SPECIFICATION

Surface Acoustic Wave Filter

USER	
USER PART No.	
WISOL PART No.	SFXG45BU702
DOC. No.	SMS-51-L-SFT-FS-222
DATE	October 24, 2019
REVISION	000

WISOL					
ISSUED BY	Ryoo,Hye-Ok	APPROVED BY (R&D)	Ha, Sang-Ki	APPROVED BY (QC)	Jeon, Bong-Seong
User					
ISSUED BY		CHECKED BY		APPROVED BY	

WISOL CO., LTD.
531-7, Gajang-ro, Osan-si,
Gyeonggi-do, KOREA, 18103
http://www.wisol.co.kr

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1. REVISION HISTORY

000	October 24, 2019	All Page	Make specification

2. DEFINITION

2-1. PART No.

S F X G 4 5 B U 7 0 2

① ② ③ ④ ⑤ ⑥

No.	EXPLANATION
①	SAW Filter
②	Design Type
③	Center Frequency :1745MHz(1710 ~ 1780) 2155MHz(2110 ~ 2200)
④	Input:50ohm,Output:50ohm
⑤	Package size: 1.8×1.4mm^2
⑥	Design Revision (02 : Molding Type)

2-2. APPLICATION : LTE B66 Duplexer

2-3. SPEC

ESD Level HBM=250V

3. PRECAUTIONS

3-1. This device should not be used in any type of fluid such as water, oil, organic solvent, etc.

3-2. This is a hermetic device.
MSL(Moisture Sensitive Level) is the '2a' level.

3-3. Ultrasonic cleaning shall be avoided.

3-4. Isopropyl Alcohol and Ethyl Alcohol can be used for cleaning. Contact us before using other cleaning solvents than above

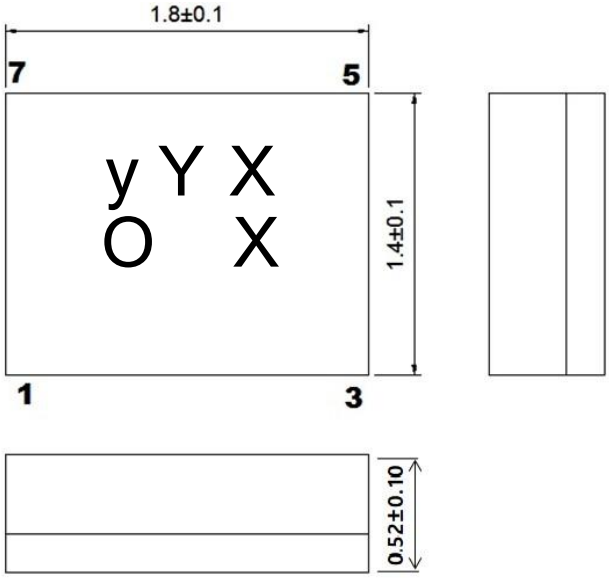
3-5. This is an electrostatic sensitive device.
Please avoid static voltage during operation and storage.

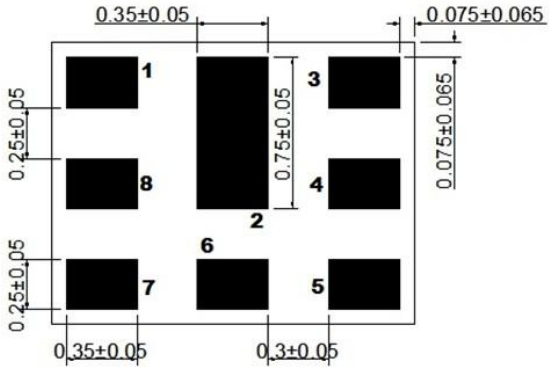
3-6. Sudden change of temperature shall be avoided, deterioration of the characteristics can occur.

3-7. If any malfunction due to designing or manufacturing which is out of specification occurs within one year after the products have been delivered, the maker should exchange the defective products.

4. OUTLINE DRAWING & DIMENSIONS

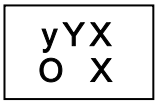
[Unit: mm]





No.	Function
1	Rx Output
3	Tx Output
6	Antenna
2, 4, 5, 7, 8	Ground

5. MARKING



5-1. y Y X X

- The 1st 2nd character 'yY' indicates the model name of SAW Filter SFXG45BU702.
- The 3rd character 'X' indicates the year and the month of manufacture..

Year	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
2017	1	2	3	4	5	6	7	8	9	A	B	C
2018	D	E	F	G	H	I	J	K	L	M	N	O
2019	P	Q	R	S	T	U	V	W	X	Y	Z	a
2020	1	2	3	4	5	6	7	8	9	A	B	C

※ This rotates by the 3 years.

- The 4th character 'X' indicates Date of manufacture

DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
MARKING	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
DATE	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
MARKING	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V

5-2. ○

- This symbol indicates input pin 1.
- This indicates the producing center
  ○ : China

5-3. Marking : Laser Marking

6. PERFORMANCE

6-1. MAXIMUM RATINGS

CHARACTERISTICS	RATINGS	UNITS	NOTES
DC Permissive Voltage	5	V	
Maximum Input Power	30	dBm	55 ℃, 5000 h
Operating Temperature Range	−30 ~ +85	℃	
Storage Temperature Range	−40 ~ +85	℃	

