short-circuited tests of the test samples until discharged, there was no visible sign of electrolyte leakage from the test samples.

B.5 Tests for intrinsically safe apparatus containing piezoelectric devices

Equipment Tested:	A sample of the G-Finder Multi GFM-400 series Portable Multi Gas Detector
Date of Test (yyyy/mm/dd):	2019/11/15
Clause and Standards:	Cl.10.7 of IEC 60079-11

B.5.1 Test procedures

The capacitance of the piezoelectric device was first obtained from the manufacturer's specification or measured using suitable instruments (such as E4980AL Precision LCR Meter of KEYSIGHT). The enclosure of the device was then subjected to two impact at (20 ± 10) °C and the maximum voltage generated across the piezoelectric device was measured using suitable instruments (such as DL1740 Digital Oscilloscope of Yokogawa). An impact energy of 7 J was affected by 1 kg test mass having a hardened steel impact head 25 mm in diameter falling through a vertical distance of 0.7 m. For the test, the intrinsically safe equipment was mounted on a steel base having a mass of at least 20 kg.

For portable equipment, the position was determined to produce the highest voltage. Protective guards(enclosure) used to prevent direct physical impact of the piezoelectric device were left in place for the test.

At the conclusion of the test, the energy stored by the piezoelectric device was calculated using the following formula:

$$E = 1/2 \times CV^2$$

Where: E = energy stored by the piezoelectric device, J
C = capacitance of the piezoelectric device, F
V = voltage measured across the piezoelectric device, V

B.5.2 Results

The test ambient temperature was 24.7 °C. The test results were as follows.

Test sample			Capacitance	Impact No.	Measured Voltage (V)	Calculated Energy (μJ)
Part No.	Manufacturer	Condition	19.5 nF	1	10.63	1.10
CBE1440BP-L	Daeyoung Electric	Installed in the equipment	(@ 120 Hz)	2	17.50	2.99

The energy stored by the piezoelectric device did not exceed 50 μJ for Group IIC. There was no damage to the protective guard(enclosure).

B.6 Drop test

Equipment Tested:	A sample of the G-Finder Multi GFM-400 series Portable Multi Gas Detector
Date of Test (yyyy/mm/dd):	2019/11/15
Clause and Standards:	Cl.26.4.3 and Cl.26.4.4 of IEC 60079-0

B.6.1 Test procedures

Prior to being dropped, the sample of the equipment employing a non-metallic enclosure was placed in a climate chamber for 24 hours to reduce its temperature to 5 °C below the lowest ambient temperature of the equipment, -25 °C.
The equipment was dropped four times onto a smooth concrete surface from a height of 1 m. the sample was released from the most unfavourable initial position(s) as determined by examination of the overall construction of the equipment.
The sample was observed for displacement or deformation invalidating the intrinsic safety and no ejection of any component.

B.6.2 Results

There was no significant visible damage of the equipment except superficial damage and no ejection of any component.

B.7 Surface resistance test of parts of parts of enclosures of non-metallic materials

Equipment Tested:	Each rectangular plate with 149 mm x 60 mm size of conductive elastomer, RTP 2099 E X 100781, and anti-static coating film, JB-SD10008
Date of Test (yyyy/mm/dd):	2019/03/21, 2019/06/04
Clause and Standards:	Cl.26.13 of IEC 60079-0

B.7.1 Test procedures

Each rectangular plate of conductive elastomer, RTP 2099 E X 100781, and anti-static coating film, JB-SD10008, having an intact clean surface was obtained from the manufacturer of the equipment.
The test pieces were cleaned with distilled water, then with isopropyl alcohol, then once more with distilled water before being dried. Untouched by bare hands, they were placed in a climate chamber and conditioned for at least 24 h at (23 ± 2) °C and (30 ± 5) or (50 ± 5) % relative humidity. The surface resistance tests were carried out under the same ambient conditions.
A voltage of (500 ± 10) V was applied for (65 ± 5) s between the electrodes and the resistance was measured using suitable instruments (such as UNILAP ISO X Digital Insulation tester).

B.7.2 Results

The surface resistance of the conductive elastomer, RTP 2099 E X 100781, was measured to be less than 3×10^8 Ω at (30 ± 5) % relative humidity.
The surface resistance of the anti-static coating film, JB-SD10008, was measured to be less than 2×10^7 Ω at (50 ± 5) % relative humidity.

GFM-400 ELECTRONIC SCHEDULE DRAWING LIST

Drawing No.	Title	Rev. No.	Date of Revision	Designed	Checked	Approved	Remarks
Ex-GE-25S00	GFM-400 INTRINSIC BLOCK DIAGRAM	1	14.08.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25S01	GFM-400 MAIN SCHEMATIC	1	24.07.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25S02	GFM-400 SENSOR SCHEMATIC	1	13.08.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25S03	GFM-400 BLEUTOOTH SCHEMATIC	1	15.07.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P00-1	TOP LAYER	0	22.07.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P00-2	SILK SCREEN TOP + SOLDER MASK TOP LAYERS	0	22.07.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P00-3	BOTTOM LAYER	0	22.07.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P00-4	SILK SCREEN BOTTOM + SOLDER MASK BOTTOM LAYERS	0	22.07.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P00-5	GROUND PLANE	0	22.07.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P00-6	POWER PLANE	0	22.07.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P00-7	TOP LAYER DIMENSION	0	22.07.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P00-8	BOTTOM LAYER DIMENSION	0	22.07.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P00-9	GROUND PLANE DIMENSION	0	22.07.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P00-10	POWER PLANE DIMENSION	0	22.07.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P00-11	DRILL	0	22.07.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P01-1	TOP LAYER	0	20.09.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P01-2	SILK SCREEN TOP + SOLDER MASK TOP LAYERS	0	20.09.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P01-3	BOTTOM LAYER	0	20.09.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P01-4	SILK SCREEN BOTTOM + SOLDER MASK BOTTOM LAYERS	0	20.09.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P01-5	GROUND PLANE	0	20.09.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P01-6	POWER PLANE	0	20.09.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P01-7	TOP LAYER DIMENSION	0	20.09.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P01-8	BOTTOM LAYER DIMENSION	0	20.09.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P01-9	GROUND PLANE DIMENSION	0	20.09.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P01-10	POWER PLANE DIMENSION	0	20.09.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P01-11	DRILL	0	20.09.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P02-1	TOP LAYER(SILK SCREEN TOP + SOLDER MASK TOP) LAYERS	0.3	19.07.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P02-2	BOTTOM(SILK SCREEN BOT + SOLDER MASK BOT) LAYERS	0.3	19.07.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P02-3	GROUND-1 PLANE	0.3	19.07.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25P02-4	GROUND-2 PLANE	0.3	19.07.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25B00	GFM-400 MAIN PART LIST	1	30.09.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25B01	GFM-400 SENSOR PART LIST	1	14.08.2019	S.M. BAE	S.H. YI	H.J. JOUNG	
Ex-GE-25B02	GFM-400 BLUETOOTH PART LIST	1	24.07.2019	S.M. BAE	S.H. YI	H.J. JOUNG	

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GFM-400 / INTRINSIC BLOCK DIAGRAM

Ex-GE-25S00

REV1.0 / 2019.08.14

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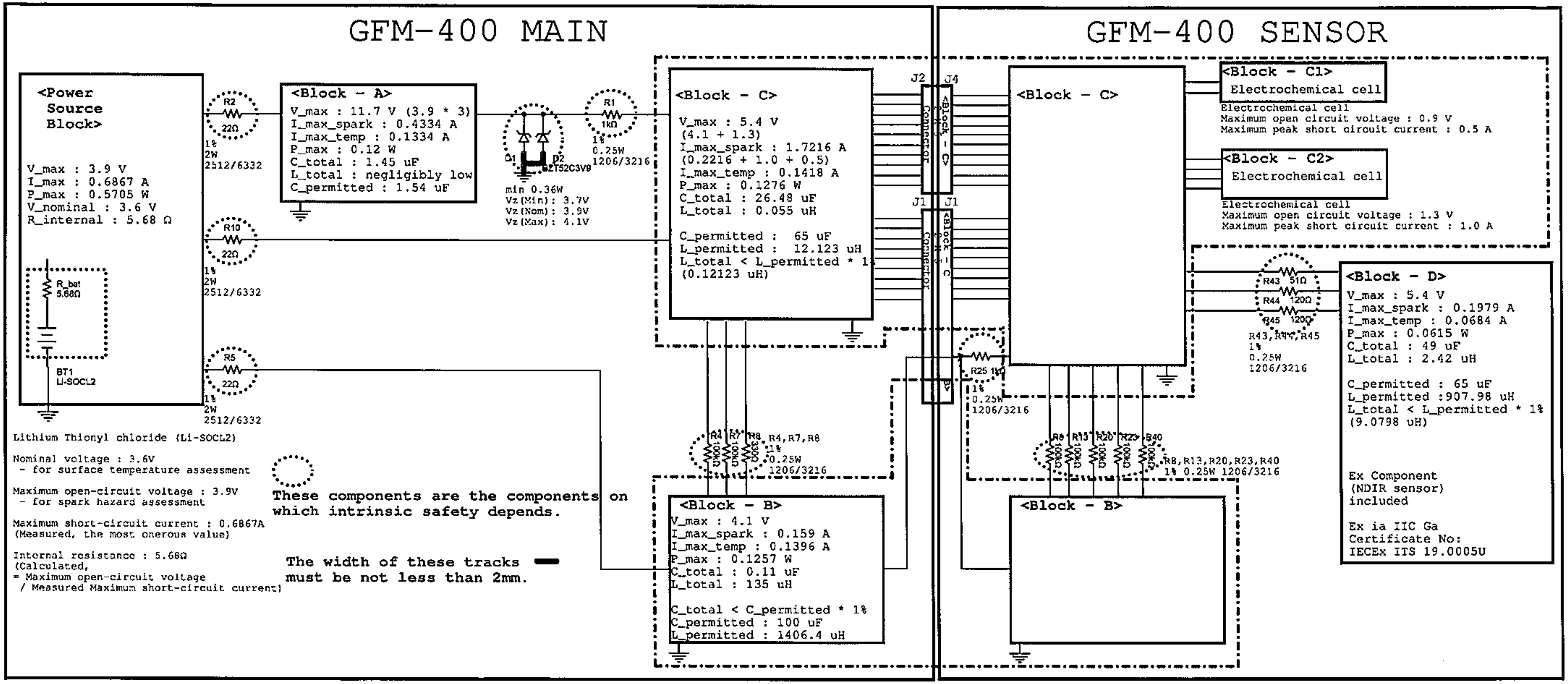
R&D PART

GASTRON

Rev.	Description	Rev. Date	DRAWN	CHECKED	APPROVED
1.0	For issued	14.08.2019	S.M. BAE	S.H. YI	H.J. JOUNG



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2019.11.19

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APPROVAL	GASTRON CO., LTD.
DRAWN S.M BAE	Model GFM-400
	Title GFM-400 Intrinsic Block Diagram
CHECKED S.H YI	Size A3 / Rev 1.0
APPROVED H.J JOUNG	Date Wednesday, August 14, 2019
	DWG. No Ex-GE-26S00 / Sheet 1 of 1

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GFM-400 / MAIN SCHEMATIC

Ex-GE-25S01

REV1.0 / 2019.07.24

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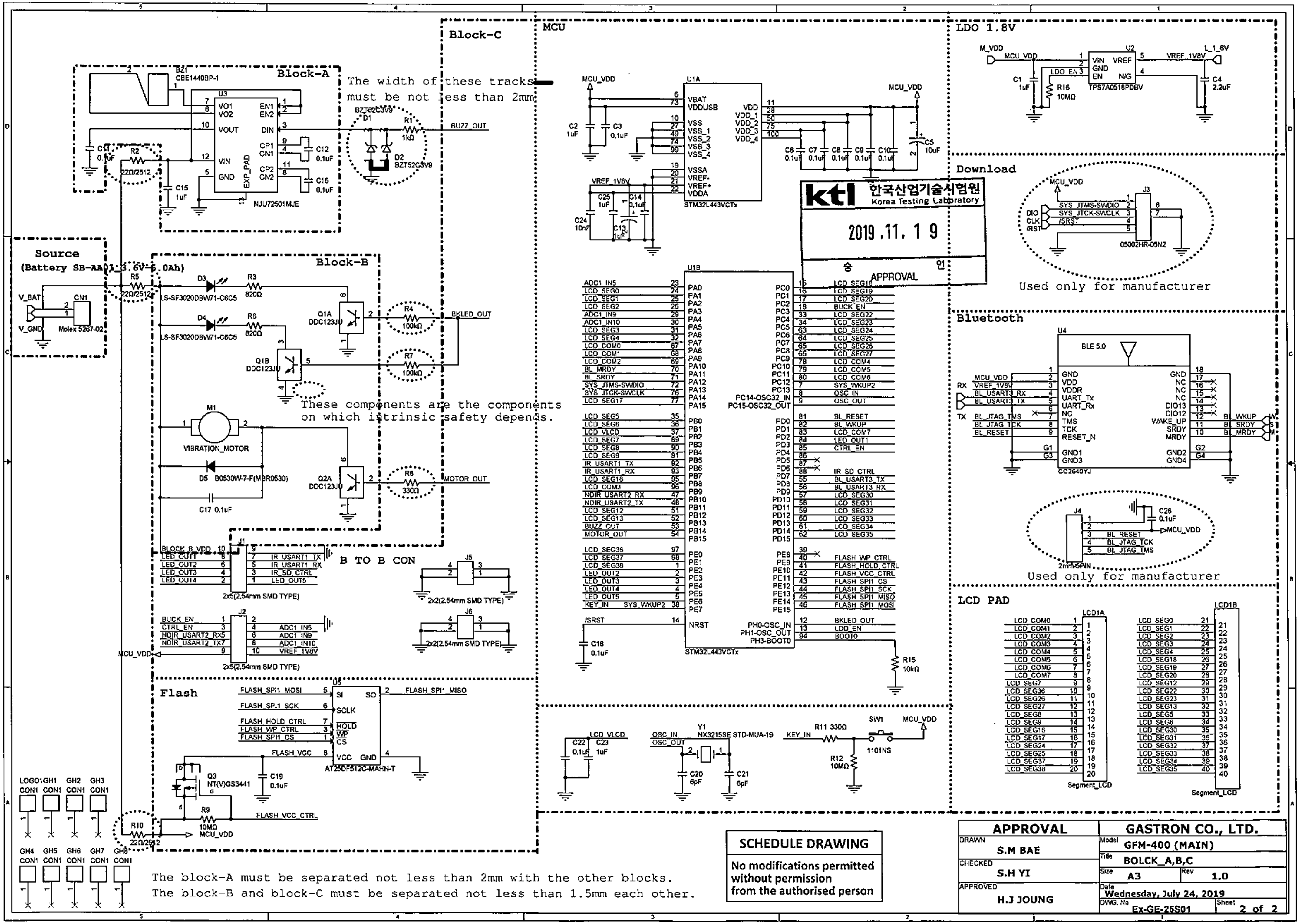
GASTRON

Rev.	Description	Rev. Date	DRAWN	CHECKED	APPROVED
1.0	For issued	24.07.2019	S.M. BAE	S.H. YI	H.J. JOUNG



The block-A must be separated not less than 2mm with the other blocks.
The block-B and block-C must be separated not less than 1.5mm each other.

SCHEDULE DRAWING

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APPROVAL		GASTRON CO., LTD.	
DRAWN	S.M BAE	Model	GFM-400 (MAIN)
CHECKED	S.H YI	Title	BOLCK_A,B,C
APPROVED	H.J JOUNG	Size A3	Rev 1.0
		Date	Wednesday, July 24, 2019
		DWG. No Ex-GE-25S01	Sheet 2 of 2

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GFM-400 / SENSOR SCHEMATIC

Ex-GE-25S02

REV1.0 / 2019.08.13

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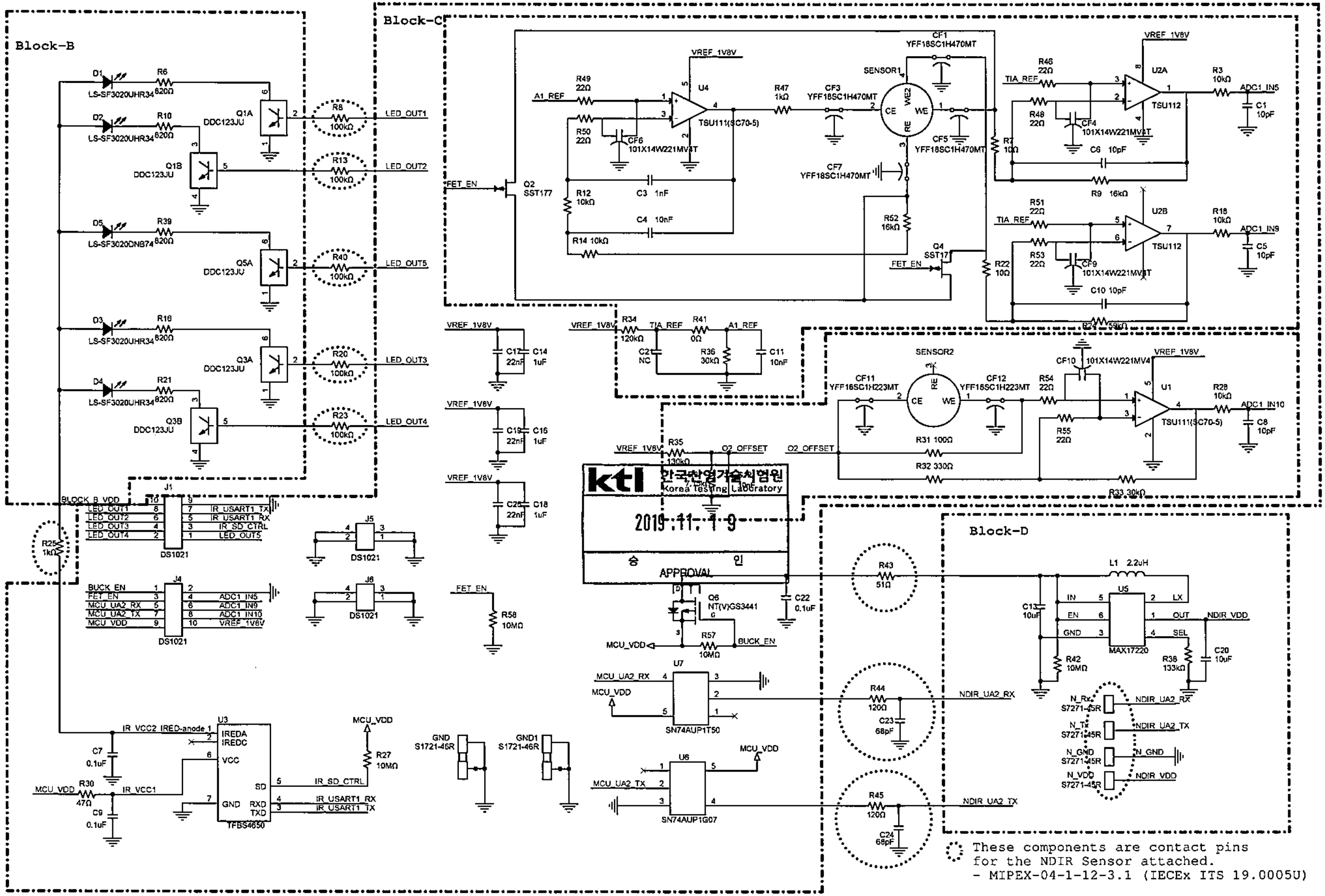
Rev.	Description	Rev. Date	DRAWN	CHECKED	APPROVED
1.0	For issued	08.13.2019	S.M. BAE	S.H. YI	H.J. JOUNG



These components are contact pins for the NDIR Sensor attached.
- MIPEX-04-1-12-3.1 (IECEx ITS 19.0005U)

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These components are the components on which intrinsic safety depends.

The block-D must be separated not less than 2mm with the other blocks.
The block-B and block-C must be separated not less than 1.5mm each other.