6-2. ELECTRICAL CHARACTERISTICS

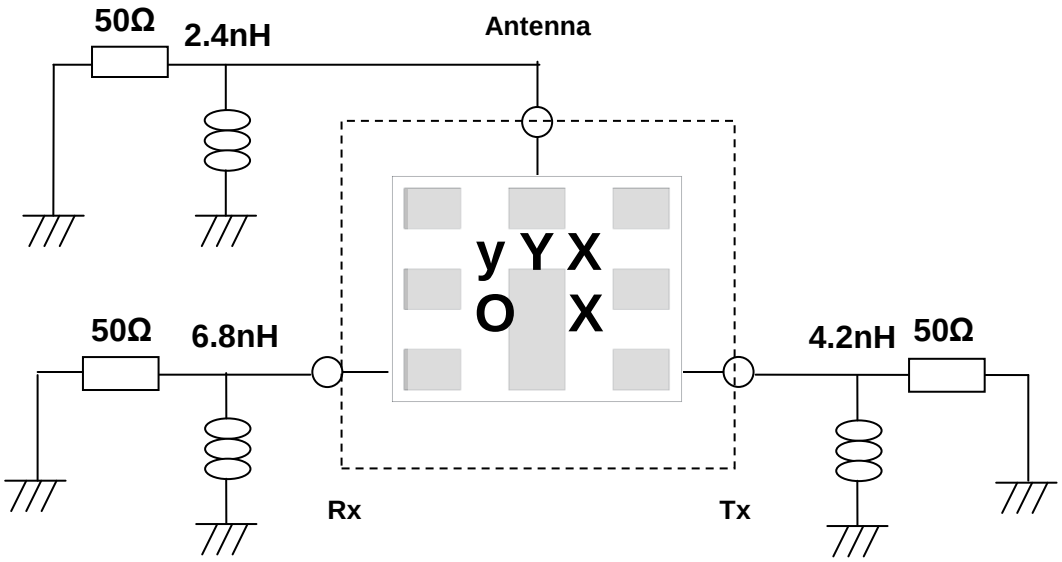
6-2-1. TABLE

Ta = -30 ~ +85℃
(*1) PCB loss is de-embedded.

Item	CONDITION [MHz]	UNIT	RATING		
			Min.	Typ.(25℃)	Max.
TX → ANTENNA					
Insertion Loss(*1)	1710 ~ 1780	dB	-	1.5	2.3
Inband Ripple	1710 ~ 1780	dB	-	0.7	1.3
Ant VSWR	1710 ~ 1780	-	-	1.6	2.0
TX VSWR	1710 ~ 1780	-	-	1.4	2.0
Absolute Attenuation	10 ~ 728	dB	30	50	-
	699 ~ 716	dB	30	50	-
	704 ~ 716	dB	30	50	-
	777 ~ 787	dB	30	47	-
	824 ~ 849	dB	30	45	-
	851 ~ 894	dB	38	44	-
	1226 ~ 1250	dB	33	37	-
	1559 ~ 1563	dB	36	51	-
	1565.42 ~ 1573.374	dB	36	50	-
	1573.374 ~ 1577.466	dB	37	48	-
	1577.466 ~ 1585.42	dB	37	47	-
	1597.5515 ~ 1605.886	dB	35	44	-
	1805 ~ 1880	dB	3	6	-
	2110 ~ 2200	dB	36	45	-
	2350 ~ 2360	dB	21	42	-
	2400 ~ 2500	dB	21	37	-
	2440 ~ 2494	dB	21	37	-
	2500 ~ 2570	dB	19	36	-
	3410 ~ 3520	dB	10	32	-
	4900 ~ 5267	dB	8	23	-
	5267 ~ 6000	dB	8	18	-
Termination Impedance : ANTENNA / Tx			50Ω//2.4[nH] / 50Ω// 4.2[nH]		