LOGO1 GH1 GH8 GH7 GH2 GH3 GH4 GH5 GH6
CON1 CON1 CON1 CON1 CON1 CON1 CON1 CON1 CON1

SCHEDULE DRAWING

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APPROVAL	GASTRON CO., LTD.
DRAWN S.M BAE	Model GFM-400 (SENSOR)
CHECKED S.H YI	Title BLOCK_B,C,D
	Size A3 Rev 1.0
APPROVED H.J JOUNG	Date Tuesday, August 13, 2019
	DWG. No Ex-GE-25S02 Sheet 2 of 2

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GFM-400 / BLUETOOTH SCHEMATIC

Ex-GE-25S03

REV1.0 / 2019.07.15

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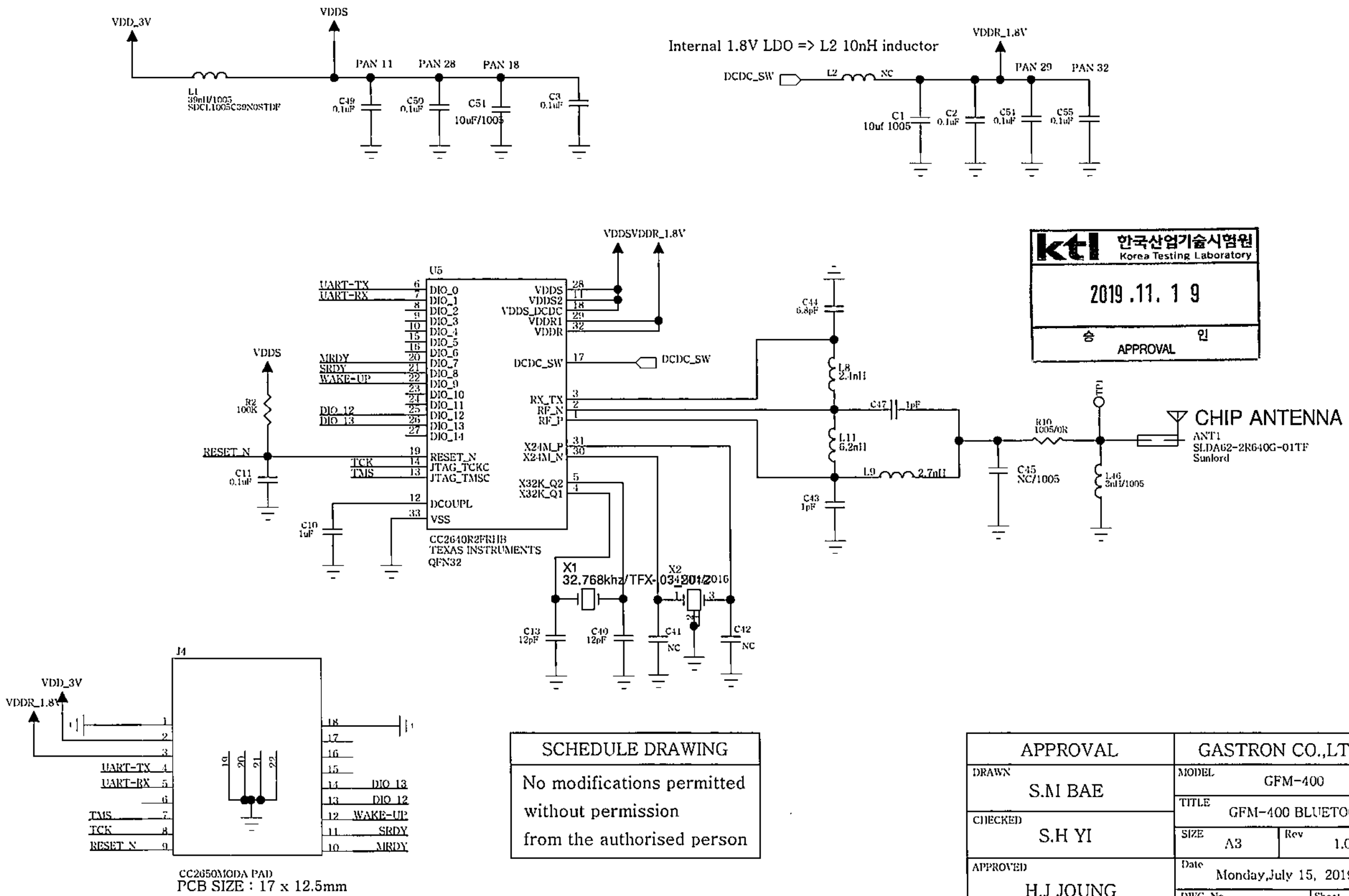
Rev.	Description	Rev. Date	DRAWN	CHECKED	APPROVED
1.0	For issued	15.07.2019	S.M. BAE	S.H. YI	H.J. JOUNG



PCB SIZE : 17 x 12.5mm

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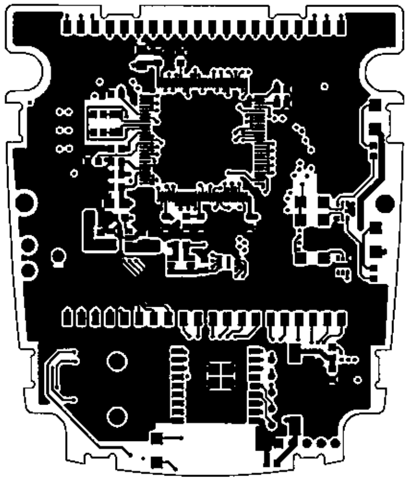
APPROVAL		GASTRON CO.,LTD.	
DRAWN S.M BAE		MODEL GFM-400	
		TITLE GFM-400 BLUETOOTH	
CHECKED S.H YI		SIZE A3	Rev 1.0
APPROVED H.J JOUNG		Date Monday,July 15, 2019	
		DWG. No Ex-GE-25S03	Sheet 1 of 1



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< PCB INFORMATION >

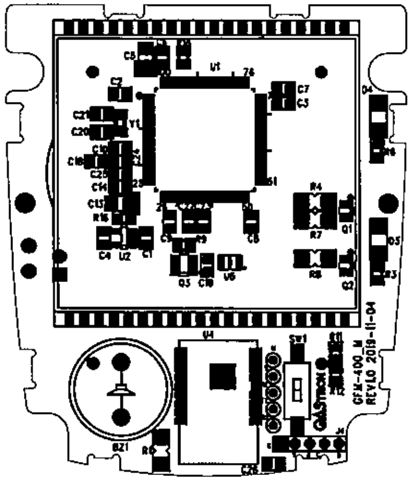
- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Power Plane
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

GASTRON CO.,LTD.

Model	GFM-400 MAIN PCB		
Title	TOP LAYER		
Part No.	490A801-0001		
Material	FR-4 / ENIG	**Finish**	
Q'ty	-	**Scale**	1/1
Pro-jection		**Units**	mm
DWG. No.	Ex-GE-25P00-1	**Rev.**	0

3					
2					
1					
0	For issued (PCB Rev1.0)	22.07.2019	S.M.BAE	S.H.YI	H.J.JOUNG
Rev.	**Description**	**Date**	**Designed**	**Checked**	**Approved**



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< PCB INFORMATION >

- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Power Plane
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

GASTRON CO.,LTD.

Model	GFM-400 MAIN PCB		
Title	SILK SCREEN TOP + SOLDER MASK TOP LAYERS		
Part No.	490A801-0001		
Material	FR-4 / ENIG	**Finish**	
Q'ty	-	**Scale**	1/1
Pro-jection		**Units**	mm
DWG. No.	Ex-GE-25P00-2	**Rev.**	0

Rev.	Description	Date	Designed	Checked	Approved
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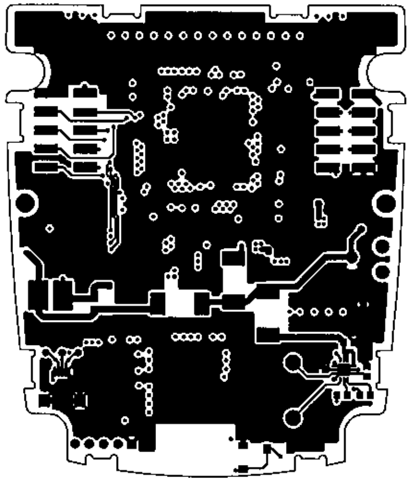
2					
1					
0	For issued (PCB Rev1.0)	22.07.2019	S.M.BAE	S.H.YI	H.J.JOUNG



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< PCB INFORMATION >

- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Power Plane
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

GASTRON CO.,LTD.

Model	GFM-400 MAIN PCB		
Title	BOTTOM LAYER		
Part No.	490A801-0001		
Material	FR-4 / ENIG	**Finish**	
Q'ty	-	**Scale**	1/1
Pro-jection		**Units**	mm
DWG. No.	Ex-GE-25P00-3	**Rev.**	0

Rev.	Description	Date	Designed	Checked	Approved
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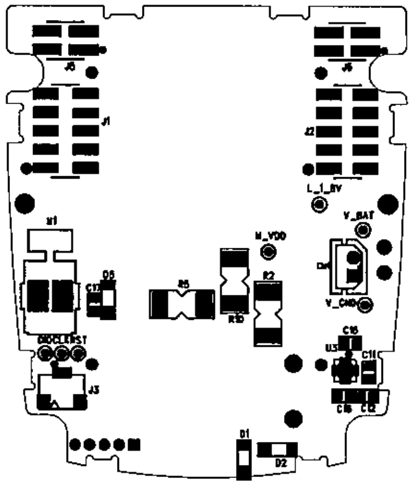
2					
1					
0	For issued (PCB Rev1.0)	22.07.2019	S.M.BAE	S.H.YI	H.J.JOUNG



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< PCB INFORMATION >

- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Power Plane
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

GASTRON CO.,LTD.

Model	GFM-400 MAIN PCB		
Title	SILK SCREEN BOTTOM + SOLDER MASK BOTTOM LAYERS		
Part No.	490A801-0001		
Material	FR-4 / ENIG	Finish	
Q'ty	-	Scale	1/1
Projection		Units	mm
DWG. No.	Ex-GE-25P00-4	Rev.	0

Rev.	Description	Date	Designed	Checked	Approved
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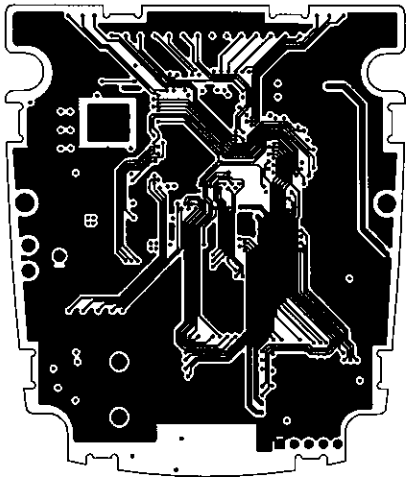
2					
1					
0	For issued (PCB Rev1.0)	22.07.2019	S.M.BAE	S.H.YI	H.J.JOUNG



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< PCB INFORMATION >

- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Power Plane
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

GASTRON CO.,LTD.

Model	GFM-400 MAIN PCB
Title	GROUND PLANE
Part No.	490A801-0001

Material	FR-4 / ENIG	Finish	
Q'ty	-	Scale	1/1
Projection		Units	mm
DWG. No.	Ex-GE-25P00-5	Rev.	0

Rev.	Description	Date	Designed	Checked	Approved
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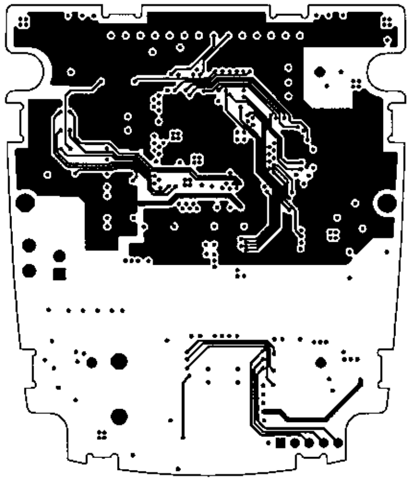
2					
1					
0	For issued (PCB Rev1.0)	22.07.2019	S.M.BAE	S.H.YI	H.J.JOUNG



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< PCB INFORMATION >

- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Power Plane
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

GASTRON CO.,LTD.

Model	GFM-400 MAIN PCB		
Title	POWER PLANE		
Part No.	490A801-0001		
Material	FR-4 / ENIG	**Finish**	
Q'ty	-	**Scale**	1/1
Pro-jection		**Units**	mm
DWG. No.	Ex-GE-25P00-6	**Rev.**	0

Rev.	**Description**	**Date**	**Designed**	**Checked**	**Approved**
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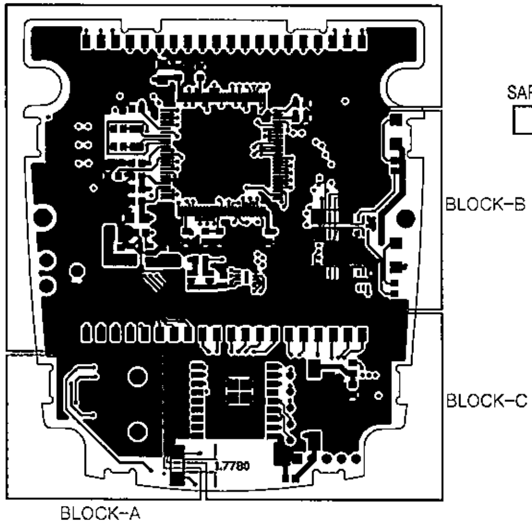
2					
1					
0	For issued (PCB Rev1.0)	22.07.2019	S.M.BAE	S.H.YI	H.J.JOUNG



SAFETY COMPONENT

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< PCB INFORMATION >

- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

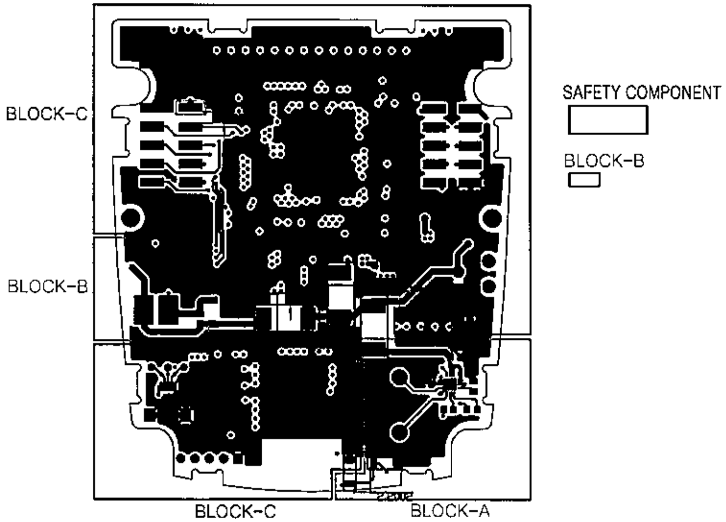
Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Power Plane
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

GASTRON CO.,LTD.

Model	GFM-400 MAIN PCB
Title	TOP LAYER DIMENSION
Part No.	490A801-0001

Rev.	Description	Date	Designed	Checked	Approved
3					
2					
1					
0	For issued (PCB Rev1.0)	22.07.2019	S.M.BAE	S.H.YI	H.J.JOUNG

Material	FR-4 / ENIG	Finish	
Q'ty	-	Scale	1/1
Projection	⌖	Units	mm
DWG. No.	Ex-GE-25P00-7	Rev.	0



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2019.11.19

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< PCB INFORMATION >

- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

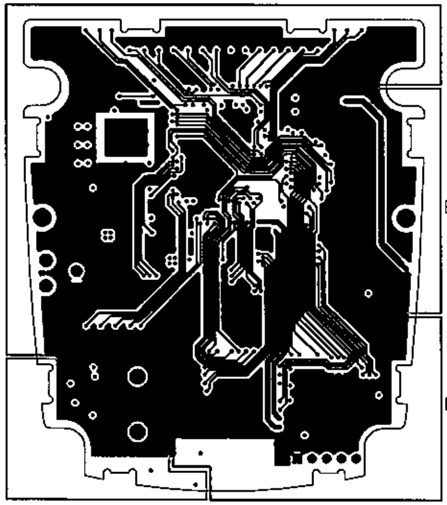
Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Power Plane
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

GASTRON CO.,LTD.

Model	GFM-400 MAIN PCB
Title	BOTTOM LAYER DIMENSION
Part No.	490A801-0001

Rev.	Description	Date	Designed	Checked	Approved
3					
2					
1					
0	For issued (PCB Rev1.0)	22.07.2019	S.M.BAE	S.H.YI	H.J.JOUNG

Material	FR-4 / ENIG	Finish	
Q'ty	-	Scale	1/1
Projection		Units	mm
DWG. No.	Ex-GE-25P00-8	Rev.	0



< PCB INFORMATION >

- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Power Plane
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

SCHEDULE DRAWING

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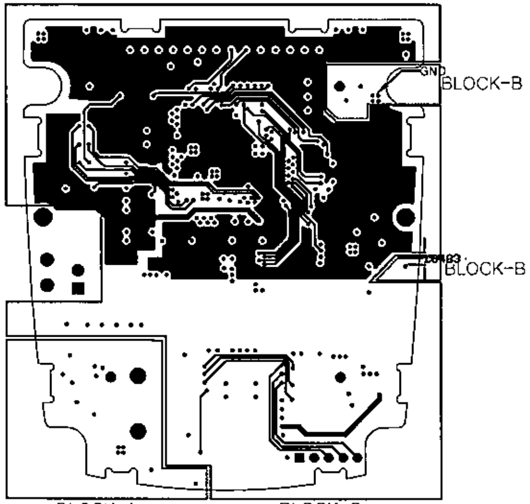
2019.11.19

승 인 APPROVAL

GASTRON CO.,LTD.

Model	GFM-400 MAIN PCB		
Title	GROUND PLANE DIMENSION		
Part No.	490A801-0001		
Material	FR-4 / ENIG	Finish	
Q'ty	-	Scale	1/1
Projection		Units	mm
DWG. No.	Ex-GE-25P00-9	Rev.	0

Rev.	Description	Date	Designed	Checked	Approved
3					
2					
1					
0	For issued (PCB Rev1.0)	22.07.2019	S.M.BAE	S.H.YI	H.J.JOUNG



SCHEDULE DRAWING

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without permission
from the authorised person

< PCB INFORMATION >

- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Power Plane
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

GASTRON CO.,LTD.

Model	GFM-400 MAIN PCB		
Title	POWER PLANE DIMENSION		
Part No.	490A801-0001		
Material	FR-4 / ENIG	Finish	
Q'ty	-	Scale	1/1
Projection		Units	mm
DWG. No.	Ex-GE-25P00-10	Rev.	0

Rev.	Description	Date	Designed	Checked	Approved
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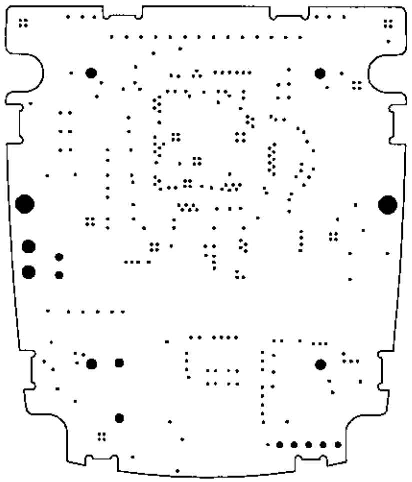
2					
1					
0	For issued (PCB Rev1.0)	22.07.2019	S.M.BAE	S.H.YI	H.J.JOUNG



SCHEDULE DRAWING
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2019 .11. 1 9

승 인
APPROVAL

< PCB INFORMATION >

- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Power Plane
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

GASTRON CO.,LTD.

Model	GFM-400 MAIN PCB		
Title	DRILL		
Part No.	490A801-0001		
Material	FR-4 / ENIG	**Finish**	
Q'ty	-	**Scale**	1/1
Projection	⊕⊲	**Units**	mm
DWG. No.	Ex-GE-25P00-11	**Rev.**	0

Rev.	Description	Date	Designed	Checked	Approved
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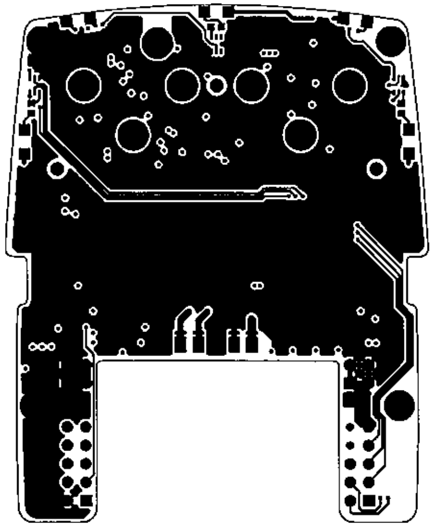
2					
1					
0	For issued (PCB Rev1.0)	22.07.2019	S.M.BAE	S.H.YI	H.J.JOUNG



SCHEDULE DRAWING

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2019.11.19

승인 APPROVAL

- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Power Plane
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

GASTRON CO.,LTD.

Model	GFM-400 SENSOR PCB		
Title	TOP LAYER		
Part No.	490A802-0001		
Material	FR-4 / ENIG	Finish	
Q'ty	-	Scale	1/1
Projection	⌖	Units	mm
DWG. No.	Ex-GE-25P01-1	Rev.	0

Rev.	Description	Date	Designed	Checked	Approved
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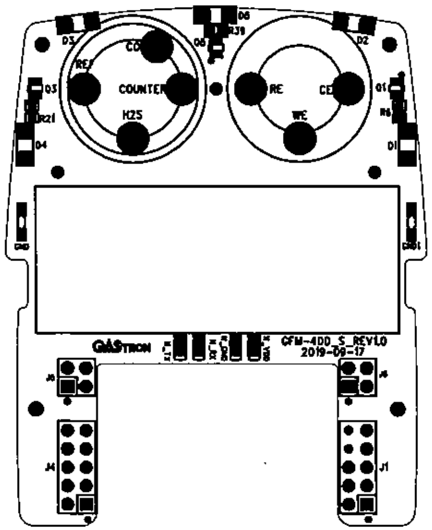
2					
1					
0	For issued (PCB Rev1.0)	20.09.2019	S.M.BAE	S.H.YI	H.J.JOUNG



SCHEDULE DRAWING
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2019 .11. 1 9

승 인 APPROVAL

- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Power Plane
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

GASTRON CO.,LTD.

Model	GFM-400 SENSOR PCB		
Title	SILK SCREEN TOP + SOLDER MASK TOP LAYERS		
Part No.	490AB02-0001		
Material	FR-4 / ENIG	Finish	
Q'ty	-	Scale	1/1
Projection		Units	mm
DWG. No.	Ex-GE-25P01-2	Rev.	0

Rev.	Description	Date	Designed	Checked	Approved
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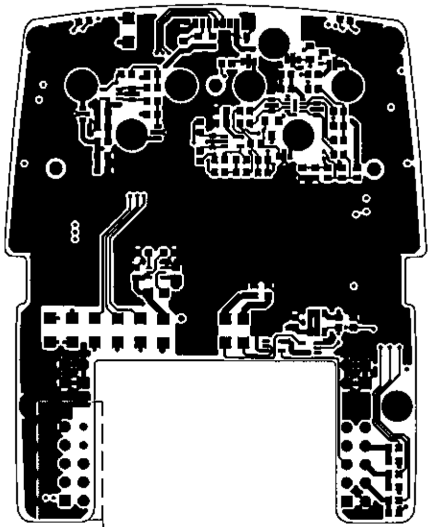
2					
1					
0	For issued (PCB Rev1.0)	20.09.2019	S.M.BAE	S.H.YI	H.J.JOUNG



< Coating area on the bottom layer for the SENSOR PCB >
This area should be coated at least once with coating material "PAS-7800" by using a brush after soldering.

SCHEDULE DRAWING
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2019.11.19
승인 APPROVAL

- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

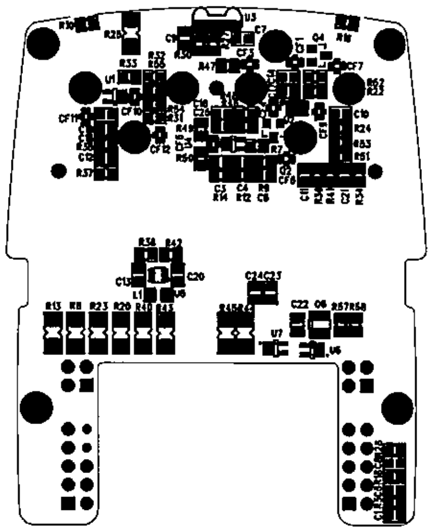
Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Power Plane
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

GASTRON CO.,LTD.

Model	GFM-400 SENSOR PCB
Title	BOTTOM LAYER
Part No.	490A802-0001

Material	FR-4 / ENIG	Finish	
Q'ty	-	Scale	1/1
Projection	⊕◁	Units	mm
DWG. No.	Ex-GE-25P01-3	Rev.	△0

Rev.	Description	Date	Designed	Checked	Approved
△3					
△2					
△1					
△0	For issued (PCB Rev1.0)	20.09.2019	S.M.BAE	S.H.YI	H.J.JOUNG



SCHEDULE DRAWING
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2019.11.19
승인 APPROVAL

- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Power Plane
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

GASTRON CO.,LTD.

Model	GFM-400 SENSOR PCB
Title	SILK SCREEN BOTTOM + SOLDER MASK BOTTOM LAYERS
Part No.	490A802-0001

Material	FR-4 / ENIG	Finish	
Q'ty	-	Scale	1/1
Projection	⊕◁	Units	mm
DWG. No.	Ex-GE-25P01-4	Rev.	0

Rev.	Description	Date	Designed	Checked	Approved
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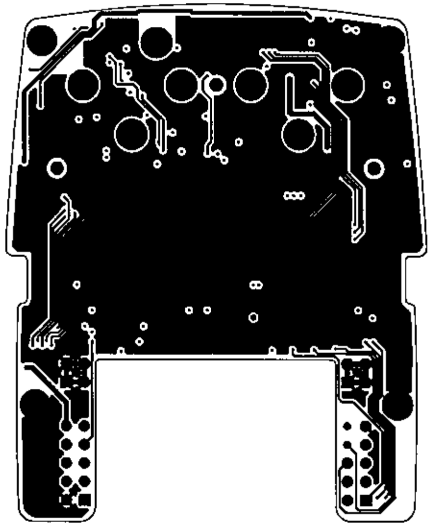
2					
1					
0	For issued (PCB Rev1.0)	20.09.2019	S.M.BAE	S.H.YI	H.J.JOUNG



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2019.11.19

승인 APPROVAL

- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Power Plane
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

GASTRON CO.,LTD.