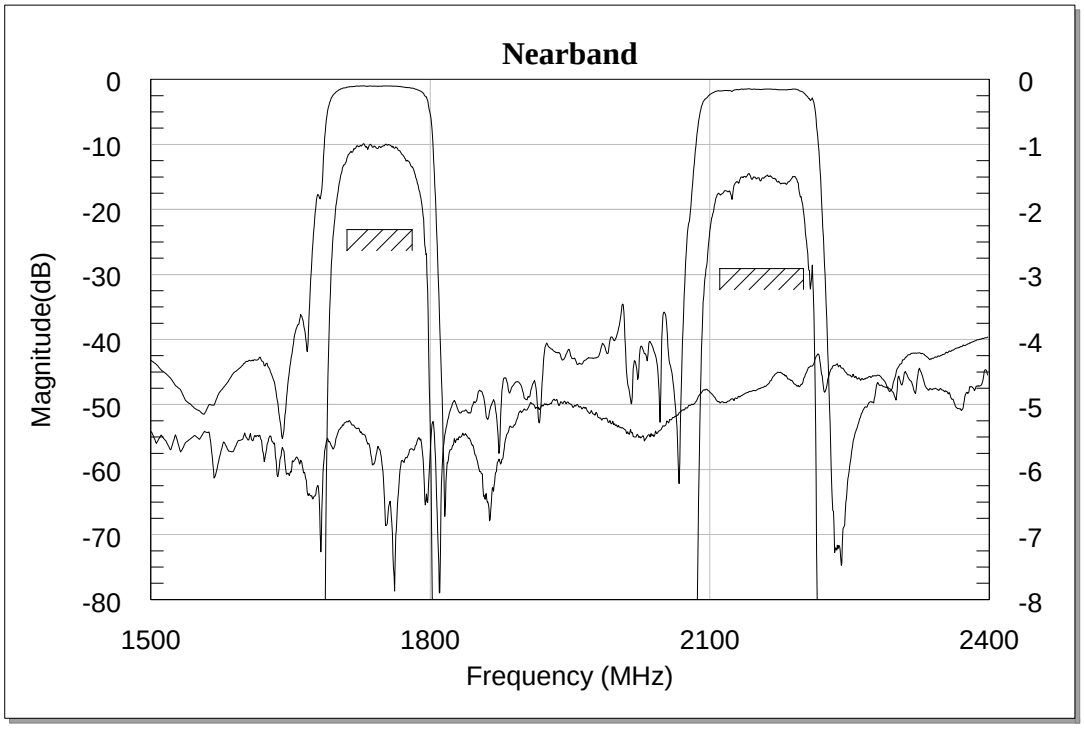
ANTENNA → RX					
Insertion Loss(*1)	2110 ~ 2200	dB	-	2.0	2.9
Inband Ripple	2110 ~ 2200	dB	-	0.7	1.6
Ant VSWR	2110 ~ 2200	-	-	1.6	2.0
RX VSWR	2110 ~ 2200	-	-	1.8	2.1
Absolute Attenuation	10 ~1649	dB	40	53	-
	400	dB	50	86	-
	699 ~ 716	dB	45	71	-
	777 ~ 787	dB	40	68	-
	824 ~ 849	dB	40	66	-
	1310 ~ 1355	dB	40	55	-
	1649 ~ 1672	dB	30	55	-
	1672 ~ 1710	dB	40	52	-
	1710~1780	dB	45	52	-
	1755 ~ 2025	dB	15	33	-
	1910 ~ 1955	dB	30	39	-
	2255 ~ 6000	dB	23	34	-
	2305 ~ 2315	dB	40	44	-
	2400 ~ 2500	dB	39	44	-
	2500 ~ 3820	dB	35	44	-
	3820 ~ 3910	dB	35	44	-
	4220 ~ 4310	dB	34	38	-
	4310 ~ 4900	dB	25	34	-
	4900 ~ 5510	dB	25	34	-
	5510 ~ 5685	dB	30	34	-
	5685 ~ 6000	dB	30	34	-
Termination Impedance : ANTENNA / Rx			50Ω //2.4[nH] / 50Ω//6.8[nH]		
TX → RX					
Isolation between Rx and Tx	1574 ~ 1577	dB	40	69	-
	1710 ~ 1780	dB	50	53	-
	2110 ~ 2200	dB	50	53	-
	3410 ~ 3570	dB	20	58	-
	5120 ~ 5350	dB	20	46	-