Model	GFM-400 SENSOR PCB		
Title	GROUND PLANE		
Part No.	490A802-0001		
Material	FR-4 / ENIG	Finish	
Q'ty	-	Scale	1/1
Projection	⌖	Units	mm
DWG. No.	Ex-GE-25P01-5	Rev.	0

Rev.	Description	Date	Designed	Checked	Approved
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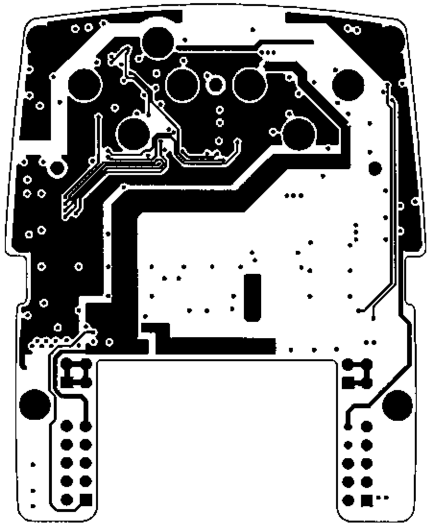
2					
1					
0	For issued (PCB Rev1.0)	20.09.2019	S.M.BAE	S.H.YI	H.J.JOUNG



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Korea Testing Laboratory

2019 .11. 1 9

승 인
APPROVAL

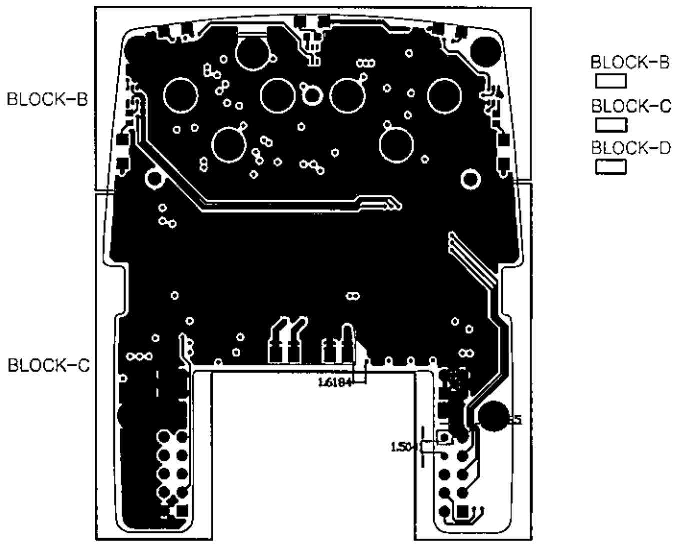
- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Power Plane
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

Rev.	Description	Date	Designed	Checked	Approved
3					
2					
1					
0	For issued (PCB Rev1.0)	20.09.2019	S.M.BAE	S.H.YI	H.J.JOUNG

GASTRON CO.,LTD.

Model	GFM-400 SENSOR PCB		
Title	POWER PLANE		
Part No.	490A802-0001		
Material	FR-4 / ENIG	Finish	
Q'ty	-	Scale	1/1
Pro-jection		Units	mm
DWG. No.	Ex-GE-25P01-6	Rev.	0



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Korea Testing Laboratory

2019 .11. 1 9

승 인
APPROVAL

- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Power Plane
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

GASTRON CO.,LTD.

Model	GFM-400 SENSOR PCB		
Title	TOP LAYER DIMENSION		
Part No.	490A802-0001		
Material	FR-4 / ENIG	Finish	
Q'ty	-	Scale	1/1
Projection	⌖	Units	mm
DWG. No.	Ex-GE-25P01-7	Rev.	0

Rev.	Description	Date	Designed	Checked	Approved
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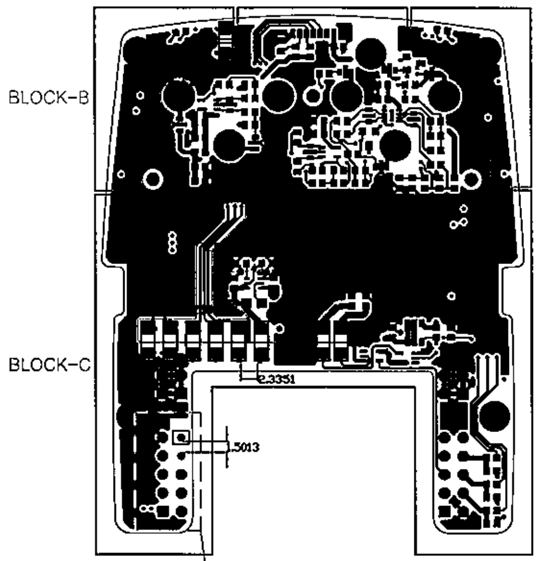
1					
0	For issued (PCB Rev1.0)	20.09.2019	S.M.BAE	S.H.YI	H.J.JOUNG



SAFETY COMPONENT

BLOCK-B

BLOCK-D

< Coating area on the bottom layer for the SENSOR PCB >
This area should be coated at least once with coating material "PAS-7800" by using a brush after soldering.

SCHEDULE DRAWING

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2019.11.19
승인 APPROVAL

- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Power Plane
Prepreg / Substrate	0.06 – 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

GASTRON CO.,LTD.

Model	GFM-400 SENSOR PCB		
Title	BOTTOM LAYER DIMENSION		
Part No.	490A802-0001		
Material	FR-4 / ENIG	Finish	
Q'ty	-	Scale	1/1
Projection	⊕◁	Units	mm
DWG. No.	Ex-GE-25P01-8	Rev.	0

Rev.	Description	Date	Designed	Checked	Approved
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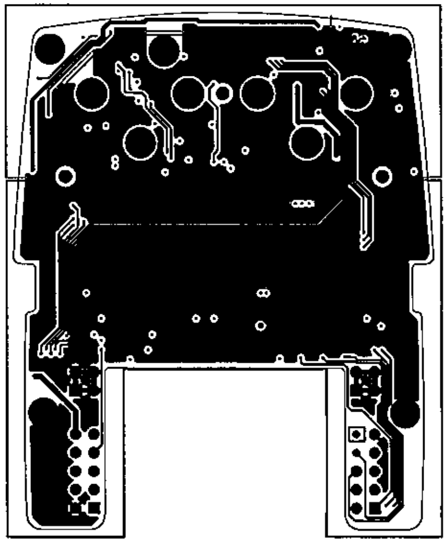
1					
0	For issued (PCB Rev1.0)	20.09.2019	S.M.BAE	S.H.YI	H.J.JOUNG



SCHEDULE DRAWING

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2019 .11. 1 9
승 인 APPROVAL

- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Power Plane
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

GASTRON CO.,LTD.

Model	GFM-400 SENSOR PCB		
Title	GROUND PLANE DIMENSION		
Part No.	490A802-0001		
Material	FR-4 / ENIG	Finish	
Q'ty	-	Scale	1/1
Projection		Units	mm
DWG. No.	Ex-GE-25P01-9	Rev.	0

Rev.	Description	Date	Designed	Checked	Approved
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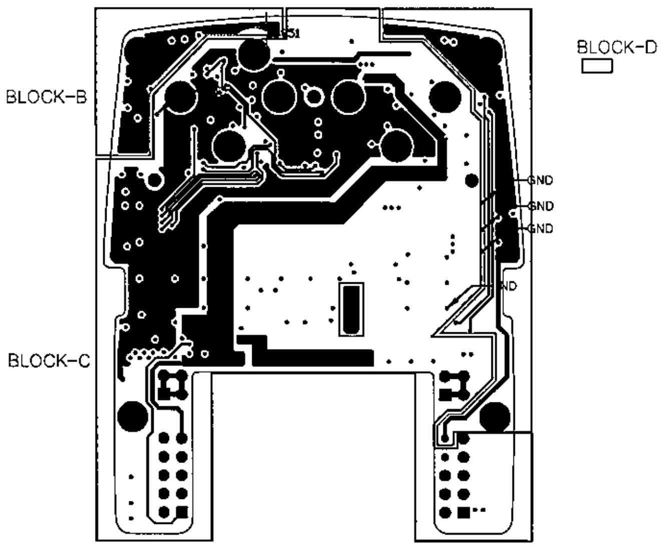
2					
1					
0	For issued (PCB Rev1.0)	20.09.2019	S.M.BAE	S.H.YI	H.J.JOUNG



SCHEDULE DRAWING
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ktl 한국산업기술시험원 Korea Testing Laboratory

2019.11.19

승 인 APPROVAL

- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Power Plane
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

GASTRON CO.,LTD.

Model	GFM-400 SENSOR PCB		
Title	POWER PLANE DIMENSION		
Part No.	490A802-0001		
Material	FR-4 / ENIG	Finish	
Q'ty	-	Scale	1/1
Projection		Units	mm
DWG. No.	Ex-GE-25P01-10	Rev.	0

Rev.	Description	Date	Designed	Checked	Approved
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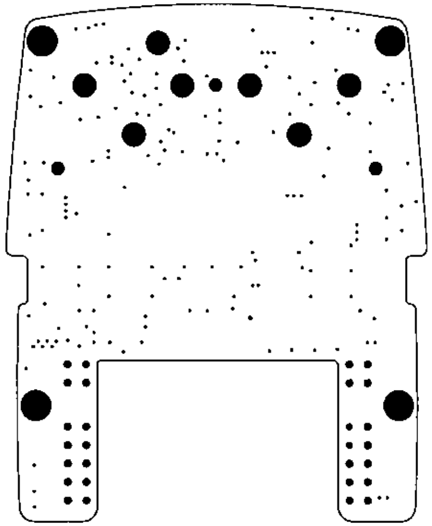
2					
1					
0	For issued (PCB Rev1.0)	20.09.2019	S.M.BAE	S.H.YI	H.J.JOUNG



SCHEDULE DRAWING
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ktl 한국산업기술시험원 Korea Testing Laboratory

2019 .11. 1 9

승 인
APPROVAL

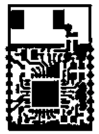
- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

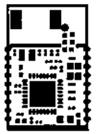
Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Power Plane
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

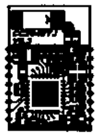
GASTRON CO.,LTD.

Model	GFM-400 SESNSOR PCB		
Title	DRILL		
Part No.	490A802-0001		
Material	FR-4 / ENIG	Finish	
Q'ty	-	Scale	1/1
Projection		Units	mm
DWG. No.	Ex-GE-25P01-11	Rev.	0

Rev.	Description	Date	Designed	Checked	Approved
3					
2					
1					
0	For issued (PCB Rev1.0)	20.09.2019	S.M.BAE	S.H.YI	H.J.JOUNG







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< PCB INFORMATION >

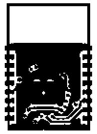
- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

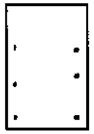
Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground-1 Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Ground-2 Plane
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

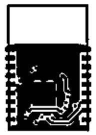
GASTRON CO.,LTD.

Model	GFM-400 BLUETOOTH PCB		
Title	TOP(SILK + SOLDER) LAYER		
Part No.	490A801-0001		
Material	FR-4 / ENIG	Finish	
Q'ty	-	Scale	1/1
Pro-jection	⌖	Units	mm
DWG. No.	Ex-GE-25P02-1	Rev.	0.3

Rev.	Description	Date	Designed	Checked	Approved
3					
2					
1					
0.3	For issued (PCB Rev0.3)	19.07.2019	S.M.BAE	S.H.YI	H.J.JOUNG







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< PCB INFORMATION >

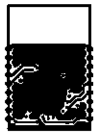
- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground-1 Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Ground-2 Plane
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

GASTRON CO.,LTD.

Model	GFM-400 BLUETOOTH PCB		
Title	BOTTOM(SILK + SOLDER) LAYER		
Part No.	490A801-0001		
Material	FR-4 / ENIG	Finish	
Q'ty	-	Scale	1/1
Projection	⌖	Units	mm
DWG. No.	Ex-GE-25P02-2	Rev.	0.3

Rev.	Description	Date	Designed	Checked	Approved
3					
2					
1					
0	For issued (PCB Rev0.3)	19.07.2019	S.M.BAE	S.H.YI	H.J.JOUNG



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< PCB INFORMATION >

- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

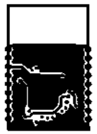
Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground-1 Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Ground-2 Plane
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

GASTRON CO.,LTD.

Model	GFM-400 BLUETOOTH PCB
Title	Ground-1 LAYER
Part No.	490A801-0001

Rev.	Description	Date	Designed	Checked	Approved
△					
△					
△					
△	For issued (PCB Rev0.3)	19.07.2019	S.M.BAE	S.H.YI	H.J.JOUNG

Material	FR-4 / ENIG	Finish	
Q'ty	-	Scale	1/1
Projection	⊕⊲	Units	mm
DWG. No.	Ex-GE-25P02-3	Rev.	△ 0.3



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2019.11.19

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< PCB INFORMATION >

- PCB Material : FR-4
- PCB Thickness : 1.6 mm
- PCB Layer : 4 Layers
- Conductor material : Copper
- Minimum conducting track thickness: 33.5 um
- Minimum track width: 0.2 mm
- CTI: 100 or Greater
- Laminated structure of the PCB

Structure	Thickness	Layer
Silk	-	Silk Top
Soldermask	-	Soldermask Top
Copper	> 33 um	Top Layer
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	35 um (1 oz)	Ground-1 Plane
Core	1.13 mm or 0.93 mm	-
Copper	35 um (1 oz)	Ground-2 Plane
Prepreg / Substrate	0.06 ~ 0.2 mm	-
Copper	> 33 um	Bottom Layer
Soldermask	-	Soldermask Bottom
Silk	-	Silk Bottom

GASTRON CO.,LTD.

Model	GFM-400 BLUETOOTH PCB
Title	Ground-2 LAYER
Part No.	490A801-0001

Material	FR-4 / ENIG	**Finish**	
Q'ty	-	**Scale**	1/1
Projection		**Units**	mm
DWG. No.	Ex-GE-25P02-4	**Rev.**	△

Rev.	Description	Date	Designed	Checked	Approved
△					
△					
△					
△	For issued (PCB Rev0.3)	19.07.2019	S.M.BAE	S.H.YI	H.J.JOUNG

SCHEDULE DOCUMENT	GFM-400_MAIN Part List	Doc. NO.	Ex-GE-25B00				
No modifications permitted without permission from the authorised person		Rev. No.	Description	Rev. Date	Prepared by	Reviewed by	Approved by
		1.0	For issued	2019.09.30	S.M. BAE	S.H. YI	H.J. JOUNG

NO.	Reference	Value (Available Range)	Value (Default)	Tolerance	Maximum Rating	Package	Manufacturer	Part Number of Manufacturer	Remarks
1	BT1	SB-AA11	SB-AA11	-	-	AA-size	VITZRO CELL	SB-AA11	Component on which intrinsic safety depends
2	R2,R5,R10	22Ω	22Ω	1%	≥ 1 W	R2512	WALSIN or ANY	WR25X22R0FTL	Component on which intrinsic safety depends
3	D1,D2	BZT52C3V9	BZT52C3V9	3.7 ~ 4.1 V	≥ 0.3 W	SOD123	GAOMI FEI SHI LONG DA ELECTRONICS Co.,Ltd or Diodes Incorporated	BZT52C3V9	Component on which intrinsic safety depends
4	R1	1kΩ	1kΩ	1%	≥ 0.25 W	R1206	WALSIN or ANY	WR12X1001FTL	Component on which intrinsic safety depends
5	R8	330Ω	330Ω	1%	≥ 0.25 W	R1206	WALSIN or ANY	WR12X3300FTL	Component on which intrinsic safety depends
6	R4,R7	100kΩ	100kΩ	1%	≥ 0.25 W	R1206	WALSIN or ANY	WR12X1003FTL	Component on which intrinsic safety depends
7	BZ1	CBE1440BP-L	CBE1440BP-L	±30%	25 V	-	Daeyoung Electric Co., LTD.	CBE1440BP-L	-
8	M1	Z6SH1B0060711	Z6SH1B0060711	-	0.105A	-	JINLONG MACHINERY & ELECTRONICS CO., LTD.	Z6SH1B0060711	-
9	CN1	5267-02A	5267-02A	-	-	-	Molex	0022035025	-
10	J1,J2	DS1023-15_10pin	DS1023-15_10pin	-	-	-	CONNFLY ELECTRONIC CO., LTD.	DS1023-15	-
11	J5,J6	DS1023-15_4pin	DS1023-15_4pin	-	-	-	CONNFLY ELECTRONIC CO., LTD.	DS1023-15	-
12	J3	05002HR-05N2 / NC	05002HR-05N2	-	-	-	YEONHO ELECTRONICS CO., LTD.	05002HR-05N2	-
13	LCD1	Segment LCD	KJCEL01023FS6-03_A	-	-	-	KJC Display Corporation	KJCEL00933FR6-03_A	-
14	LCD1	LCD Rubber connector	KJCER00120-05_A	-	-	-	KJC Display Corporation	KJCER00105-03_A	-
15	SW1	1101NS(4.3mm)	1101NS(4.3mm)	-	12V / 0.05A	-	ECHO TECH or ANY	1101NS(4.3mm)	-
16	C1,C2,C15,C23,C25	1uF	1uF	±10%	50 V	C0603	SAMSUNG or ANY	CL10A105KB8NNNC	-
17	C3,C6,C7,C8,C9,C10,C11,C12,C14, C16,C17,C18,C19,C22,C26	0.1uF	0.1uF	±10%	50 V	C0603	MULATA or ANY	GRM188R71H104KA93D / CL10B104KB8NNNC	-
18	C4	2.2uF	2.2uF	±10%	50 V	C0603	MURATA or ANY	GRM188R61H225KE11D	-
19	C5	10uF	10uF	±20%	10 V	CT_R	VISHAY or ANY	TAJP106M010RNJ	-
20	C13	1uF	1uF	±20%	16 V	CT_P	VISHAY or ANY	TAJR105M016RNJ	-
21	C20,C21	6pF	6pF	±0.25pF	50 V	C0603	SAMSUNG or ANY	CL10C060CB8NNNC	-
22	C24	10nF	10nF	±10%	50 V	C0603	SAMSUNG or ANY	CL10B103KB8NNNC	-
23	D3,D4	LS-SF3020DBW71-C6C5	LS-SF3020DBW71-C6C5	-	0.1 A	-	Daeyoung Electric Co., LTD. (Zhejiang Guyue LongShan Electronic Technology Development Co., LTD.)	LS-SF3020DBW71-C6C5	-
24	D5	B0530W-7-F / MBR0530	B0530W-7-F	-	0.5A	SOD123	Diodes Incorporated or ON Semiconductor or Micro Commercial Components	B0530W-7-F	-
25	Q1,Q2	DDC123JU	DDC123JU	-	50 V / 0.1 A / 0.2 W	SOT363	Diodes Incorporated	DDC123JU	-
26	Q3	NTGS3441 / NVGS3441	NTGS3441	-	20 V / 1.65 A / 0.5 W	TSOP-6	ON Semiconductor	NTGS3441	-
27	R3,R6	min 100Ω	820Ω	±1%	0.1 W	R0603	WALSIN or ANY	WR06X8200FTL	-
28	R9,R12,R16	1MΩ or 10MΩ	10MΩ	±1%	0.1 W	R0603	WALSIN or ANY	WR06X1005FTL	-
29	R11	330Ω	330Ω	±1%	0.1 W	R0603	WALSIN or ANY	WR06X3300FTL	-
30	R15	10kΩ	10kΩ	±1%	0.1 W	R0603	WALSIN or ANY	WR06X1002FTL	-
31	U1	STM32L443VCT6	STM32L443VCT6	-	4 V / 1.4 A / 0.444 W	LQFP100(14x14)	STMicroelectronics	STM32L443VCT6	-
32	U2	TPS7A0518PDBV	TPS7A0518PDBV	-	6 V / 0.65 A	SOT23_5	Texas Instruments	TPS7A0518PDBV	-
33	U3	NJU72501MJE	NJU72501MJE	-	4 V / 1.3 W	EQFN12-3X3	New Japan Radio Co., LTD.	NJU72501MJE	-
34	U4	CC2640YJ Module	CC2640YJ Module	-	-	-	YJ SYSTEMS Co., LTD.	CC2640YJ	-
35	U5	AT25DF512C-MAHN-T / AT25DF011-MAHN-T	AT25DF512C-MAHN-T	-	4.1 V	UDFN8_2X3	Adesto Technologies	AT25DF512C-MAHN-T	-
36	Y1	NX3215SE STD-MUA-19	NX3215SE STD-MUA-19	-	-	NX3215SE	NIHON DEMPA KOGYO CO., LTD.	NX3215SE STD-MUA-19	-

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SCHEDULE DOCUMENT No modifications permitted without permission from the authorised person	GFM-400_SENSOR Part List	Doc. NO.	Ex-GE-25B01			
		Rev. No.	Description	Rev. Date	Prepared by	Reviewed by / Approved by
		1.0	For issued	2019.08.14	S.M. BAE	S.H. YI / H.J. JOUNG