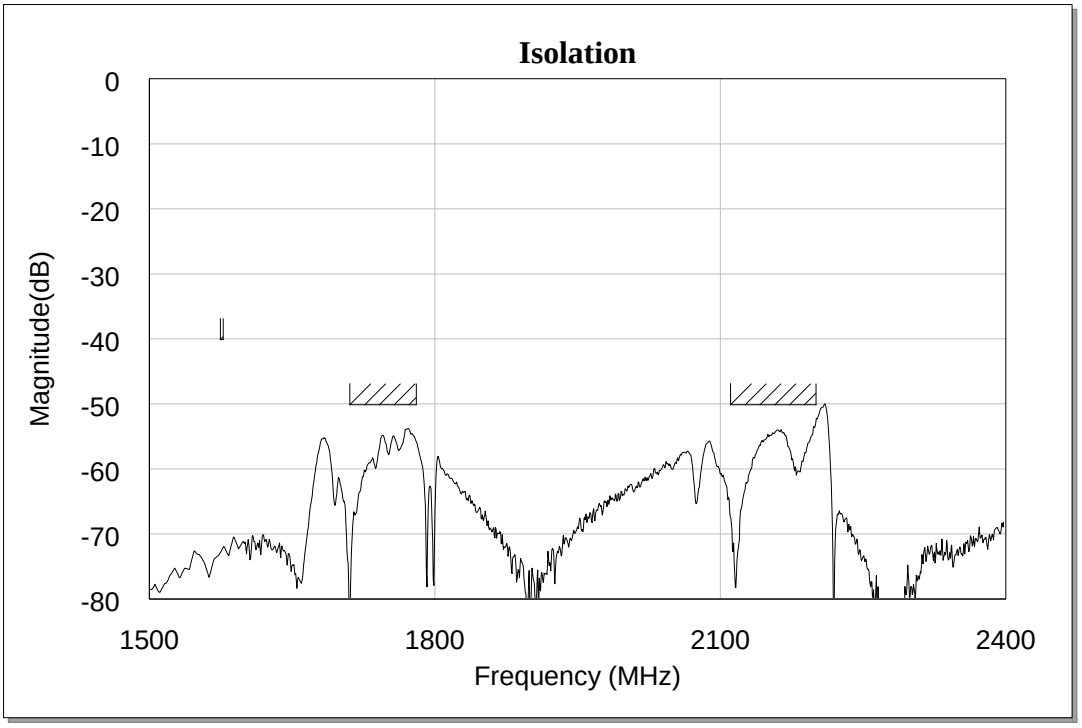
6-2-2. TEST FIXTURE

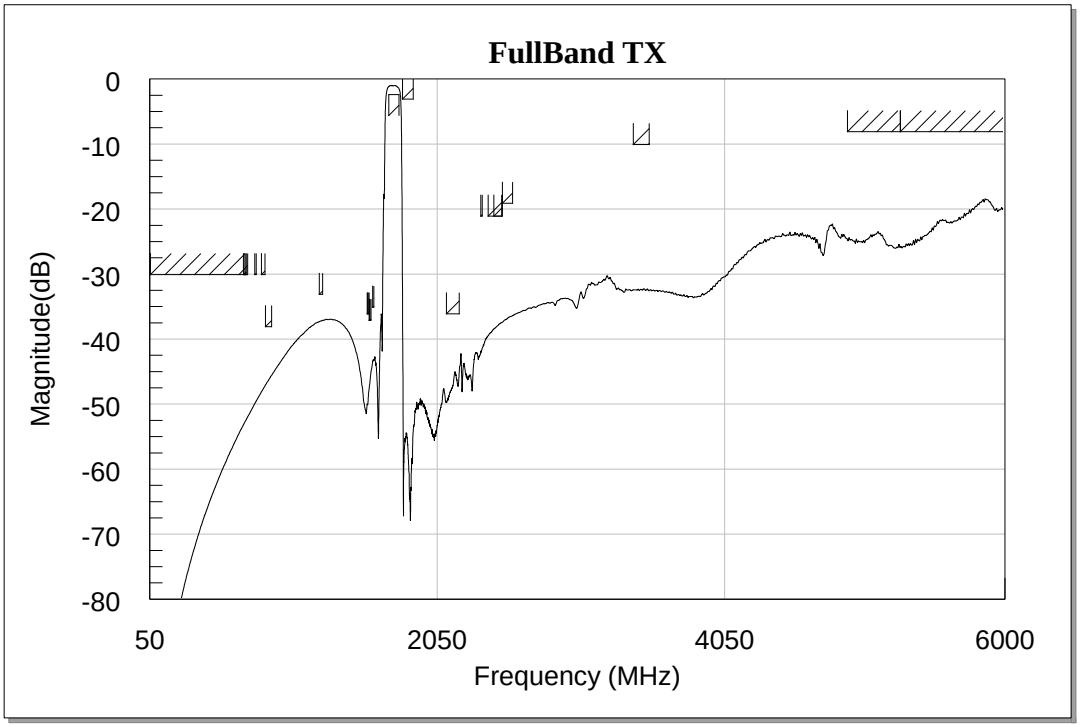


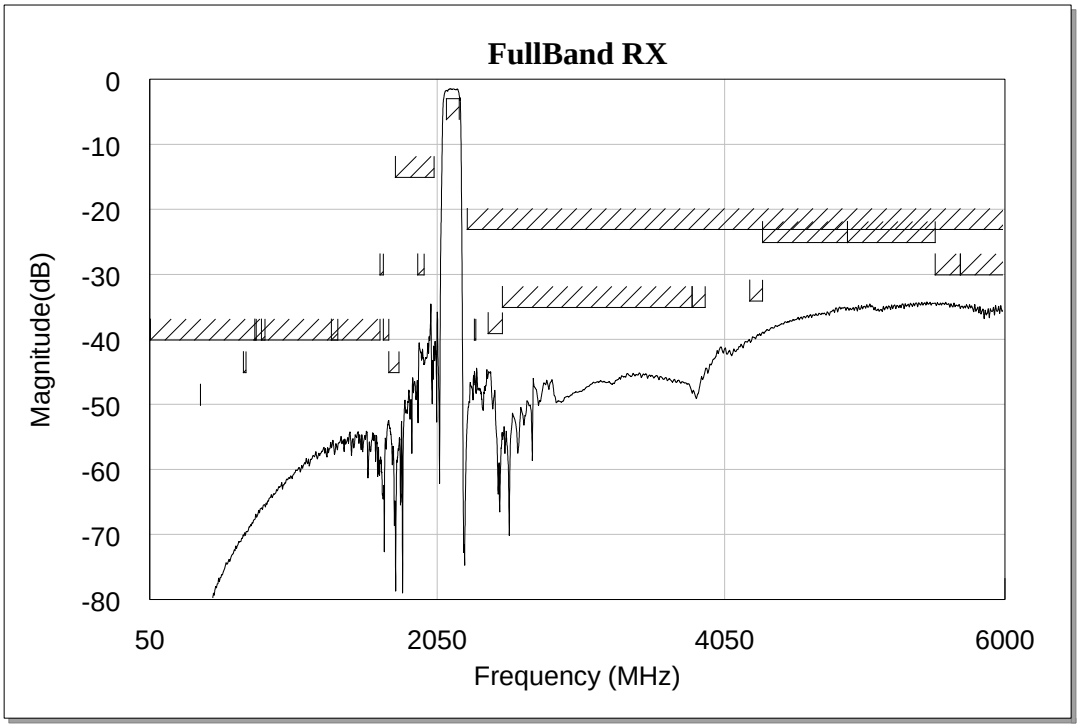
[X–Ray Top View]

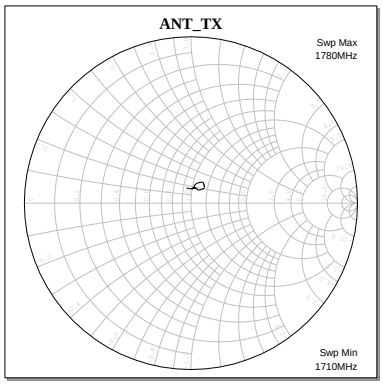
6-2-3. GRAPH

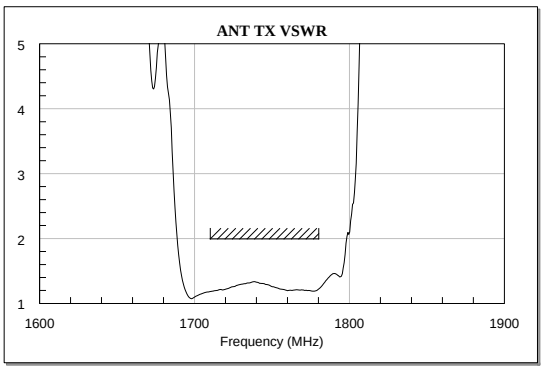

Nearband
Magnitude(dB)
0
-10
-20
-30
-40
-50
-60
-70
-80
0
-1
-2
-3
-4
-5
-6
-7
-8
1500
1800
2100
2400
Frequency (MHz)