NO.	Reference	Value (Available Range)	Value (Default)	Tolerance	Maximum Rating	Package	Manufacturer	Part Number of Manufacturer	Remarks
1	**R25**	1kΩ	1kΩ	**1%**	**≥ 0.25 W**	**R1206**	**WALSIN or ANY**	**WR12X1001FTL**	**Component on which intrinsic safety depends**
2	**R43**	51Ω	51Ω	**1%**	**≥ 0.25 W**	**R1206**	**WALSIN or ANY**	**WR12X51R0FTL**	**Component on which intrinsic safety depends**
3	**R44,R45**	120Ω	120Ω	**1%**	**≥ 0.25 W**	**R1206**	**WALSIN or ANY**	**WR12X1200FTL**	**Component on which intrinsic safety depends**
4	**R8,R13,R20,R23,R40**	100kΩ	100kΩ	**1%**	**≥ 0.25 W**	**R1206**	**WALSIN or ANY**	**WR12X1003FTL**	**Component on which intrinsic safety depends**
5	C14,C16,C18	1uF	1uF	±10%	50 V	C0603	SAMSUNG or ANY	CL10A105KB8NNNC	-
6	C7,C9,C22	0.1uF	0.1uF	±10%	50 V	C0603	MULATA or ANY	GRM188R71H104KA93D / CL10B104KB8NNNC	-
7	CF4,CF6,CF9,CF10	101X14W series	101X14W221MV4T (220pF)	±20%	50 V	C0603	Johanson Dielectrics, Inc.	101X14W221MV4T	-
8	CF1,CF3,CF5,CF7	YFF18SC1H series	YFF18SC1H470MT0H0N	±20%	50 V	C0603	TDK Corporation.	YFF18SC1H223MT0H0N / YFF18SC1H470MT0H0N	-
9	CF11,CF12	YFF18SC1H series	YFF18SC1H223MT0H0N	±20%	50 V	C0603	TDK Corporation.	YFF18SC1H223MT0H0N / YFF18SC1H470MT0H0N	-
10	C3	1nF	1nF	±10%	50 V	C0603	SAMSUNG or ANY	WR06X000PTL / CL10B102KB8NNNC	-
11	C1,C5,C6,C8,C10	10pF	10pF	±5%	50 V	C0603	SAMSUNG or ANY	CL10C100JBNC	-
12	C13,C20	10uF	10uF	±20%	16V	C0603	SAMSUNG or ANY	CL10A106KO8NQNC	-
13	C17,C19,C25	22nF	22nF	±10%	50 V	C0603	SAMSUNG or ANY	CL10B223KB8NNNC	-
14	C4,C11,C12	10nF	10nF	±10%	50 V	C0603	SAMSUNG or ANY	CL10B103KB8NNNC	-
15	C21	NC	NC	-	-	-	-	-	-
16	C23,C24	68pF	68pF	±5%	50 V	C0603	SAMSUNG or ANY	CL10C680JB8NNNC	-
17	D1,D2,D3,D4	LS-SF3020UHR34	LS-SF3020UHR34	-	-	-	Daeyoung Electric Co., Ltd. (Zhejiang Guyue LongShan Electronic Technology Development Co., Ltd.)	LS-SF3020UHR34	-
18	D5	LS-SF3020DNB74	LS-SF3020DNB74	-	-	-	Daeyoung Electric Co., Ltd. (Zhejiang Guyue LongShan Electronic Technology Development Co., Ltd.)	LS-SF3020DNB74	-
19	GND,GND1	S1721-46R	S1721-46R	-	-	-	HARWIN	S1721-46R	-
20	N_VDD,N_TX,N_RX,N_GND	S7271-45R	S7271-45R	-	-	-	HARWIN	S7271-45R	-
21	N_VDD,N_TX,N_RX,N_GND	MIPEX-04-1-02-3.1(Option code : MM2.5), MIPEX-04-1-22-3.1(Option code : MM100), MIPEX-04-1-62-3.1(Option code : MP1.5), MIPEX-04-1-72-3.1(Option code : MP2.5), MIPEX-04-2-62-3.1(Option code : PP1.5), MIPEX-04-2-72-3.1(Option code : PP2.5)	MIPEX-04-1-12-3.1	-	-	-	Optosense LLC	MIPEX-04-1-12-3.1	-
22	J1,J4	DS1021_10pin	DS1021_10pin	-	-	-	CONNFLY ELECTRONIC CO.,LTD	DS1021	-
23	J5,J6	DS1021_4pin	DS1021_4pin	-	-	-	CONNFLY ELECTRONIC CO.,LTD	DS1021	-
24	L1	2.2uH	2.2uH	±10%	-	L0805	Sunlord	SDFL2012Q2R2KTF	-
25	Q1,Q3,Q5	DDC123JU	DDC123JU	-	-	SOT363	Diodes Incorporated	DDC123JU	-
26	Q2,Q4	SST177	SST177	-	-	SOT-23	VISHAY or ANY	SST177	-
27	Q6	NTGS3441	NTGS3441	-	-	TSOP-6	ON Semiconductor	NTGS3441	-
28	R41	0Ω	0Ω	±1%	0.1 W	R0603	WALSIN or ANY	WR06X000PTL	-
29	R3,R12,R14,R18,R28	10kΩ	10kΩ	±1%	0.1 W	R0603	WALSIN or ANY	WR06X1002FTL	-
30	R30	47Ω	47Ω	±1%	0.1 W	R0603	WALSIN or ANY	WR06X47R0FTL	-
31	R6,R10,R16,R21,R39	min 100Ω	820Ω	±1%	0.1 W	R0603	WALSIN or ANY	WR06X8200FTL	-
32	R7,R22	10Ω	10Ω	±1%	0.1 W	R0603	WALSIN or ANY	WR06X10R0FTL	-
33	R27,R42,R57,R58	1MΩ or 10MΩ	10MΩ	±1%	0.1 W	R0603	WALSIN or ANY	WR06X1005FTL	-
34	R32	330Ω	330Ω	±1%	0.1 W	R0603	WALSIN or ANY	WR06X3300FTL	-
35	R31	100Ω	100Ω	±1%	0.1 W	R0603	WALSIN or ANY	WR06X1000FTL	-
36	R9,R52	1kΩ ~ 100kΩ	16kΩ	±1%	0.1 W	R0603	WALSIN or ANY	WR06X1602FTL	-
37	R24	1kΩ ~ 100kΩ	59kΩ	±1%	0.1 W	R0603	WALSIN or ANY	WR06X5902FTL	-
38	R33,R36	1kΩ ~ 100kΩ	30kΩ	±1%	0.1 W	R0603	WALSIN or ANY	WR06X3002FTL	-
39	R34	1kΩ ~ 10MΩ	120kΩ	±1%	0.1 W	R0603	WALSIN or ANY	WR06X1203FTL	-
40	R35	1kΩ ~ 10MΩ	130kΩ	±1%	0.1 W	R0603	WALSIN or ANY	WR06X1303FTL	-
41	R37	1kΩ ~ 10MΩ	7.15kΩ	±1%	0.1 W	R0603	WALSIN or ANY	WR06X7151FTL	-
42	R38	133kΩ	133kΩ	±1%	0.1 W	R0603	WALSIN or ANY	WR06X1333FTL	-
43	R46,R48,R49,R50,R51,R53,R54,R55	0Ω ~ 1kΩ	22Ω	±1%	0.1 W	R0603	WALSIN or ANY	WR06X22R0FTL	-
44	R47	0Ω ~ 10MΩ	1kΩ	±1%	0.1 W	R0603	WALSIN or ANY	WR06X1001FTL	-
45	CE, WE, CO, H2S, REF, COUNTER	ds15s40	ds15s40	-	-	-	Young Jin Enterprise or ANY	ds15s40	-
46	RE	NC	NC	-	-	-	-	-	-
47	CE, WE	O2 Sensor	O2 Sensor	-	-	-	DD-Scientific or ANY	S+4OX	-
48	CO, H2S, REF, COUNTER	CO / H2S Dual Toxic Sensor	CO / H2S Dual Toxic Sensor	-	-	-	DD-Scientific or ANY	GS+4DT	-
49	U1,U4	TSU111	TSU111	-	-	SC70-5	STMicroelectronics	TSU111ICT	-
50	U2	TSU112	TSU112	-	-	DFN8_2X2_0P5	STMicroelectronics	TSU112IQ2T	-
51	U3	TFBS4650	TFBS4650	-	-	TFBS4650	Vishay	TFBS4650	-
52	U5	MAX17220	MAX17220	-	-	uDFN	Maxim	MAX17220	-
53	U6	SN74AUP1G07	SN74AUP1G07	-	-	SC70-5	Texas Instruments	SN74AUP1G07	-
54	U7	SN74AUP1T50	SN74AUP1T50	-	-	SC70-5	Texas Instruments	SN74AUP1T50	-

SCHEDULE DOCUMENT	GFM-400_BLUETOOTH Part List	Doc. NO.	Ex-GE-25B02			
No modifications permitted without permission from the authorised person		Rev. No.	Description	Rev. Date	Prepared by	Reviewed by	Approved by
		1.0	For issued	2019.07.24	S.M. BAE	S.H. YI	H.J. JOUNG

NO.	Reference	Value (Available Range)	Value (Default)	Tolerance	Maximum Rating	Package	Manufacturer	Part Number of Manufacturer	Remarks
1	U5	CC2640R2FRHB	CC2640R2FRHB	-	4.1 V	VQFN(32pin 5x5)	TEXAS INSTRUMENTS	CC2640R2FRHB	-
2	C43,C47	1pF	1pF	±0.25pF	25 V	C0201	SAMSUNG	CL03C010CA3GNNC	-
3	C44	6.8pF	6.8pF	±0.25pF	25 V	C0201	MURATA	GRM0335C1E6R8CA01D	-
4	C13,C40	12pF	12pF	±5%	50 V	C0201	MURATA	GRM0335C1H120JA01D	-
5	C10	1uF	1uF	±20%	16 V	C0201	SAMSUNG	CL03A105MO3NRNH	-
6	C2,C3,C11,C49,C50,C54,C55	0.1uF	0.1uF	±10%	16 V	C0201	MURATA	GRM033C71C104KE14D	-
7	C1,C51	1uF	1uF	±10%	25 V	C0402	SAMSUNG	CL05A105KA5NQNC	-
8	L8	2.4nH	2.4nH	±0.3nH	310 mA	L0201	Sunlord	SDCL0603Q2N4ST02B01	-
9	L9	2.7nH	2.7nH	±0.3nH	310 mA	L0201	Sunlord	SDCL0603Q2N7ST02B01	-
10	L11	6.2nH	6.2nH	±0.3nH	210 mA	L0201	Sunlord	SDCL0603Q6N2ST02B01	-
11	L46	3nH	3nH	±0.3nH	300 mA	L0402	Sunlord	SDCL1005C3N0STDF	-
14	L1	39nH	39nH	±0.3nH	200 mA	L0402	Sunlord	SDCL1005C39NSTDF	-
12	R10	0Ω	0Ω	-	0.0625 W	R0402	Walsin	WR04X000PTL	-
13	R2	100kΩ	100kΩ	±5%	0.05 W	R0201	Walsin	WR02X104JTL	-
14	X2	24.000Mhz	24.000Mhz	-	-	3225	EPSON	TSX-3225 24.0000MF15X-AC3	-
15	X1	32.768Khz	32.768Khz	-	-	3215	EPSON	FC-135 32.7680KA-AG0	-
16	ANT1	SLDA62-2R640G-01TF	SLDA62-2R640G-01TF	-	-	6x2mm	Sunlord	SLDA62-2R640G-01TF	-

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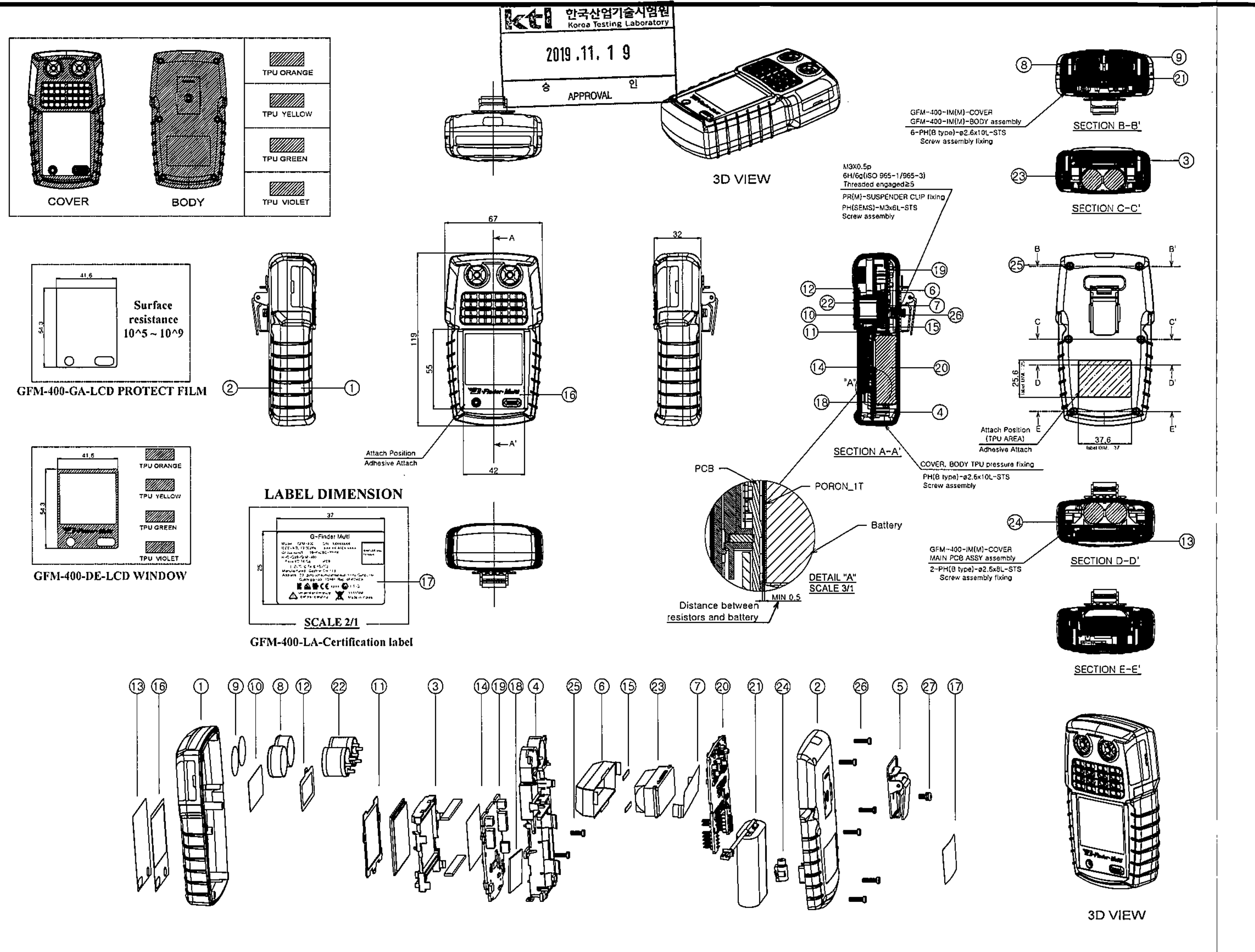
DATA SHEET LIST

NO.	DWG No. Rev No.	Part name Part No.	Image	Material	Date	Remark	DATA SHEET	RTI	COT
1	Ex-A19060018 0.0	GENERAL ASSEMBLY 1501001-0007-00		N/A	2019-07-29	Product color : Orange / Yellow / Green / violet	N/A	N/A	N/A
2	Ex-A19060019 0.0	GFM-400-IM(M)-COVER 4301112-0042		PC 1201-15 / TPU (RTP2099EX100781)	2019-07-29	Product color : Orange / Yellow / Green / violet	PC : O TPU : O	PC : O TPU:X	PC : X TPU:X
3	Ex-A19060020 0.0	GFM-400-IM(M)-BODY 4301111-0045		PC 1201-15 / TPU (RTP2099EX100781)	2019-07-29	Product color : Orange / Yellow / Green / violet	PC : O TPU : O	PC : O TPU:X	PC : X TPU:X
4	Ex-A19060021 0.0	GFM-400-IM(M)-LCD BKT 4301113-0056		PC 1201-15	2019-07-29		O	O	X
5	Ex-A19060022 0.0	GFM-400-IM(M)-PCB BKT 4301113-0057		LUPOY SC1004A	2019-07-29		O	O	X
6	Ex-A18120012 0.0	PR(M)-SUSPENDER CLIP 4301220-0019		STS 304	2019-07-29	GFS-100 PR(M)-SUSPENDER CLIP 공용자재	O	-	-
7	Ex-A19060023 0.0	GFM-400-PR(M)-SHIELDCASE 4301213-0036		STS 304	2019-07-29		O	-	-
8	Ex-A19060024 0.0	GFM-400-GA-SHIELDTAPE 4302530-0020		CT10CX	2019-07-29		O	-	-
9	Ex-A18120009 0.0	GFM-400-RU-SENSOR CAP 4301330-0053		NBR(50°) JSLR-NBR50-0811	2019-07-29	GFS-100 RU-SENSOR CAP 공용자재	O	X	O
10	Ex-A18120013 0.0	GFM-400-MEMBRANE FILTER 4800202-0005		e-PTFE	2019-07-29	GFS-100 MEMBRANE FILTER 공용자재	O	X	O
11	Ex-A19060025 0.0	GFM-400-MEMBRANE FILTER_B 4800202-0006		e-PTFE (MV-9)	2019-07-29		O	X	O
12	Ex-A19060026 0.0	GFM-400-GA-LCD CUSHION 4302310-0031		MSR 070	2019-07-29		O	X	O
13	Ex-A19060027 0.0	GFM-400-GA-NDIR CUSHION 4302310-0032		MSR 030	2019-07-29		O	X	O
14	Ex-A19060028 0.0	GFM-400-GA-LCD PROTECT FILM 4302530-0021		JB-SD10008	2019-07-29		O	X	O
15	Ex-A19060029 0.0	GFM-400-GA-LCD BKT Sheet 4302530-0022		CP70	2019-07-29		O	X	O
16	Ex-A19060030 0.0	GFM-400-GA-INSULATION SHEET 4302530-0023		MSR 050	2019-07-29		O	X	O
17	Ex-A19060031 0.0	GFM-400-DE-LCD WINDOW 4302280-0053		PC Film G11	2019-07-29	Product color : Orange / Yellow / Green / violet	O	X	O
18	Ex-A19060032 0.0	GFM-400-LA- CERTIFICATION LABEL 4304111-0068		Matt Silver Pet MZ0104	2019-07-29		O	X	O
19	Ex-A19100005 0.0	GFM-400-GA- PCB CUSHION 4302310-0036		PSR -1.0	2019-11-08		O	X	O



ASSEMBLY COMPONETS INFORMATION

No.	Part Description	Q'ty	Material	Finish	Maker
1	GFM-400-IM(M)-COVER	1	PC 1201-15/TPU (RTP2099EX100781)	·	·
2	GFM-400-IM(M)-BODY	1	PC 1201-15/TPU (RTP2099EX100781)	·	·
3	GFM-400-IM(M)-LCD BKT	1	PC 1201-15	·	·
4	GFM-400-IM(M)-PCB BKT	1	LUPOY SC1004A	·	·
5	PR(M)-SUSPENDER CLIP	1	STS304	·	·
6	GFM-400-PR(M)-SHIELDCASE	1	STS304	·	·
7	GFM-400-GA-SHIELDTAPE	1	CT10CX	·	·
8	GFM-400-RU-SENSOR CAP	2	NBR (50°) JSLR-NBR50-0811	·	·
9	GFM-400-MEMBRANE FILTER	2	e-PTFE	·	·
10	GFM-400-MEMBRANE FILTER_B	1	e-PTFE (MV-9)	·	·
11	GFM-400-GA-LCD CUSHION	1	MSR 070	·	·
12	GFM-400-GA-NDIR CUSHION	1	MSR 030	·	·
13	GFM-400-GA-LCD Protect Film	1	JB-SD10008	·	·
14	GFM-400-GA-LCD BKT Sheet	1	CP70	·	·
15	GFM-400-GA-Insulation sheet	2	MSR 050	·	·
16	GFM-400-DE-LCD WINDOW	1	PC Film G11	·	·
17	GFM-400-LA-Certification label	1	Matt Silver Pet MZ0104	·	·
18	GFM-400-GA-PCB CUSHION	1	PSR-1.0	·	·
19	MAIN PCB ASSY	1	FR-4	·	·
20	SENSOR PCB ASSY	1	FR-4	·	·
21	BATTERY ASSY	1	Li-SOCl2	·	·
22	SINGLE / DUAL SENSOR ASSY	1	electrochemical cell	·	·
23	NDIR ASSY	1	Nondispersive infrared sensor	·	·
24	MOTOR	1	MOTOR	·	·
25	PH(B type)-ø2.6x8L-STS	2	STS304	·	·
26	PH(B type)-ø2.6x10L-STS	6	STS304	·	·
27	PH(SEMS)-M3x6L-STS	1	STS304	·	·

<GENERAL SPECIFICATION>

Approval : Ex ia IIC T4 Ga (−20°C ≤ Ta ≤ +50°C)

IP Grade : IP68

Weight: 0.223 Kg (Suspender clip include)

Battery Specification (Part no. : SB-AA11)

1.Type : Primary Lithium Thionyl Chloride (Li-SOCl2)
2.Manufacturer : VITZRO CELL
3.Nominal capacity : 2.5Ah / Nominal voltage : 3.6V
4.Maximum recommended continuous current : 60mA
5.Maximum recommended pulse current : 100mA
6.Operating temperature range : −55℃ ~ +85℃

Sensor Type : Single plug-in electrochemical cell
Dual plug-in electrochemical cell
Nondispersive infrared sensor

Related Standards
IECEx : IEC60079-0:2017, IEC60079-11:2011
ATEX : EN60079-0:2012, EN60079-11:2012
NEPSI : GB 3836.1-2010, GB 3836.4-2010
KCs : Announcement No. 2019-15 of Ministry of Employment and Labor

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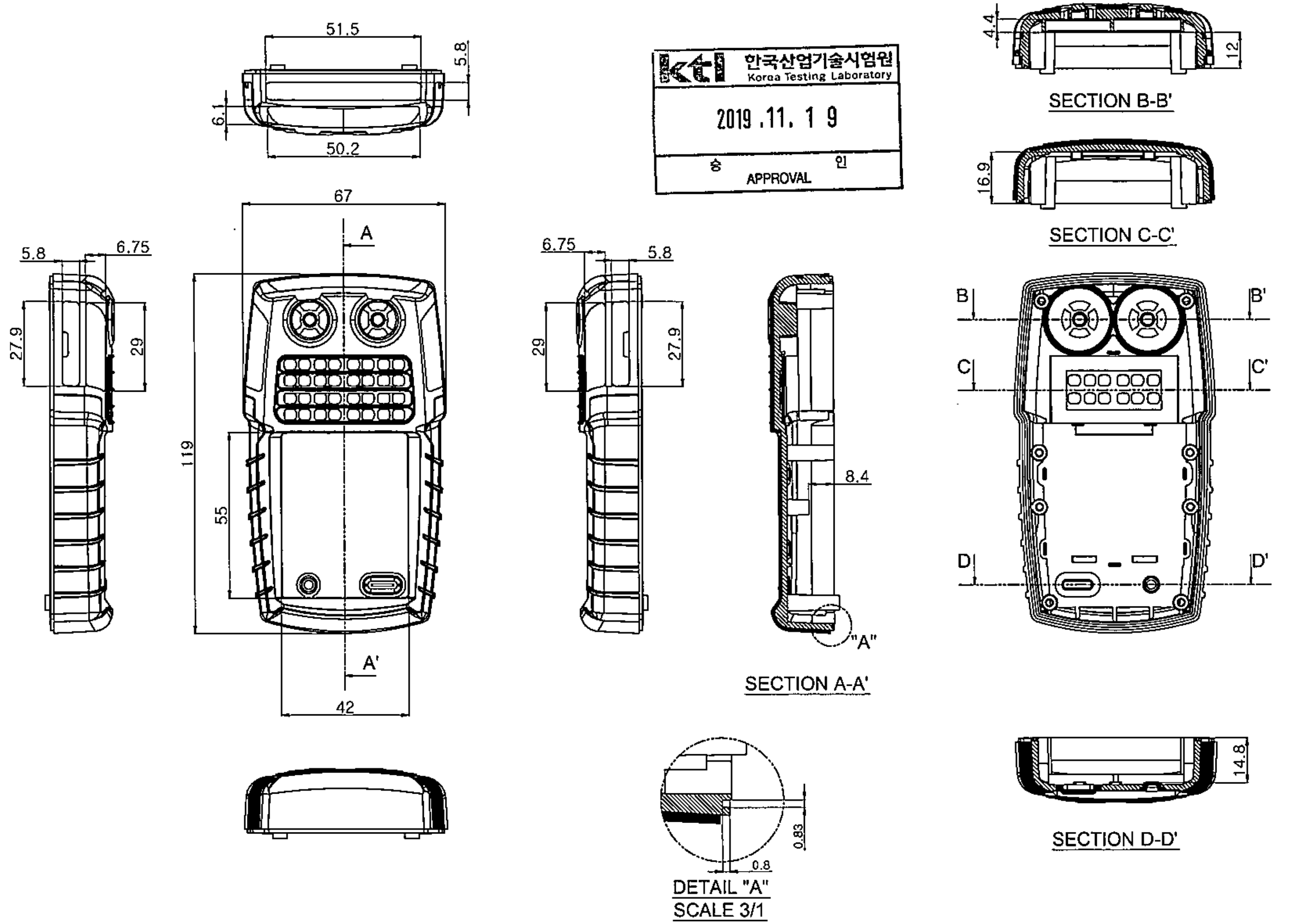
GASTRON CO.,LTD.

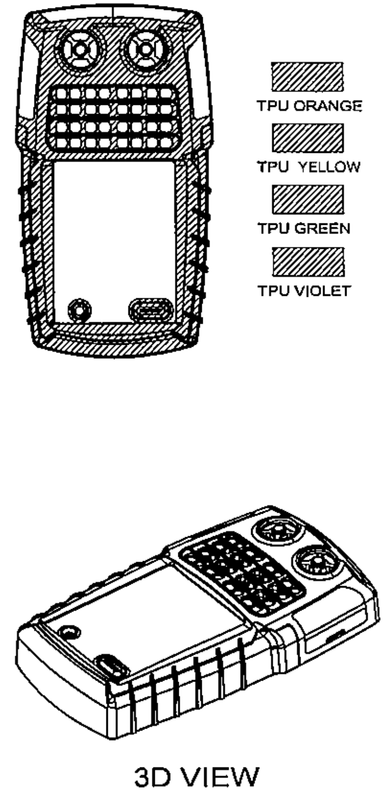
Model	GFM-400		
Title	General Assembly		
Part No.	1501001-0007-00		
Material	-	**Finish**	-
Q'ty	1	**Scale**	1/1
Projection	⊕◁	**Units**	mm
DWG. No.	Ex-A19060018	**Rev.**	0

General Note

1. Tolerance Limits : ±0.1
2. No indecations R=0.5, C=0.5
3. No indecations surface processing: ≤12S(▽▽▽)
4. Color: Orange / yellow / green / Violet / ETC.

Rev.	Description	Date	Designed	Checked	Approved
3					
2					
1					
0	For issued	07.29.2019	Y.S.HA	J.M.SONG	H.J.JUNG





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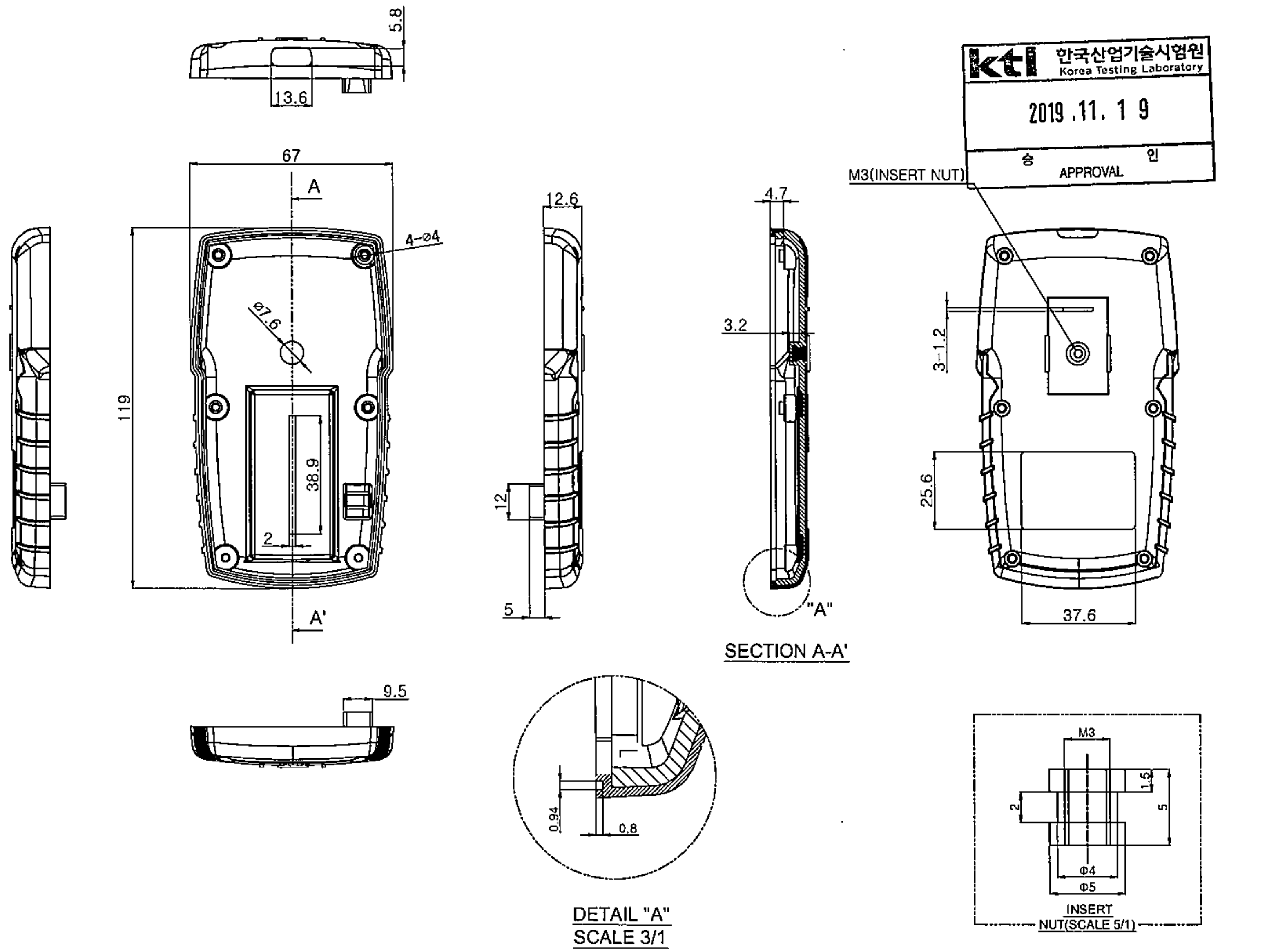
General Note

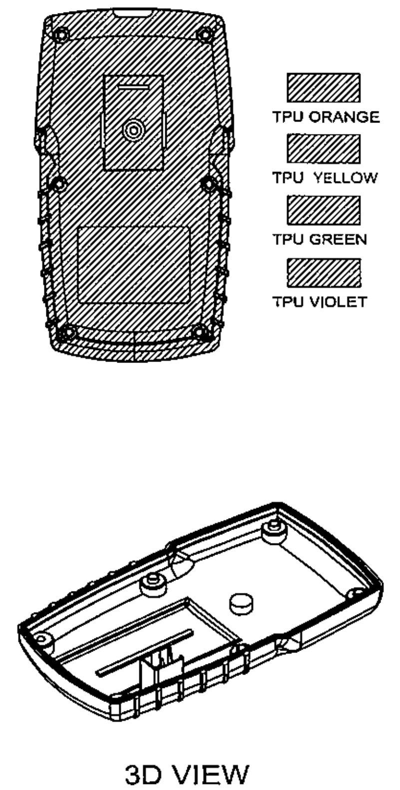
1. Tolerance Limits : ±0.1
2. No indecations R=0.5, C=0.5
3. No indecations surface processing: ≤12S(▽▽▽)

Rev.	Description	Date	Designed	Checked	Approved
△3					
△2					
△1					
△0	For issued	07.29.2019	Y.S.HA	J.M.SONG	H.J.JUNG

GASTRON CO.,LTD.

Model	GFM-400		
Title	GFM-400-IM(M)-COVER		
Part No.	4301112-0042		
Material	PC 1201-15 /TPU (RTP2099EX100781)	Finish	-
Q'ty	1	Scale	1/1
Pro-jection	⊕◁	Units	mm
DWG. No.	Ex-A19060019	Rev.	△0





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GASTRON CO.,LTD.

Model	GFM-400		
Title	GFM-400-IM(M)-BODY		
Part No.	4301111-0045		
Material	PC 1201-15 /TPU (RTP2099EX100781)	Finish	-
Q'ty	1	Scale	1/1
Projection	⌖◁	Units	mm
DWG. No.	Ex-A19060020	Rev.	0

General Note

1. Tolerance Limits : ±0.1
2. No indecations R=0.5, C=0.5
3. No indecations surface processing: ≤12S(▽▽▽)

Rev.	Description	Date	Designed	Checked	Approved
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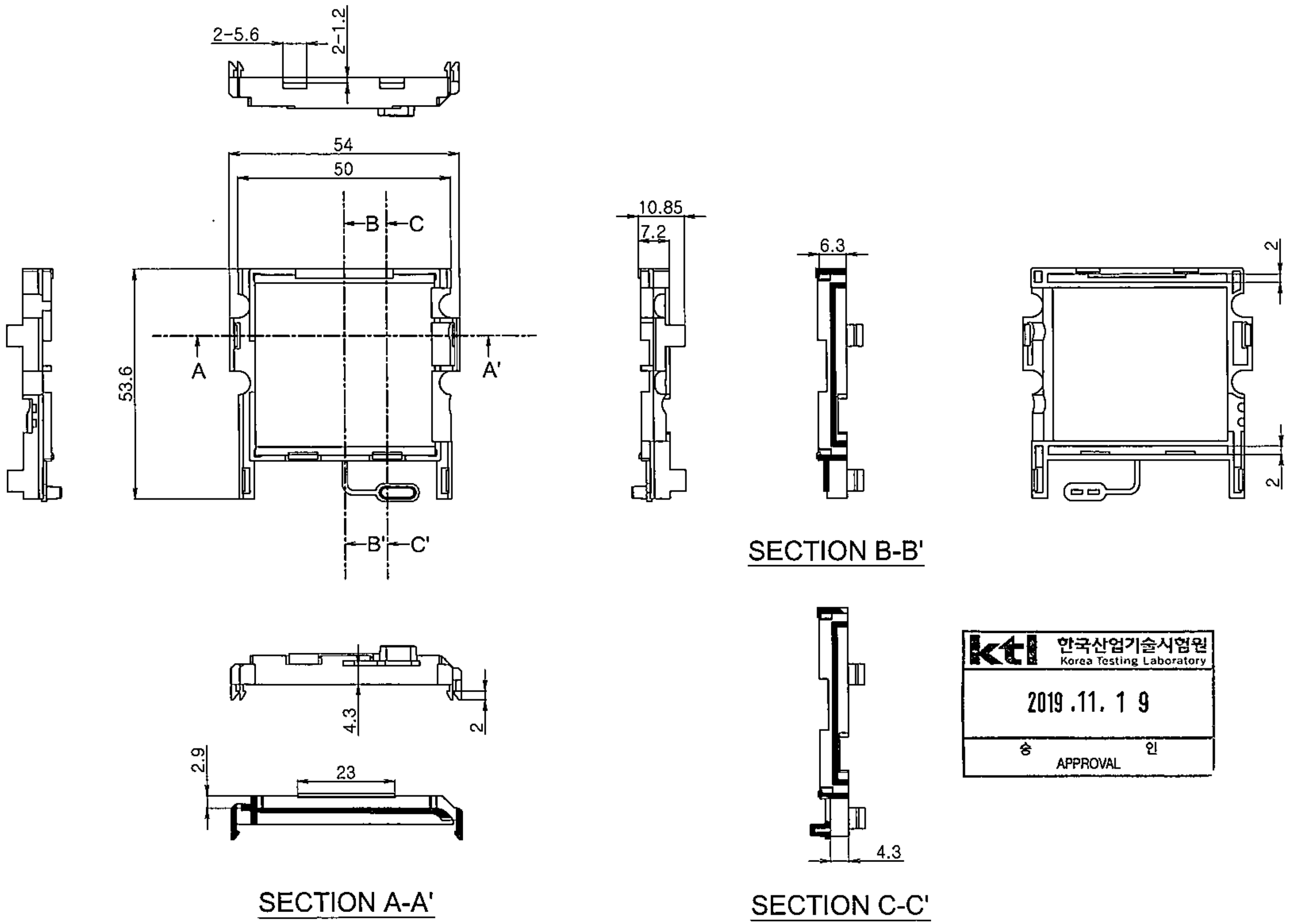
2					
1					
0	For issued	07.29.2019	Y.S.HA	J.M.SONG	H.J.JUNG



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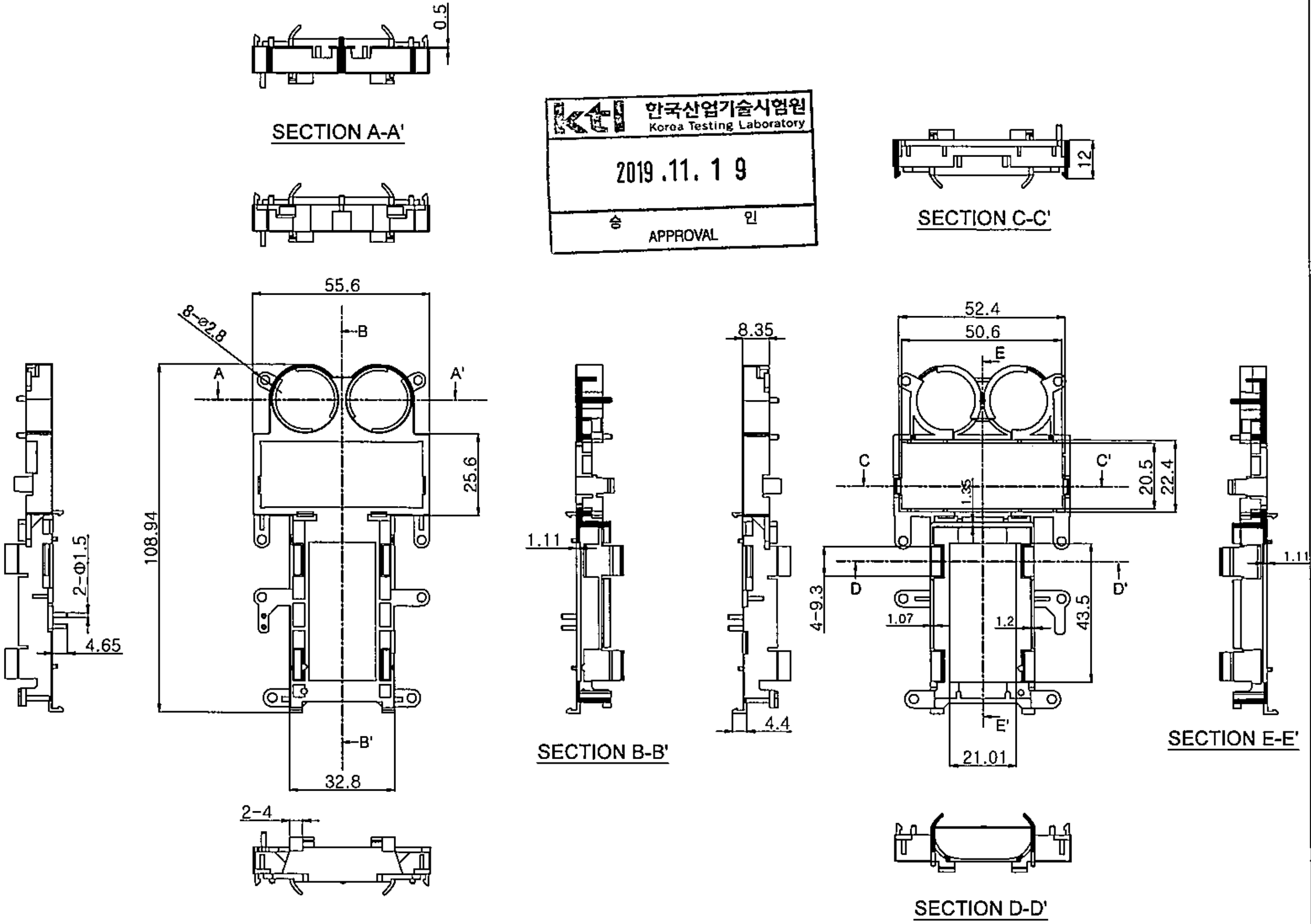
GASTRON CO.,LTD.

Model	GFM-400		
Title	GFM-400-IM(M)-LCD BKT		
Part No.	4301113-0056		
Material	PC 1201-15	Finish	-
Q'ty	1	Scale	1/1
Projection	⊕◁	Units	mm
DWG. No.	Ex-A19060021	Rev.	0

General Note

1. Tolerance Limits : ±0.1
2. No indecations R=0.5, C=0.5
3. No indecations surface processing: ≤12S(▽▽▽)
4. Color: None

Rev.	Description	Date	Designed	Checked	Approved
3					
2					
1					
0	For issued	07.29.2019	Y.S.HA	J.M.SONG	H.J.JUNG



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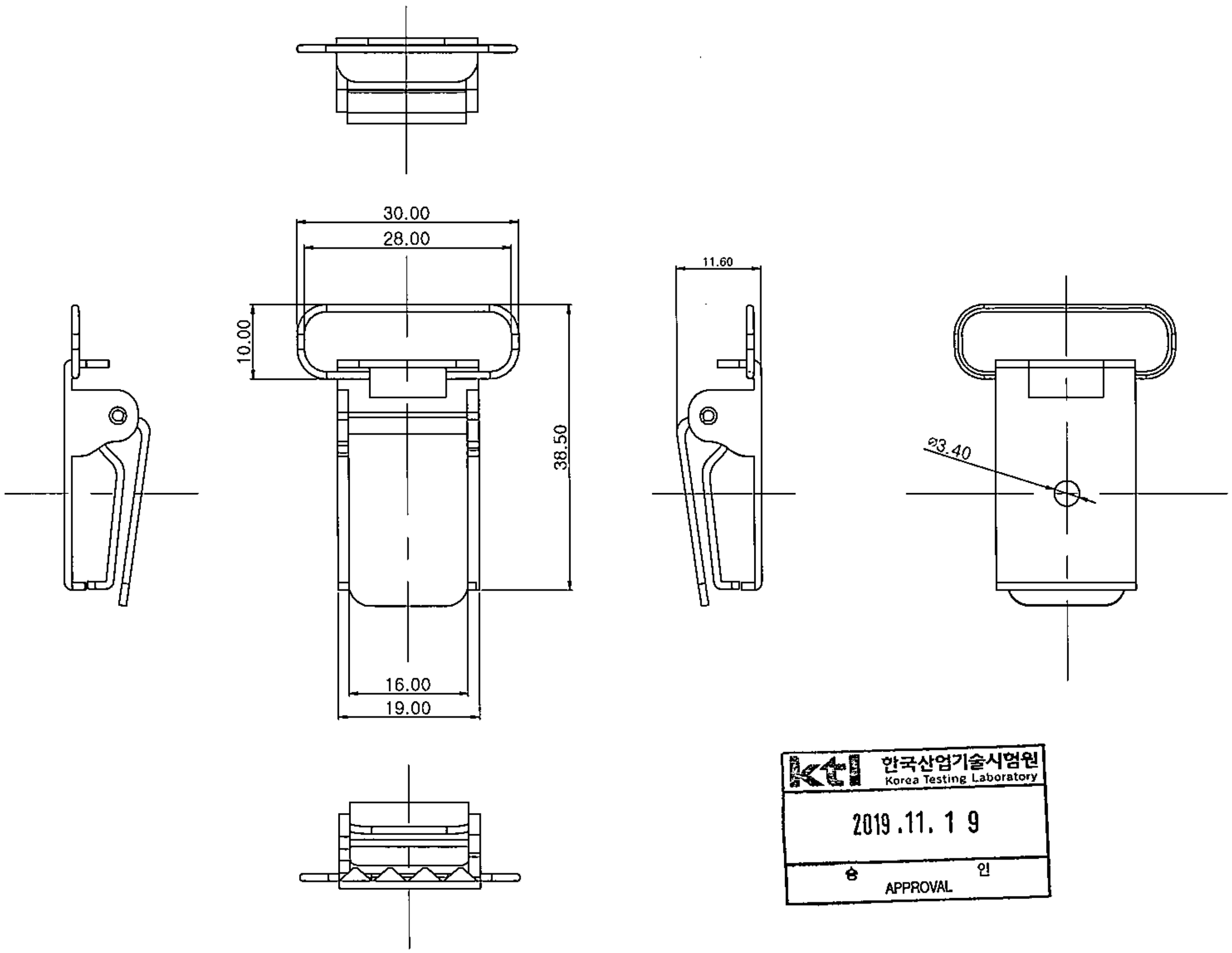
General Note

1. Tolerance Limits : ±0.1
2. No indecations R=0.5, C=0.5
3. No indecations surface processing: ≤12S(▽▽▽)

Rev.	Description	Date	Designed	Checked	Approved
3					
2					
1					
0	For issued	07.29.2019	Y.S.HA	J.M.SONG	H.J.JUNG

GASTRON CO.,LTD.

Model	GFM-400		
Title	GFM-400-IM(M)-PCB BKT		
Part No.	4301113-0057		
Material	LUPOY SC1004A	Finish	-
Q'ty	1	Scale	1/1
Projection	⊕◁	Units	mm
DWG. No.	Ex-A19060022	Rev.	0



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GASTRON CO.,LTD.