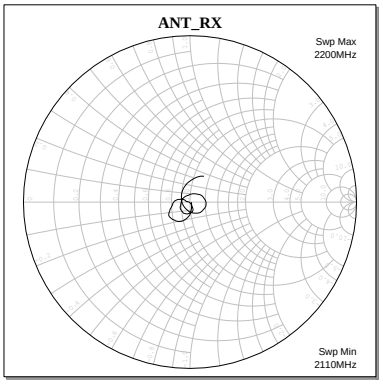

Isolation
Magnitude(dB)
0
-10
-20
-30
-40
-50
-60
-70
-80
1500
1800
2100
2400
Frequency (MHz)

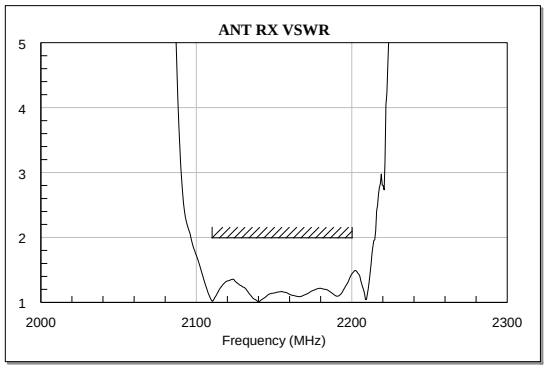

FullBand TX
0
-10
-20
-30
-40
-50
-60
-70
-80
Magnitude(dB)
50
2050
4050
6000
Frequency (MHz)

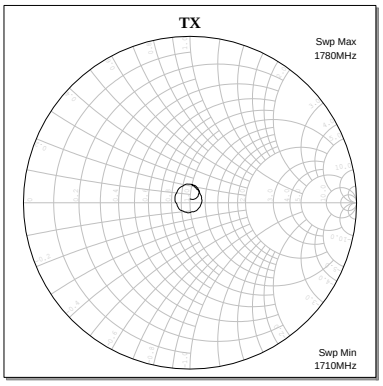

FullBand RX
0
-10
-20
-30
-40
-50
-60
-70
-80
Magnitude(dB)
50
2050
4050
6000
Frequency (MHz)

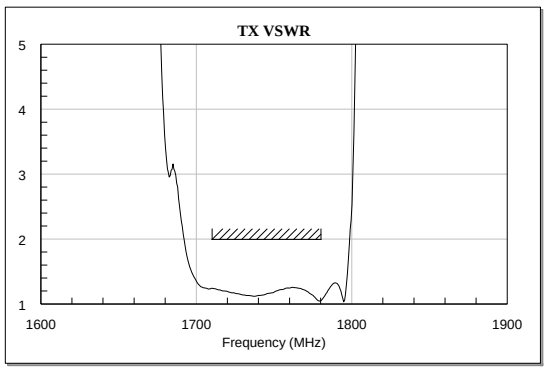

ANT_TX
Swp Max
1780MHz
Swp Min
1710MHz

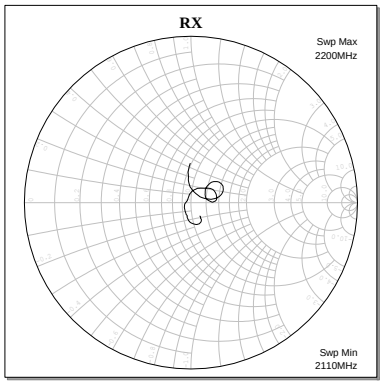

ANT TX VSWR
5
4
3
2
1
1600
1700
1800
1900
Frequency (MHz)

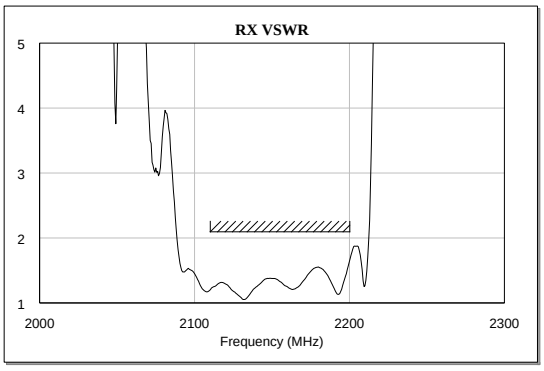

ANT_RX
Swp Max
2200MHz
Swp Min
2110MHz


ANT RX VSWR
5
4
3
2
1
2000
2100
2200
2300
Frequency (MHz)