Model	GFM-400		
Title	PR(M)-SUSPENDER CLIP		
Part No.	4301220-0019		
Material	STS304 S185883E	Finish	
Q'ty	1	Scale	1/1
Pro-jection		Units	mm
DWG. No.	Ex-A18120012	Rev.	0

General Note

1. Tolerance Limits : ±0.1
2. No indecations R=0.5, C=0.5
3. No indecations surface processing: ≤12S(▽▽▽)

Rev.	Description	Date	Designed	Checked	Approved
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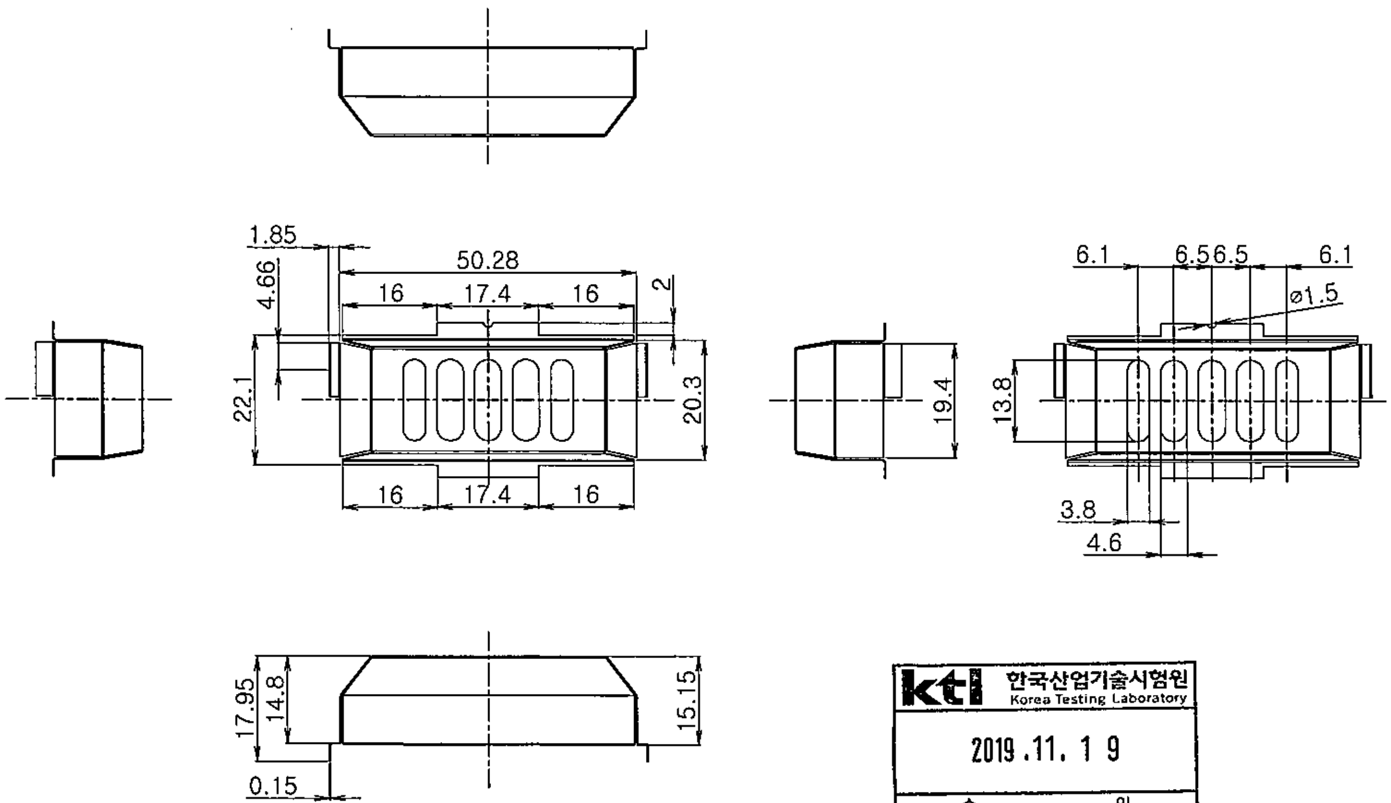
2					
1					
0	For issued	07.29.2019	Y.S.HA	J.M.SONG	H.J.JUNG



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GASTRON CO.,LTD.

Model	GFM-400		
Title	GFM-400-PR(M)-SHIELDCASE		
Part No.	4301213-0036		
Material	STS304	Finish	
Q'ty	1	Scale	1/1
Pro-jection	⊕◁	Units	mm
DWG. No.	Ex-A19060023	Rev.	0

General Note

1. Tolerance Limits : ±0.1
2. No indecations R=0.5, C=0.5
3. No indecations surface processing: ≤12S(▽▽▽)

Rev.	Description	Date	Designed	Checked	Approved
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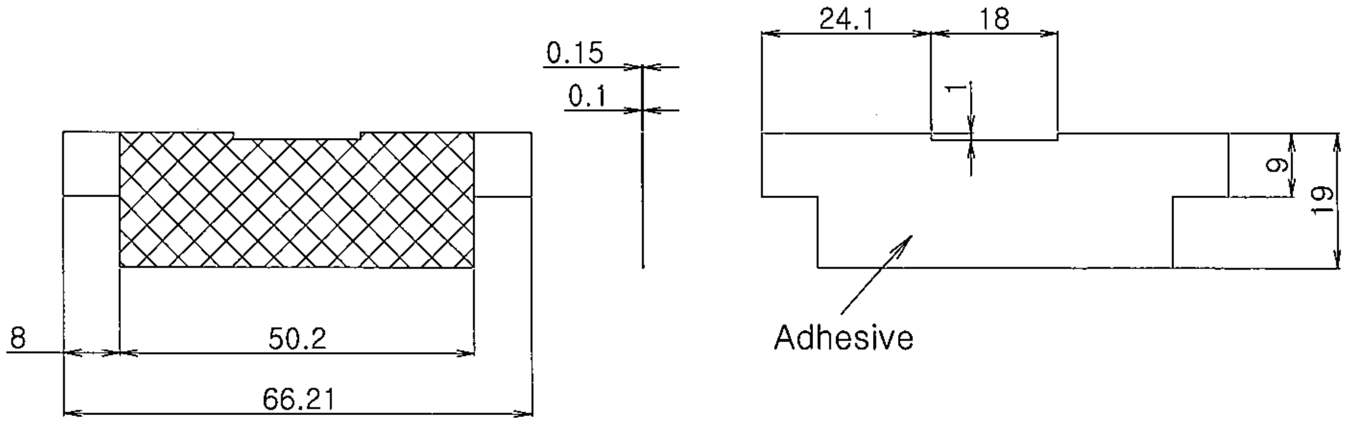
2					
1					
0	For issued	07.29.2019	Y.S.HA	J.M.SONG	H.J.JUNG



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2019.11.19

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General Note

1. Tolerance Limits : ±0.1
2. No indecations R=0.5, C=0.5
3. No indecations surface processing: ≤12S(▽▽▽)

Rev.	Description	Date	Designed	Checked	Approved
△3					
△2					
△1					
△0	For issued	07.29.2019	Y.S.HA	J.M.SONG	H.J.JUNG

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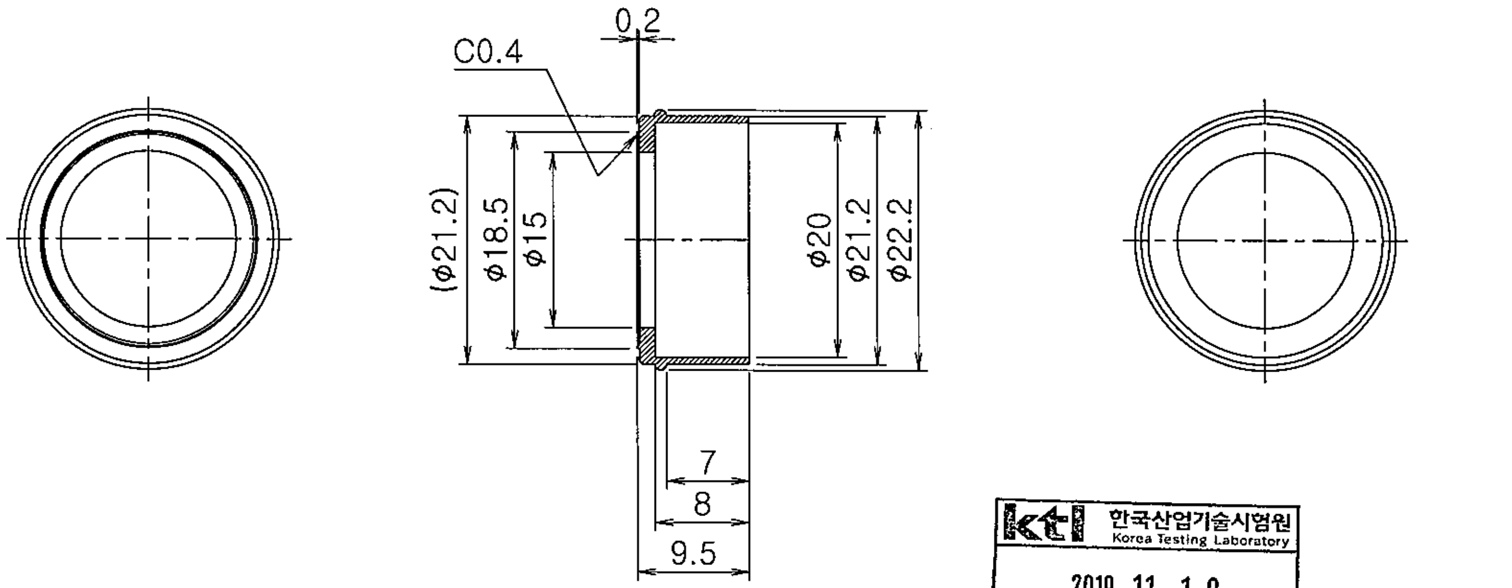
GASTRON CO.,LTD.

Model	GFM-400		
Title	GFM-400-GA-SHIELDTAPE		
Part No.	4302530-0020		
Material	CT10CX	Finish	-
Q'ty	1	Scale	1/1
Pro-jection	⊕◁	Units	mm
DWG. No.	Ex-A19060024	Rev.	△0



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HARDNESS : 50°

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GASTRON CO.,LTD.

Model	GFM-400		
Title	GFM-400-RU-SENSOR CAP		
Part No.	4301330-0053		
Material	NBR (50°) JSLR-NBR50-0811	Finish	-
Q'ty	1	Scale	1/1
Pro-jection	⌖	Units	mm
DWG. No.	Ex-A18120009	Rev.	0

General Note

1. Tolerance Limits : ±0.1
2. No indecations R=0.5, C=0.5
3. No indecations surface processing: ≤12S(▽▽▽)
4. Color: BLACK

Rev.	Description	Date	Designed	Checked	Approved
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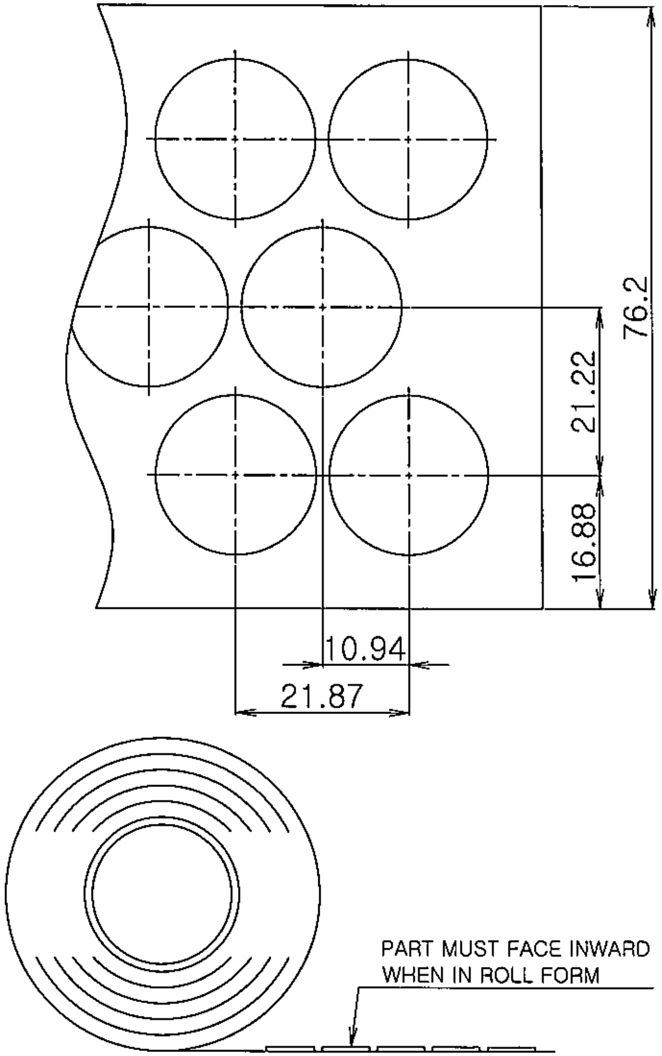
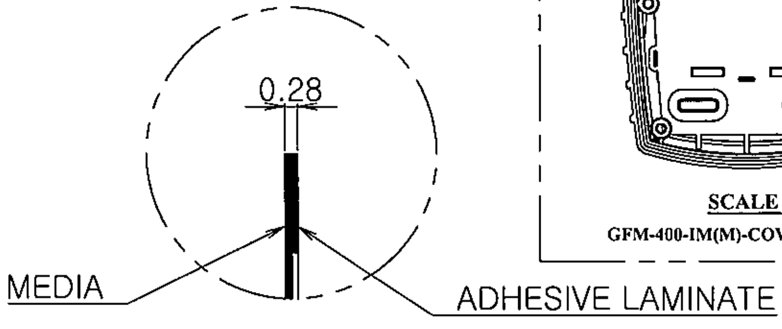
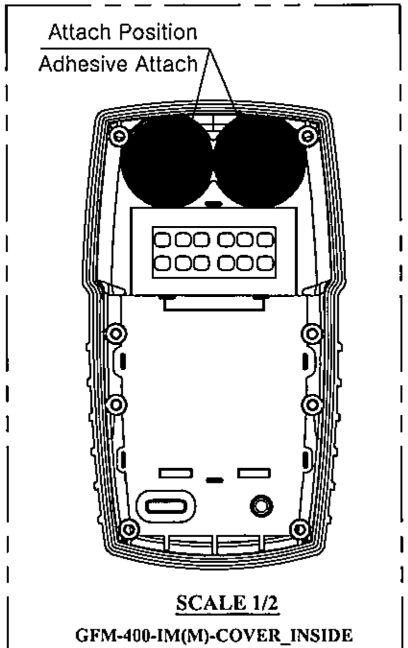
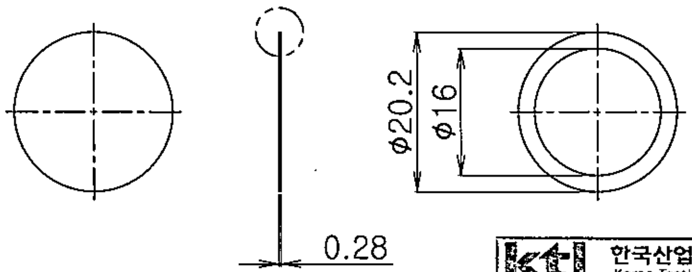
2					
1					
0	For issued	07.29.2019	Y.S.HA	J.M.SONG	H.J.JUNG









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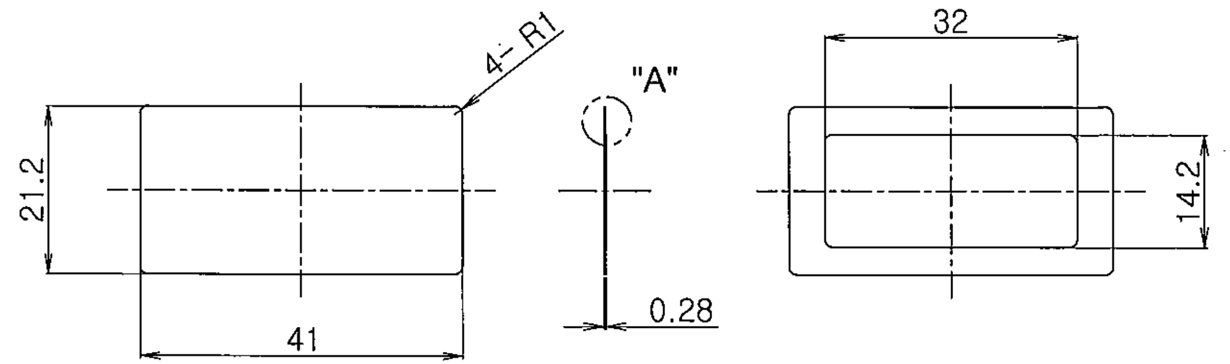
General Note

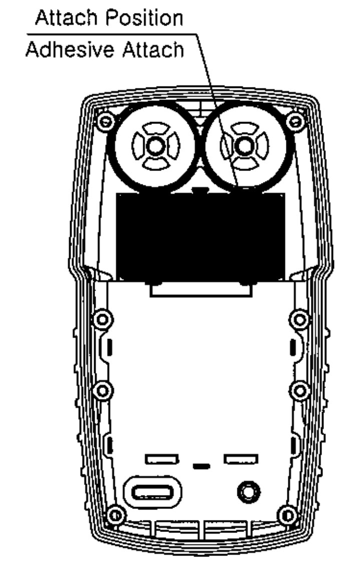
1. Tolerance Limits : ±0.1
2. No indecations R=0.5, C=0.5
3. No indecations surface processing: ≤12S(▽▽▽)
4. Color: WHITE

Rev.	Description	Date	Designed	Checked	Approved
3					
2					
1					
0	For issued	07.29.2019	Y.S.HA	J.M.SONG	H.J.JUNG

GASTRON CO.,LTD.

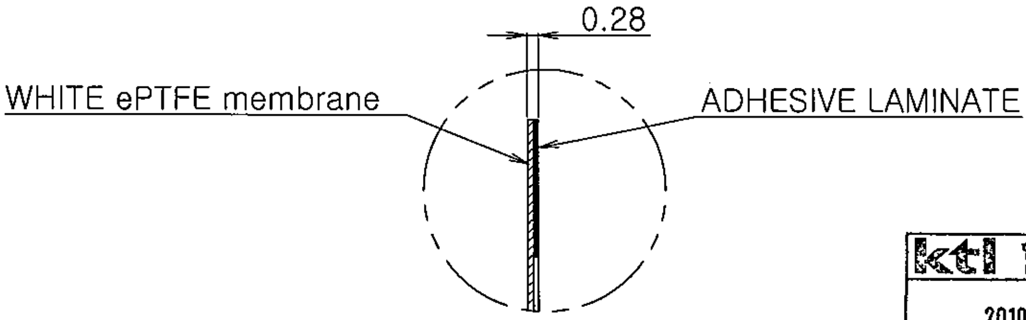
Model	GFM-400		
Title	GFM-400_MEMBRANE FILTER		
Part No.	4800202-0005		
Material	e-PTFE	Finish	-
Q'ty	1	Scale	1/1
Projection	⌖◁	Units	mm
DWG. No.	Ex-A18120013	Rev.	0





SCALE 1/2

GFM-400-IM(M)-COVER_INSIDE



DETAIL "A"
SCALE 5/1

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SCHEDULE DRAWING

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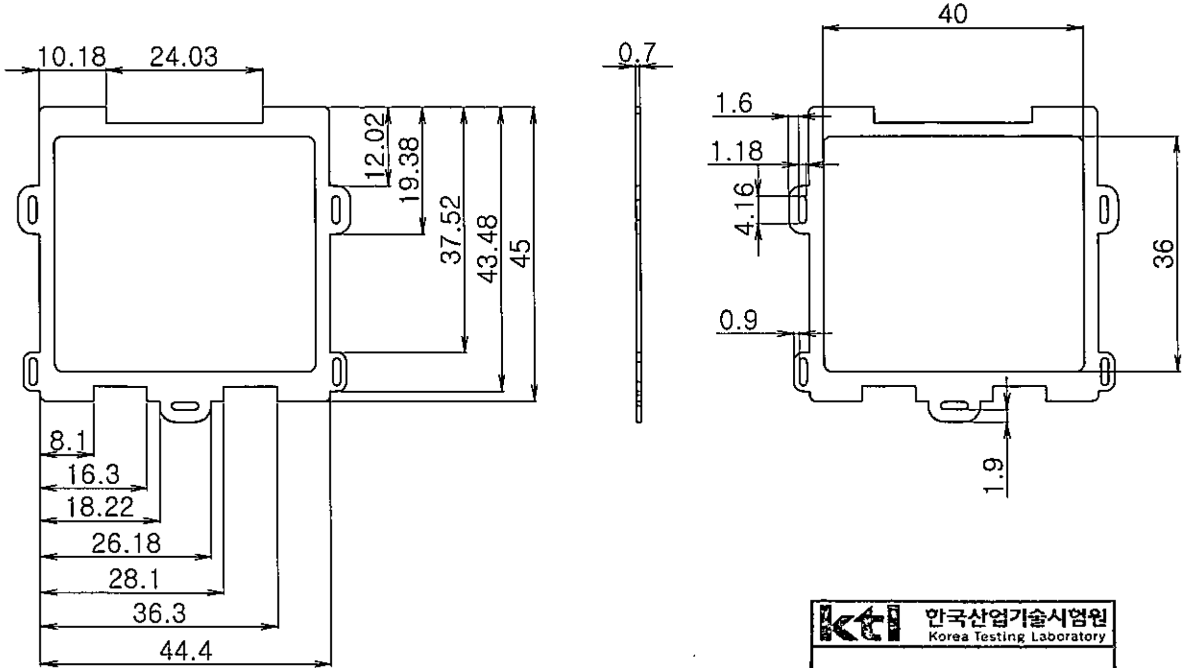
GASTRON CO.,LTD.

Model	GFM-400		
Title	GFM-400-MEMBRANE FILTER_B		
Part No.	4800202-0006		
Material	e-PTFE (MV-9)	**Finish**	-
Q'ty	1	**Scale**	1/1
Projection		**Units**	mm
DWG. No.	Ex-A19060025	**Rev.**	0

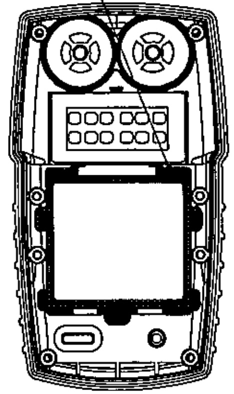
General Note

1. Tolerance Limits : ±0.1
2. No indecations R=0.5, C=0.5
3. No indecations surface processing: ≤12S(▽▽▽)
4. Color: WHITE

Rev.	Description	Date	Designed	Checked	Approved
3					
2					
1					
0	For issued	07.29.2019	Y.S.HA	J.M.SONG	H.J.JUNG



Attach Position



SCALE 1/2

GFM-400-IM(M)-COVER_INSIDE

SCHEDULE DRAWING

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from the authorised person

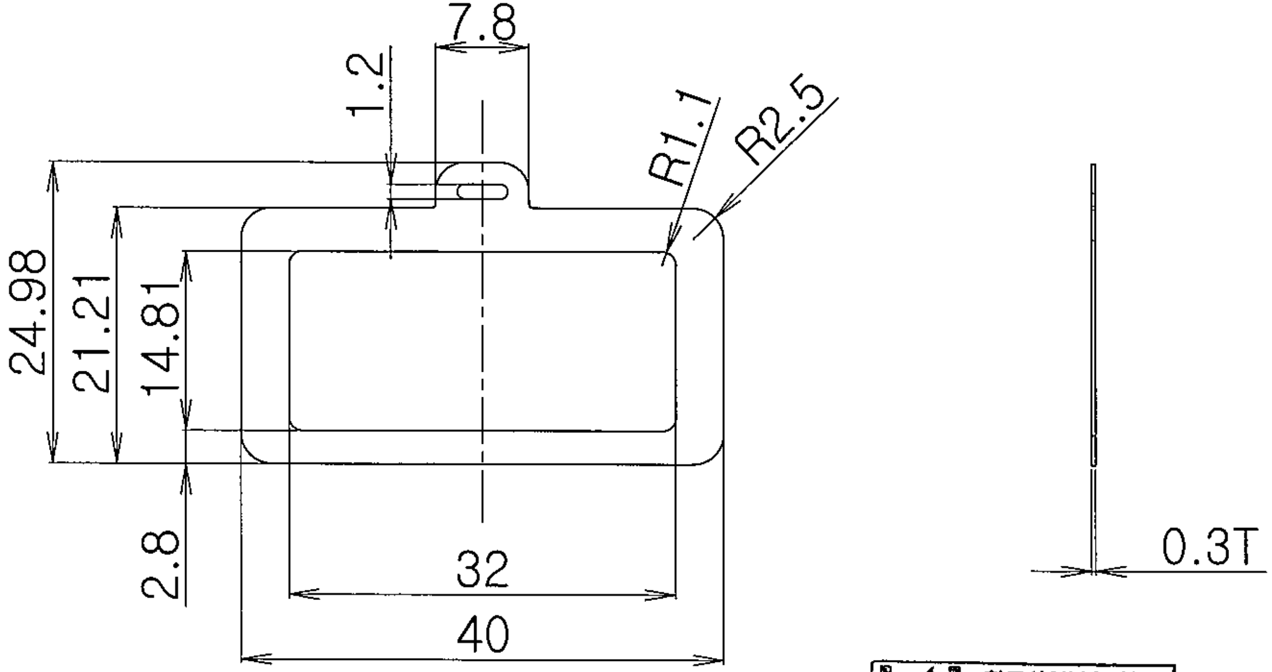
General Note

1. Tolerance Limits : ±0.1
2. No indecations R=0.5, C=0.5
3. No indecations surface processing: ≤12S(▽▽▽)

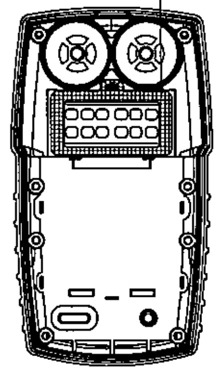
Rev.	Description	Date	Designed	Checked	Approved
3					
2					
1					
0	For issued	07.29.2019	Y.S.HA	J.M.SONG	H.J.JUNG

GASTRON CO.,LTD.