TX
Swp Max
1780MHz
Swp Min
1710MHz

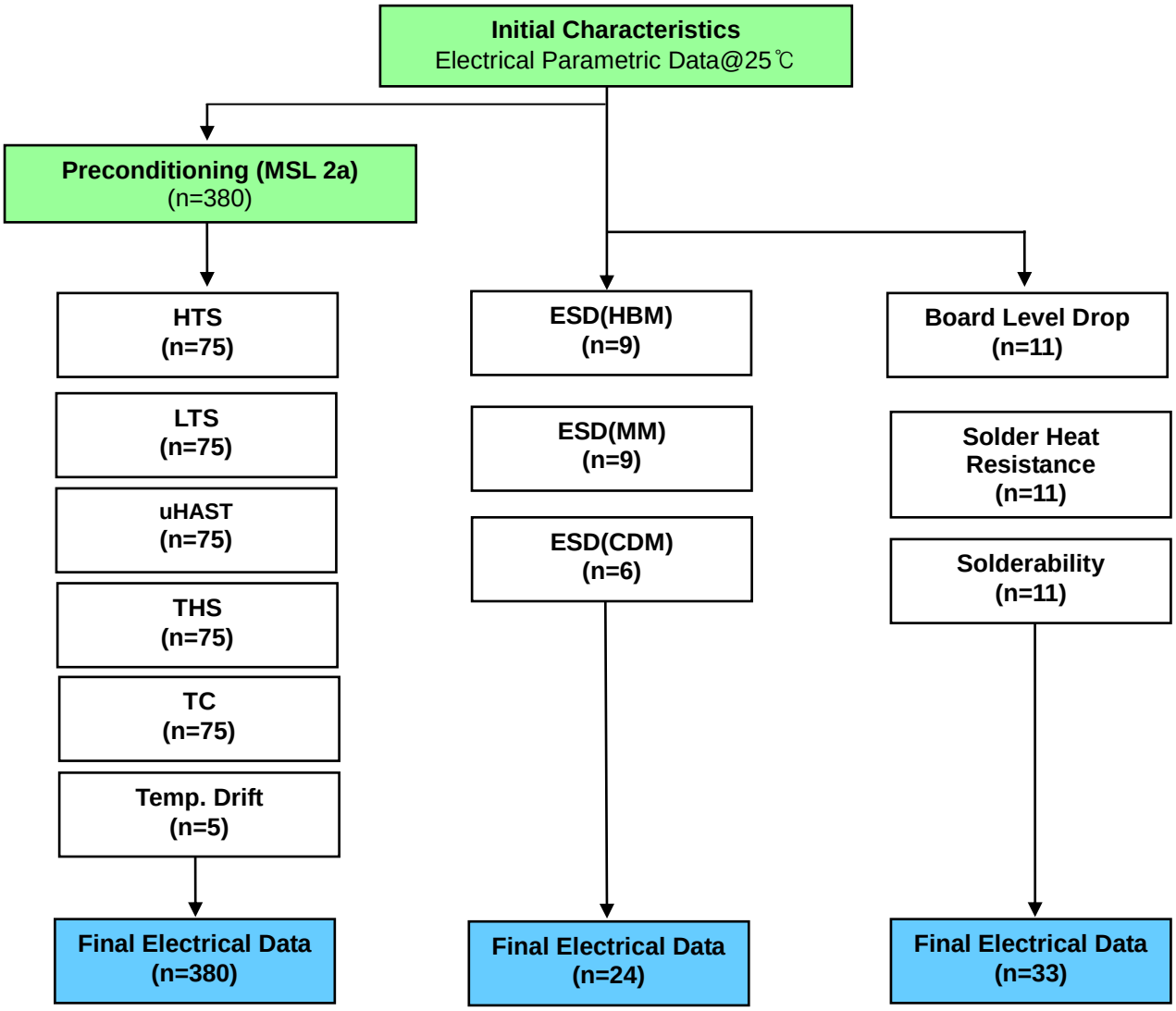

TX VSWR
5
4
3
2
1
1600
1700
1800
1900
Frequency (MHz)


RX
Swp Max
2200MHz
Swp Min
2110MHz


RX VSWR
5
4
3
2
1
2000
2100
2200
2300
Frequency (MHz)

7. RELIABILITY

7-1. ENGINEERING SAMPLE FLOW CHART

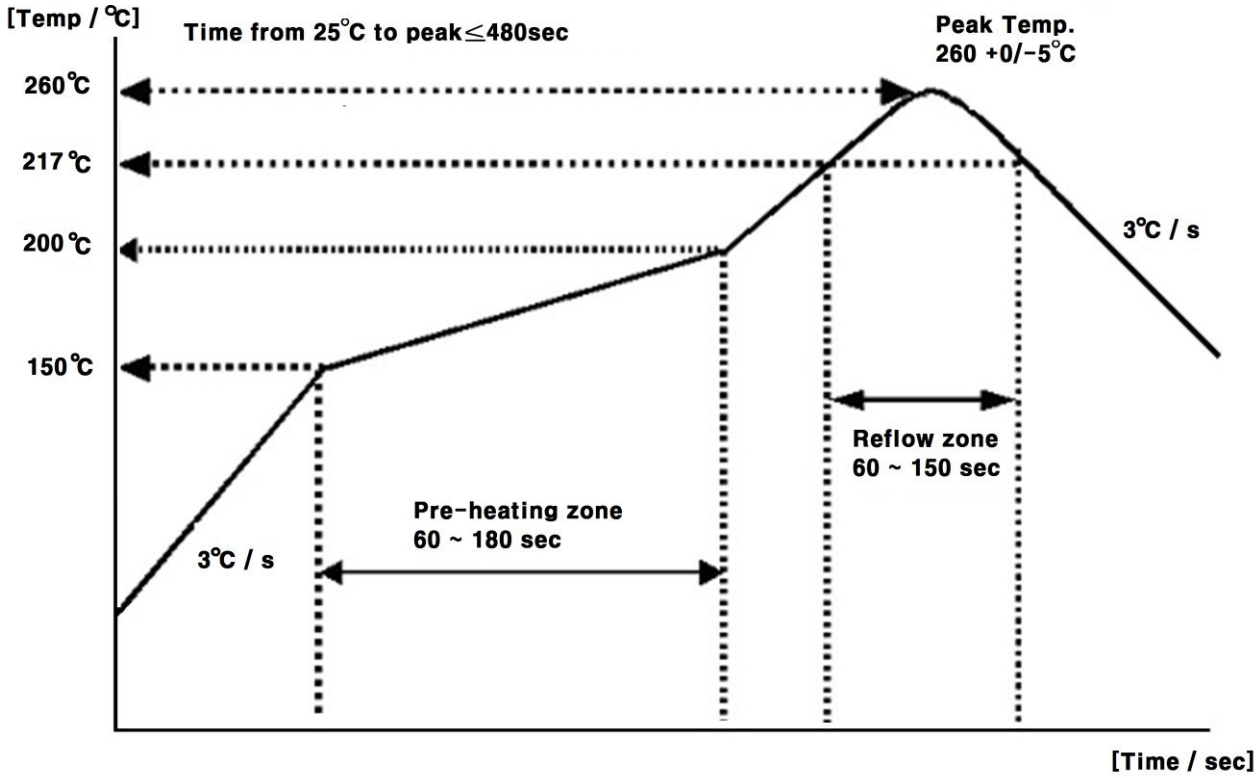


7-2. TEST ITEM & CONDITION

CATEGORY	TEST ITEM	TEST CONDITION	REMARK
Preconditioning		+85℃85%RH 24hr → +260 Peak Reflow Test (3times)	-

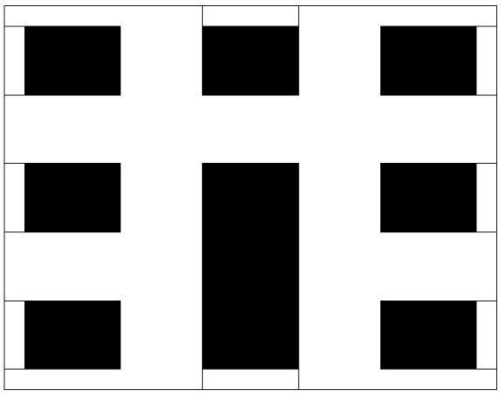
TEST ITEM	REMARK	TEST CONDITION	Duration
HTS (High Temperature Storage)	JESD22-A103	condition B +125(-0/+10)℃	1000hr
LTS (Low Temperature Storage)	JESD22-A119	condition A -40(-10/+0)℃	1000hr
uHAST (Unbiased HAST)	JESD22-A118	condition A 130±2℃, 85±5%, 33.3psi	96hr
THS (Temperature Humidity Storage)	JESD22-A101	85±2℃, 85±5% RH	1000hr
TC (Temperature Cycle)	JESD22-A104	condition B (-55℃⇔ +125℃) Soak mode 4 (30min)	700cycle
ESD(HBM)	JS-001-2017	200V, 250V, 300V	All pin 1sec 1time
ESD(MM)	JESD22-A115	100V 150V 200V	All pin 1sec 1time
ESD(CDM)	JS-002-2018	1.0KV, 1.2KV	All pin 1sec 1time
Board Level Drop Test	-	120 ㎝ 19 Time, 152 ㎝ 12 Time Stell Plate Free fall	19times 12times
Solder Heat Resistance	JESD22-B106C	260℃ Solder Pore Dipping	10sec
Solderability	JESD22-B102E	235℃ Solder Pore Dipping	3sec
Temp Drift	-	-40℃ => 25℃ => 125℃	Per condition 2HR

8. REFLOW CONDITION

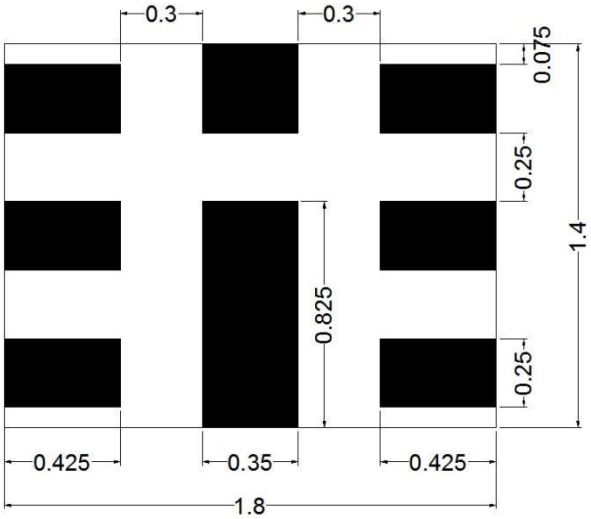


9. RECOMMENDED PCB DIMENSIONS

[unit : mm]



[SAW, X-ray Top view]



[PCB, X-ray Top view]

10. CAUTION

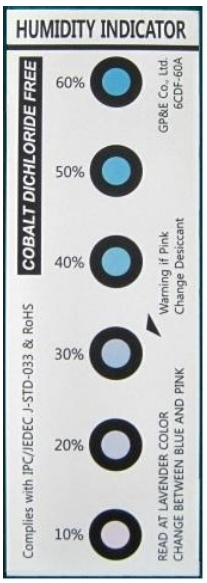
Moisture Sensitivity Device Caution (MSL LEVEL=2a)

1. Calculated shelf life in sealed bag : 12 month at 〈40℃ and 〈90% relative Humidity(RH)
2. Peak package body temperature : 260℃
3. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must be
   (a) Mounted within : 672 hours of factory conditions ≤30℃/60% RH, or
   (b) Stored per J-STD-033
4. Device require bake, before mounting, if :
   (a) Humidity Indicator Card reads 〉60% when read at 23±5℃
   (b) 3(a) or 3(b) are not met
5. If baking is required, refer to IPC/JEDEC J-STD-033 for bake procedure

Note : Level and body temperature defined by IPC/JEDEC J-STD-020

Aluminum Pack (310mmX370mm)

HIC(Humidity Indication Card)