Model	GFM-400		
Title	GFM-400-GA-LCD CUSHION		
Part No.	4302310-0031		
Material	MSR 070	Finish	-
Q'ty	1	Scale	1/1
Pro-jection	⌖◁	Units	mm
DWG. No.	Ex-A19060026	Rev.	0



Attach Position



SCALE 1/4

GFM-400-IM(M)-COVER_INSIDE

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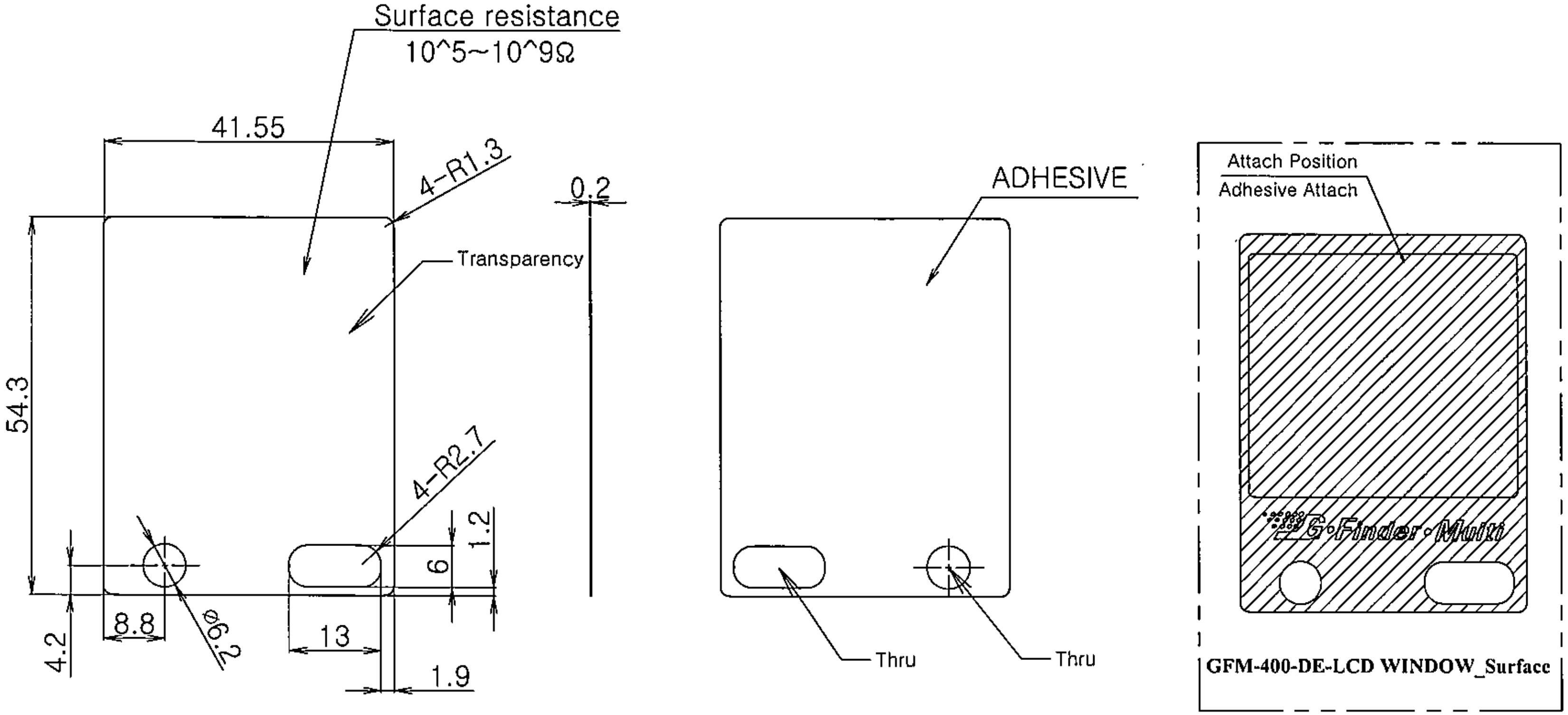
General Note

1. Tolerance Limits : ±0.1
2. No indecations R=0.5, C=0.5
3. No indecations surface processing: ≤12S(▽▽▽)

Rev.	Description	Date	Designed	Checked	Approved
3					
2					
1					
0	For issued	07.29.2019	Y.S.HA	J.M.SONG	H.J.JUNG

Model	GFM-400		
Title	GFM-400-GA-NDIR CUSHION		
Part No.	4302310-0032		
Material	MSR 030	Finish	-
Q'ty	1	Scale	1/1
Pro-jection	⊕◁	Units	mm
DWG. No.	Ex-A19060027	Rev.	0



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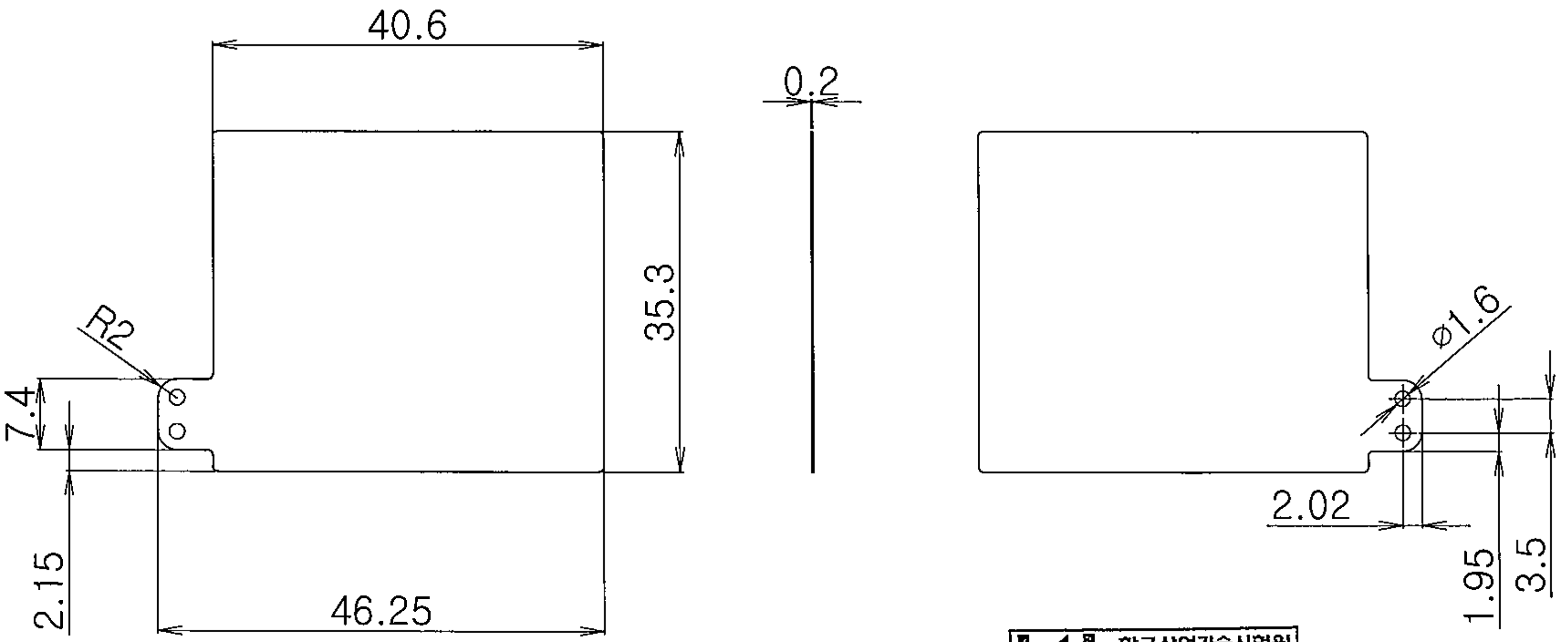
GASTRON CO.,LTD.

Model	GFM-400		
Title	GFM-400-GA-LCD PROTECT FILM		
Part No.	4302530-0021		
Material	JB-SD10008	Finish	-
Q'ty	1	Scale	1/1
Projection	⌖◁	Units	mm
DWG. No.	Ex-A19060028	Rev.	△0

General Note

1. Tolerance Limits : ±0.1
2. No indecations R=0.5, C=0.5
3. No indecations surface processing: ≤12S(▽▽▽)

Rev.	Description	Date	Designed	Checked	Approved
△3					
△2					
△1					
△0	For issued	07.29.2019	Y.S.HA	J.M.SONG	H.J.JUNG



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GASTRON CO.,LTD.

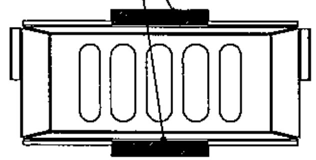
Model	GFM-400		
Title	GFM-400-GA-LCD BKT SHEET		
Part No.	4302530-0022		
Material	CP70	Finish	-
Q'ty	1	Scale	1/1
Projection	⊕◁	Units	mm
DWG. No.	Ex-A19060029	Rev.	△0

General Note

1. Tolerance Limits : ±0.1
2. No indecations R=0.5, C=0.5
3. No indecations surface processing: ≤12S(▽▽▽)

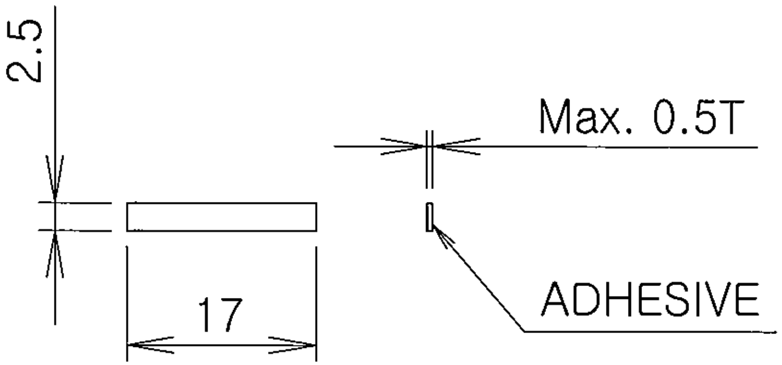
Rev.	Description	Date	Designed	Checked	Approved
△3					
△2					
△1					
△0	For issued	07.29.2019	Y.S.HA	J.M.SONG	H.J.JUNG

Attach Position
Adhesive Attach



SCALE 1/2

GFM-400-PR(M)-SHIELDCASE



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Korea Testing Laboratory
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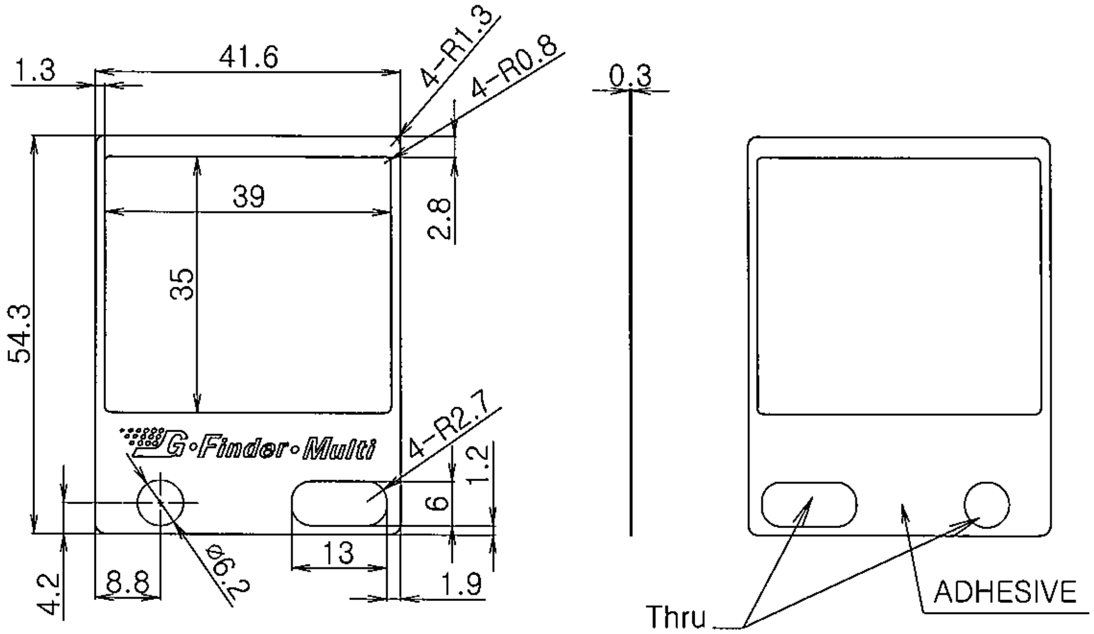
GASTRON CO.,LTD.

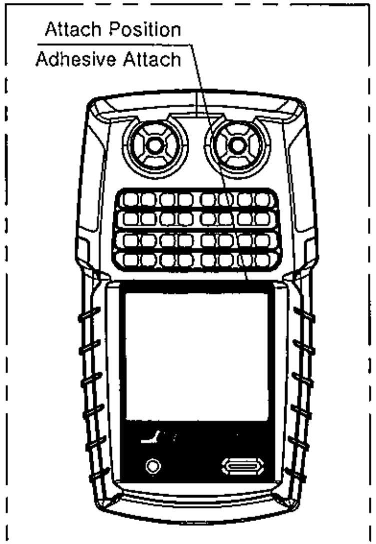
Model	GFM-400		
Title	GFM-400-GA-INSULATION SHEET		
Part No.	4302530-0023		
Material	MSR 050	Finish	-
Q'ty	1	Scale	1/1
Projection		Units	mm
DWG. No.	Ex-A19060030	Rev.	0

General Note

1. Tolerance Limits : ±0.1
2. No indecations R=0.5, C=0.5
3. No indecations surface processing: ≤12S(▽▽▽)

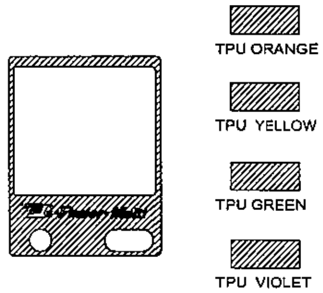
Rev.	Description	Date	Designed	Checked	Approved
3					
2					
1					
0	For issued	07.29.2019	Y.S.HA	J.M.SONG	H.J.JUNG





SCALE 1/2

GFM-400-IM(M)-COVER



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2019 .11. 1 9

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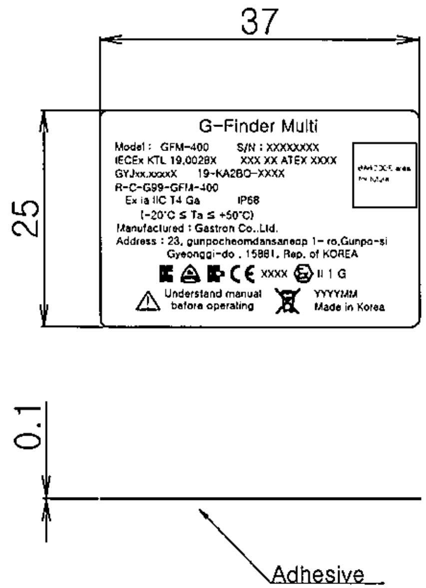
GASTRON CO.,LTD.

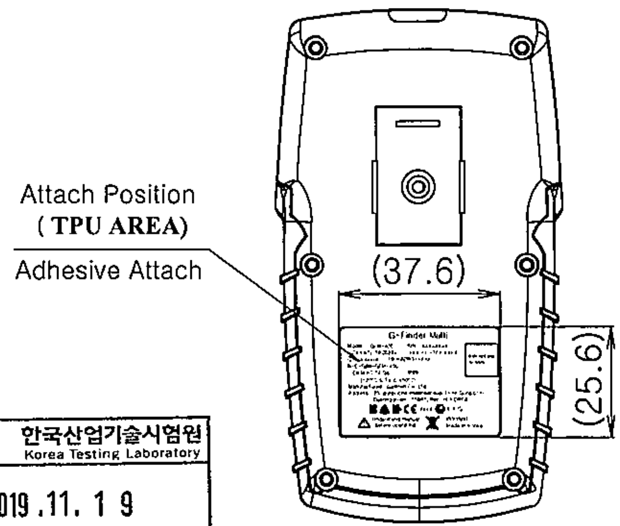
Model	GFM-400		
Title	GFM-400-DE-LCD WINDOW		
Part No.	4302280-0053		
Material	PC Film G11	**Finish**	-
Q'ty	1	**Scale**	1/1
Projection	⊕⊲	**Units**	mm
DWG. No.	Ex-A19060031	**Rev.**	0

General Note

1. Tolerance Limits : ±0.1
2. No indecations R=0.5, C=0.5
3. No indecations surface processing: ≤12S(▽▽▽)

Rev.	**Description**	**Date**	**Designed**	**Checked**	**Approved**
3					
2					
1					
0	For issued	07.29.2019	Y.S.HA	J.M.SONG	H.J.JUNG





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2019 .11. 1 9

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SCALE 1/2

GFM-400-IM(M)-BODY

SCHEDULE DRAWING

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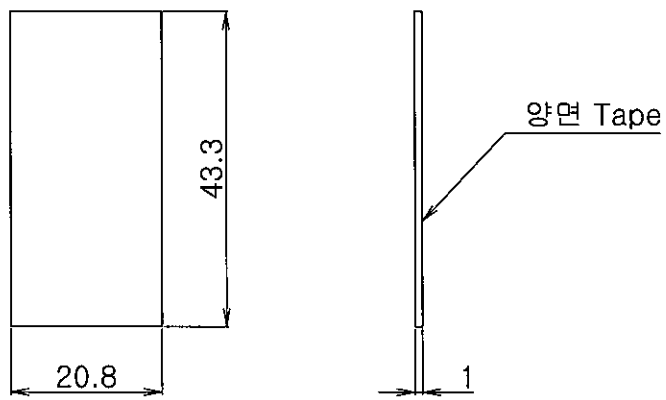
GASTRON CO.,LTD.

Model	GFM-400		
Title	GFM-400-LA- CERTIFICATION LABEL		
Part No.	4304111-0068		
Material	Matt Silver Pet MC0104	Finish	-
Q'ty	1	Scale	1/1
Projection		Units	mm
DWG. No.	Ex-A19060032	Rev.	0

General Note

1. Tolerance Limits : ±0.1
2. No indecations R=0.5, C=0.5
3. No indecations surface processing: ≤12S(▽▽▽)

⚠					
⚠					
⚠					
0	For issued	07.29.2019	Y.S.HA	J.M.SONG	H.J.JUNG
Rev.	Description	Date	Designed	Checked	Approved



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2019.11.19
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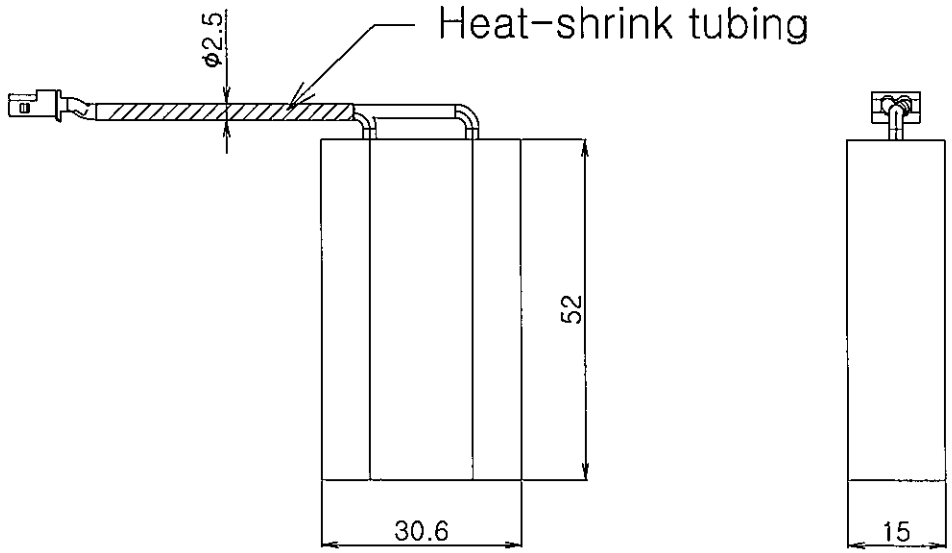
GASTRON CO.,LTD.

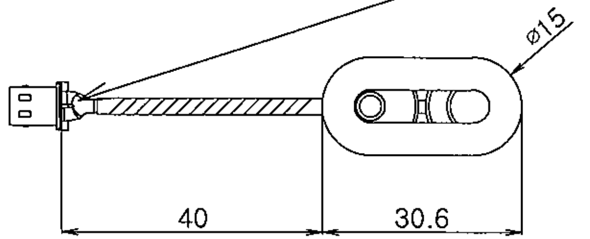
Model	GFM-400		
Title	GFM-400-GA-PCB Cushion		
Part No.	4302310-0036		
Material	PSR-1.0	Finish	-
Q'ty	1	Scale	1/1
Projection	⊕◁	Units	mm
DWG. No.	Ex-A19100005	Rev.	0

General Note

1. Tolerance Limits : ±0.1
2. No indecations R=0.5, C=0.5
3. No indecations surface processing: ≤12S(▽▽▽)

Rev.	Description	Date	Designed	Checked	Approved
3					
2					
1					
0	For issued	11.08.2019	C.Y.KIM	J.M.SONG	H.J.JUNG





Cable SPEC

Type	Conductor			Insulation		
	AWG Size	Const ruction (No/mm)	Approx Diameter	Min.thick (mm)	Ave.thick (mm)	Diameter (mm)
Stranded	24	11/0.16 T	0.61	0.69	0.77	2.15

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General Note

1. Tolerance Limits : ±0.1
2. No indecations R=0.5, C=0.5
3. No indecations surface processing: ≤12S(▽▽▽)

Rev.	Description	Date	Designed	Checked	Approved
3					
2					
1					
0	For issued	11.08.2019	C.Y.KIM	J.M.SONG	H.J.JUNG

GASTRON CO.,LTD.

Model	GFM-400		
Title	GFM-400_Battery(Ex Component)		
Part No.	4102302-0002		
Material	Li-SOCl2	Finish	
Q'ty	1	Scale	1/1
Pro-jection	⌖◁	Units	mm
DWG. No.	Ex-A19100004	Rev.	0

G-Finder Multi Instruction Manual

G-Finder Multi is a personal safety device designed to detect the presence of Oxygen (O_2), Carbon Monoxide (CO), Hydrogen Sulfide (H_2S), Methane (CH_4). Power is provided by one, non-user replaceable, lithium-thionyl chloride primary 2-cell. Readings are displayed on LCD and the device has audible, visual, and vibrating alarms when set, user-configurable conditions are exceeded. It is your responsibility to respond appropriately to the alarms. G-Finder Multi has no facilities for connection of external electrical circuits. G-Finder Multi has IR communications for changing the alarm set point, the calibration range and etc. The IR communications shall only be used in safe area.

⚠WARNING

1) G-Finder Multi is designed for single use and comes with a non-field replaceable lithium-ion battery, filter and sensor are already installed and ready for use.
2) Do not attempt replacement or substitution of components. Replacement or Substitution of components may impair Intrinsic Safety and will void the warranty of the product.
3) The electrical, electronic and battery elements of this product must not be disposed of via municipal waste streams; they should be disposed of by a qualified recycler or hazardous materials handler. Correct disposal will contribute to recycling of materials and prevent negative consequences for the environment.
4) It is recommended performing a bump test prior to G-Finder Multi use every day to confirm sensor response and alarm activation by exposing the detector to a concentration of target gas that exceeds the low alarm set point.
5) For optimal performance, periodically calibrate zero for the sensor.
6) G-Finder Multi is provided with anti-static coating over the LCD window to minimize risk of ignition due to electro-static discharge. Periodic inspection of this coating is required to ensure no degradation, delamination, abrasions or other deformities to this surface. Clean only with a damp cloth.
7) For all gas type of G-Finder Multi, always proceed bump test and calibration at room temperature and in a fresh air environment (20.9% v/v O2) that is free of hazardous gas.

⚠CAUTION

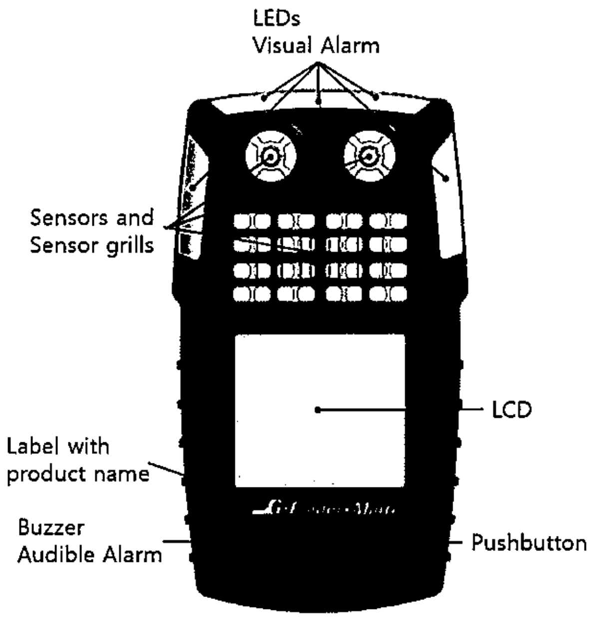
1) Activate G-Finder Multi before the activation date on the package.
2) In order to maintain normal operation of G-Finder Multi, keep the gas sensor grill from clogging and keep the gas sensor, LED and buzzer hole surfaces free from dust and dirt. Clean the exterior with a soft and damp cloth.
3) When using G-Finder Multi, sudden change in the temperature may cause change in the detected gas concentration value suddenly. Using in a stable temperature environment is recommended for more accurate detection.
4) The combustible gas sensor is initially calibrated to 50%LEL methane. Only methane gas should be used to calibrate or bump test the combustible gas sensor
5) G-Finder Multi is a gas detector, not a measurement device.
6) Portable safety gas detectors are life safety devices. Accuracy of ambient gas reading is dependent upon factors such as accuracy of the calibration gas standard used for calibration and frequency of calibration.

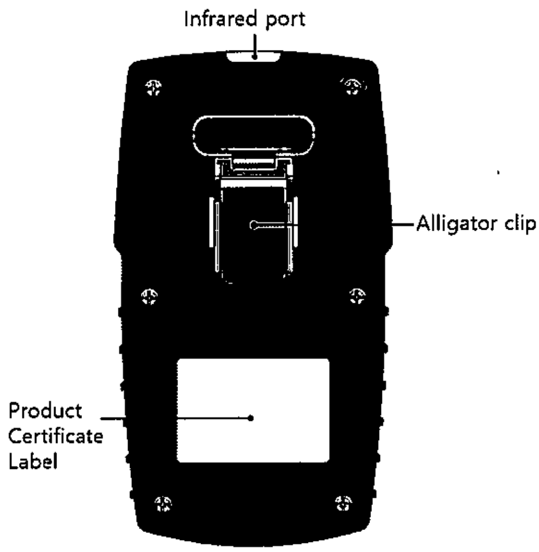
1. Specification

Item	Description
Ex marking	Ex II 1 G Ex ia IIC T4 Ga

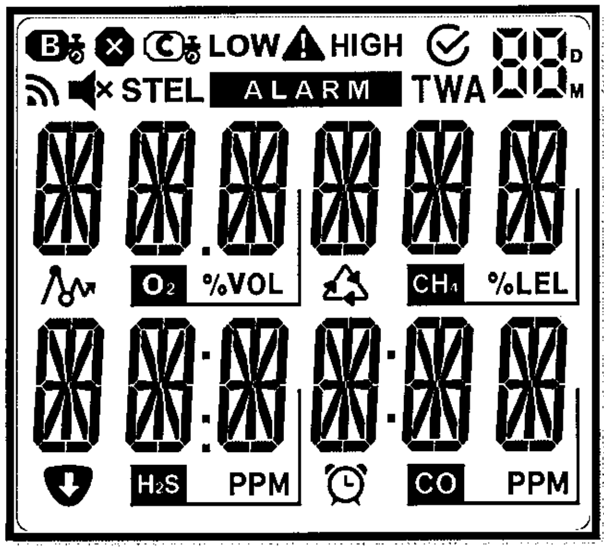
Approvals	IECEx : IECEx KTL 19.0028X KCs : 19-KA4BO-xxxx ATEX : XXXX 19 ATEX xxxx NEPSI : GYJ19.xxxx
Dimensions	120x68x41 mm (Alligator clip included)
Weight	221 g (Alligator clip included)
Temperature	-20°C ~ 50 °C
Humidity	5 ~ 95 % RH
IP	IP 68
Sensor type	O_2 - electrochemical cell CO- electrochemical cell H_2S - electrochemical cell CH_4 or C_3H_8 – Non Dispersive Infrared sensor * C_3H_8 is an option in the future.
Alarms	Visual, vibrating, audible (min. 95dB)
Display	Liquid Crystal Display (LCD)
Battery	Primary lithium-thionyl chloride (Li-SOCl2)
Event Log	Last 128 events. Newer events replace older events.
Battery Life	24 months of operation/ 2 minutes of alarm per day.
Warranty	Full 2 years

2. Each part for G-Finder Multi





3. LCD Icons Description



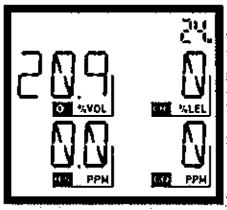
Icon	Description
LOW ⚠ ALARM ⚠ HIGH ALARM	Low alarm and high alarm. These signs are displayed when gas concentration exceeds alarm setpoints.
STEL ALARM	STEL alarm. These signs are displayed when gas concentration exceeds alarm setponits

ALARM TWA	TWA alarm. These signs are displayed when gas concentration exceeds alarm setponits
	This icon is displayed when a sensor calibration is in progress or overdue.
	This icon is displayed when a sensor bump test is in progress or overdue.
	This icon is displayed when a functional error occurs.
	This icon is displayed when a Bluetooth connection is due.
	This icon is displayed when a all alarm off.
	This icon is displayed when as long as the detector works normally without any gas alarms and functional errors.
88 D 88 M	Displays remaining product life time
%VOL	Oxygen concentration is measured as percent by volume.
%LEL	Combustible gas concentration is meaned in lower explosive limit.
PPM	Toxic gas concentration is measured in parts per million.
	This icon is displayed when an alarm event has occurred within the past 10 hours.
	End of operating life warning indicator.
	When this symbol is displays, press one time or hold the pushbutton until the symbol disappears
	Time Indicator. (Remaining product life with 00M / 00d / 00h display, 00 means remaining months / days / hours)

4. Activate a New Detector

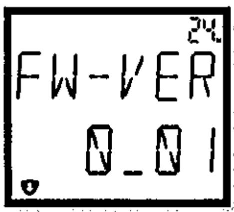
1) Move to a normal atmosphere (20.9% v/v O2) that is free of hazardous gas.
2) Press and hold the pushbutton until 5 second countdown is displayed, then continue to hold until the countdown is completed to activate G-Finder Multi.
3) When the countdown is completed, the LCD, LEDs, vibration, and beep turn on and then turn off.
4) The alarm setpoints are displayed and the sensor stabilization countdown is displayed. The time required to stabilization is 2minute. When the countdown reaches 0, the activation is completed.
   ※ In case of G-Finder Multi, when the countdown reaches 0, the zero calibration is performed automatically and after the zero calibration, the activation is completed.
5) The detector is in normal operating mode when the gas type and concentration are displayed.

5. Normal Operating Mode



Normal

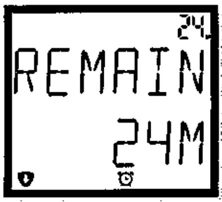
1) When the detector is in normal operating mode, the type of gas detected is permanently displayed. The detected concentration of the gas is displayed until it is disrupted by a pushbutton action, gas alarm, or error event. If you want to see the status information about the detector, please press the pushbutton once.



Firmware Version

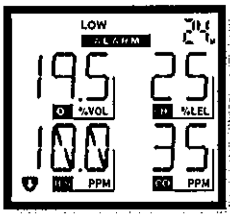
2) The display information on the LCD is changed to the current firmware version of the

detector from the normal display by pressing the button once. The number before the period '_' means major number of the firmware version, and the number after the period means minor number. In other word, "1_00" indicates the firmware number is '1.00'.



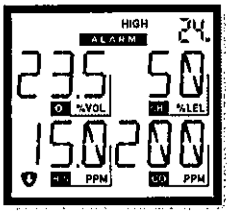
Remaining Product Life

3) The display information on the LCD is changed to the remaining product life from the current firmware version of the detector by pressing the button once. The unit of the remaining life will be changed automatically refer to the remaining life scale; "24$_{M}$" ~ "1$_{M}$", "30^{D}" ~ "1^{D}", "24" ~ "1".



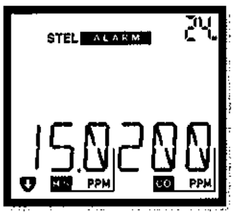
Low Alarm Set Value

4) The display information on the LCD is changed to the low alarm set value from the remaining product life by pressing the button once.



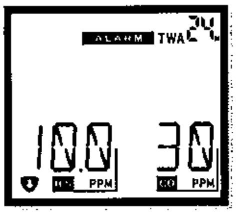
High Alarm Set Value

5) The display information on the LCD is changed to the high alarm set value from the low alarm set value by pressing the button once.



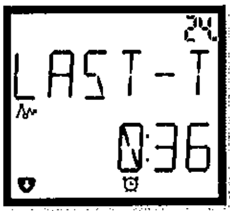
STEL Alarm Set Value

6) The display information on the LCD is changed to the short term exposure limit(STEL) alarm set value from the high alarm set value by pressing the button once.

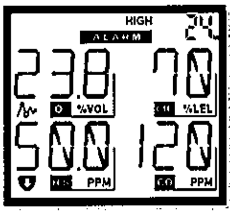


TWA Alarm Set Value

7) The display information on the LCD is changed to the time weighted average(TWA) alarm set value from the STEL alarm set value by pressing the button once.
8) The display information on the LCD is changed to the normal display from the TWA alarm set value by pressing the button once if there is not any alarm event occurred within the past 10 hours.



Elapsed Time



Alarm Value Occurred

9) Or if there is any alarm event occurred within the past 10 hours, the display information on the LCD is changed to elapsed time since the alarm occurred from the TWA alarm set value by pressing the button once, and then it is changed to the alarm value occurred by pressing the button once again, and it is changed to the normal display by pressing the button once again.

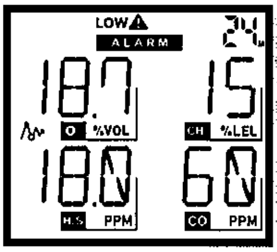
6. Alarms

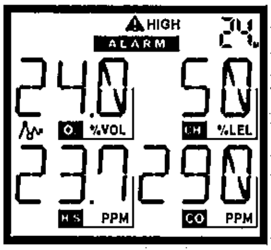
An alarm is initiated when the sensor is exposed to a gas concentration that exceeds alarm setpoints. The alarm has four types; a low alarm and a high alarm and a STEL alarm and a TWA alarm.

The alarm persists until the gas concentration returns to an acceptable range. Battery life decreases rapidly when the detector is in alarm condition.
For G-Finder Multi O_2, a low alarm occurs when the measured concentration value is lower than the low alarm setting value, while a high alarm occurs when the measured concentration value is higher than the high alarm setting value.
The following alarm settings are default for each detector gas type.

Gas Type	Low Alarm	High Alarm
O_2	19.5% v/v O_2	23.5% v/v O_2
CO	30 ppm	200 ppm
H_2S	10.0 ppm	15.0 ppm
CH_4	10% LEL	20% LEL

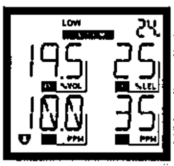
When the alarm occurs, LEDs flash, vibration and beep sounds occur and display will be changed as below for example.

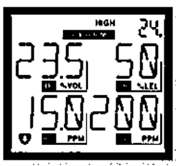




7. Bump Test

1) Press the button twice at the normal operating mode in succession to get into the menu, it shows "BUMP" on the screen.
2) Press and hold the button until a 3 second countdown is displayed, then continue to hold until the countdown is completed to perform the bump test.
3) Then the gas Injection display, the low alarm setpoint display, and the high alarm setpoint display occur cross and the detector waits for injection of gas which causes an alarm.





4) If the detector detects the gas concentration for the bump test, the bump test process is performed automatically. The result will be displayed on the screen at the end of the test. If an alarm occurs during the bump test, the test is succeeded, otherwise the test is failed.

8. Zero the Sensor

In case of G-Finder Multi O_2, over time and through use, the sensor baseline at zero exposure may drift from the manufacturer's baseline.
For optimal performance of O2 sensor, it is recommended to zero the O2 sensor at least once in a month at the condition of room temperature and in a fresh air environment (20.9% v/v O2) that is free of hazardous gas.
The user will be noted by the display of the calibration reminder icon when the sensor calibration is due. If the icon is showing please zero the sensor as instructed below:
** For all gas types, we recommend to zero the sensor periodically.

1) Move to a normal atmosphere (20.9% v/v O2) that is free of hazardous gas.
2) Press the button twice at the normal operating mode in succession to get into the menu, "BUMP" will be displayed on the screen.
3) "ZERO" is displayed on the screen by pressing the button once, then press and hold the button until a 3 second countdown is displayed. Continue to hold until the countdown is completed to calibrate zero.
4) Wait until the zeroing process is completed.
5) When the zeroing process is completed, "PASS" or "FAIL" appears.
6) After displaying the result, "ZERO" is displayed on the screen again automatically.
7) If "FAIL" appears, repeat the zeroing process according to above procedure.
8) If the zeroing process fails again, please contact our service center.
9) To calibrate gas, press the button once, and "SPAN" will be displayed on the screen. Continue calibrating according to the "Calibration Gas" section.

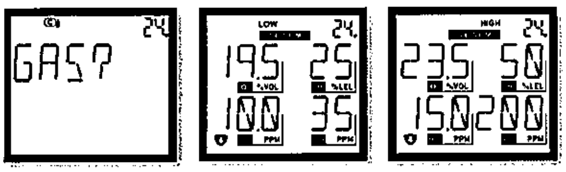
10) Or to exit the menu, press the button repeatedly to go back to normal operating mode.

9. Gas Calibration

For more optimal performance of G-Finder Multi, gas calibration may be needed. To calibrate the detector, we recommend gas calibration after doing zero calibration at room temperature and in a fresh air environment (20.9% v/v O2) that is free of hazardous gas.
By default, G-Finder Multi is configured to use the following calibration gas mixtures:

Gas Type	Standard Calibration Gas Concentration
O_2	18.0 % v/v O_2
CO	100 ppm (balance N_2)
H_2S	25 ppm (balance N_2)
CH_4	50 % LEL (balance N_2)

1) Move to a normal atmosphere (20.9% v/v O2) that is free of hazardous gas.
2) Press the button twice at the normal operating mode in succession to get into the menu. "bUMP" will be displayed on the screen.
3) "ZERO" will be displayed on the screen by pressing the button once, by pressing the button again, "SPAN" will be displayed on the screen.
4) Press and hold the button until a 3 second countdown is displayed. Continue to hold until the countdown is completed.
5) The gas Injection display and the standard calibration gas concentration display occur cross and the detector waits for injection of calibration gas.



6) If the detector detects the gas concentration for the gas calibration, the gas calibration process will be performed automatically.
7) When the gas calibration process is completed, "PASS" or "FAIL" appears.
8) After displaying the result, "SPAN" will be displayed on the screen again automatically.
9) If "FAIL" appeared, repeat the gas calibration process according to above procedure.
10) If the gas calibration fails again, please contact our service center.
11) Or to exit the menu, press the button repeatedly to go back to normal operating mode.

10. Detection Range

Detection ranges for each gas type are noted in the table below.

Gas Type	Detection Range
O_2	0 to 25.0% Vol with 0.1 increments
CO	0 to 300 ppm with 1 increment
H_2S	0 to 100 ppm with 0.1 increments
CH_4	0 to 100% LEL with 1 increments

11. Manufacturer Information

If there are any problems with our products, please contact us at the address below.

1) Address :
Gastron Co., Ltd. 23, Gunpocheomdansaneop 1-ro, Gunpo-si, Gyeonggi-do, Korea
2) Tel : 82-31-490-0800
3) Fax : 82-31-490-0801
4) URL : www.gastron.com
5) e-mail : gastron@gastron.com

12. Certifications and Approvals

1) The certification marking and certificate numbers are in the table below.

Product Name	Specific Low Power Radio Equipment for Wireless Data Communication Systems
Ex marking	ATEX : CE 0344 (Ex) II 1 G Ex ia IIC T4 Ga IECEx / KCs / NEPSI : Ex ia IIC T4 Ga
Approvals	IECEx : IECEx KTL 19.0028X KCs : 19-XXXXX-XXXX ATEX : XXXXX 19ATEXXXXX NEPSI : GYJ19. XXXX KC : R-C-G99-GFM-400

2) The product is in conformity with the following standards:
IECEx : IEC 60079-0:2017, IEC 60079-11:2011
KCs : Announcement No. 2019-15 of Ministry of Employment and Labor
ATEX : EN 60079-0:2012, EN 60079-11:2012
NEPSI : GB 3836.1-2010, GB 3836.4-2010, GB 3836.20-2010

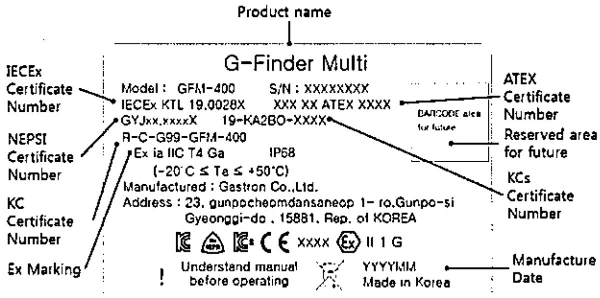
3) The product may be used in zones 0, 1 & 2 with flammable gases and vapors with apparatus groups IIC and with temperature classes T1, T2, T3, T4.

4) The product is only certified for use in ambient temperatures in the range -20℃ ≤ Ta ≤ +50℃ and should not be used outside this range.

5) With regard to explosion safety, it is not necessary to check for correct operation.

6) The product contains no user-replaceable parts and is not intended to be repaired by the user. Repair of the equipment is to be carried out by the manufacturer, or their approved agents, in accordance with the applicable code of practice.

7) The certificate label is described as below.



13. Ordering Information

Please put an order according to model code description below.

- GFM-400-X-Y
  - GFM-400 : standard model name
  - *X : Flammable gas type
    - ➢ *X : Option code (default, MM2.5 ~ PP2.5) which can be selected when ordering by user demand which is not be a default for a target gas type, a calibration gas type, and a measurement range type about the flammable gas type. For the details about options, please refer to the table below. Other option codes except default option are options in the future.

Option code	Target Gas	Calibration Gas	Measurement range, %vol
default (blank)	CH_4	CH_4	0 ~ 5
MM2.5	CH_4	CH_4	0 ~ 2.5
MM100	CH_4	CH_4	0 ~ 100
MP1.5	CH_4	C_3H_8	0 ~ 1.5
MP2.5	CH_4	C_3H_8	0 ~ 2.5
PP1.5	C_3H_8	C_3H_8	0 ~ 1.5
PP2.5	C_3H_8	C_3H_8	0 ~ 2.5

  - *Y : Housing body color (Blank : orange(default), YE : yellow, GN : green, VT : violet, etc.)
    - ➢ *Y : Option which does not affect intrinsic safety. This option code is needed at the order if you want some color different with default for the

housing body. This option code will be not printed on the label.

14. Sales Information

This equipment may be operated in all EU members.

15. Revision History

REV.	CONTENTS	DATE
0.1	Initial Document	25 JULY 2019