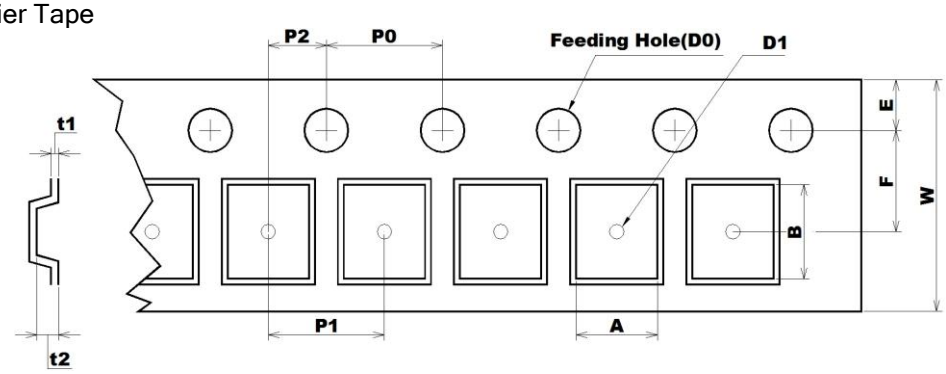


10 to 60% RH

11. PACKING

11-1. DIMENSIONS

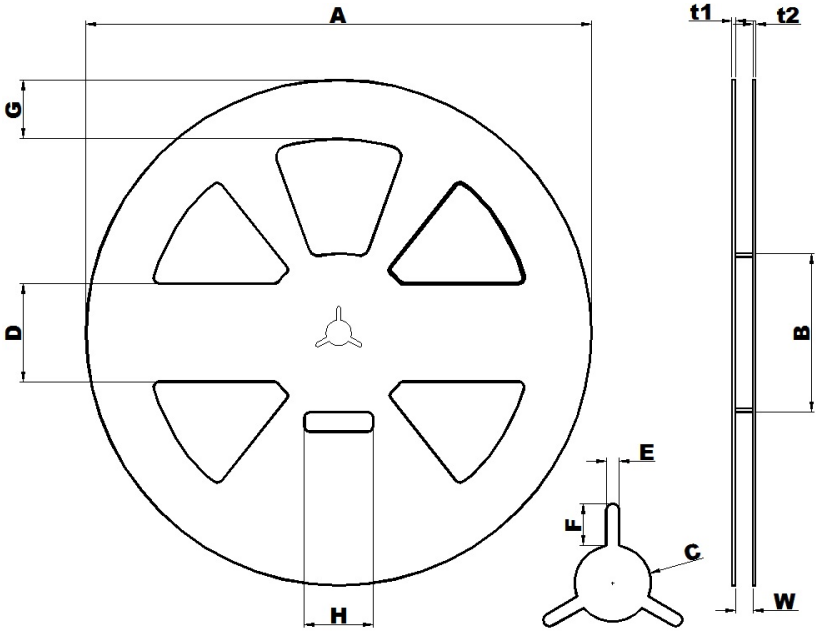
- Carrier Tape



[Unit: mm]

A	B	D0	D1	E	F	P0	P1	P2	t1	t2	W
1.60 ± 0.05	2.00 ± 0.05	Ø1.55 ± 0.05	Ø1.00 MIN	1.75 ± 0.10	3.50 ± 0.05	4.00 ± 0.10	4.00 ± 0.10	2.00 ± 0.05	0.25 ± 0.05	0.80 ± 0.05	8.00 ± 0.10

- Reel



[Unit: mm]

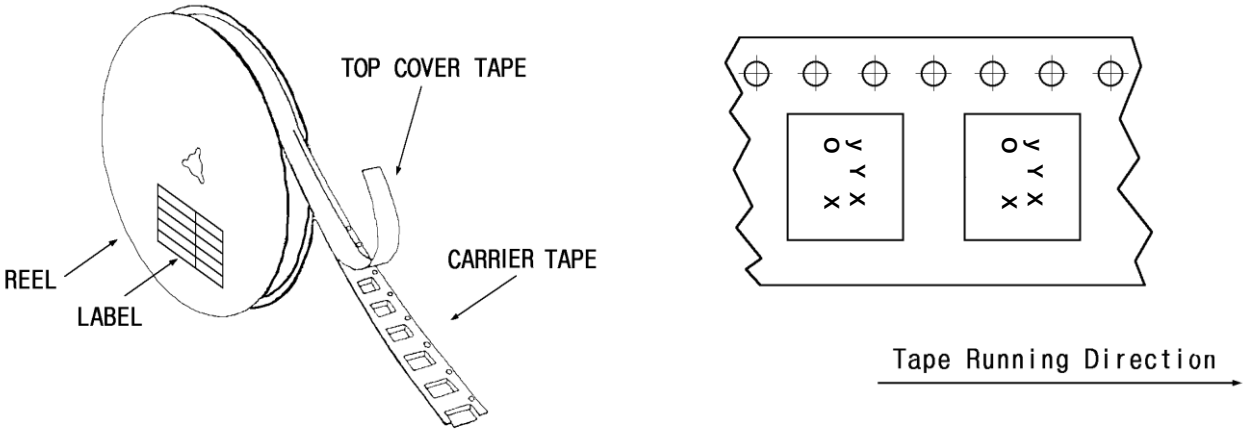
A	B	C	D	E	F	G	H	t1	t2	W
Ø258.0 +1.0 -0.5	Ø81.0 +1.0 -1.0	Ø13.0 +0.5 -0.5	50.0 +0.8 -0.8	2.2 +0.3 -0.3	7.0 +0.5 -0.5	30.0 +0.8 -0.8	35.0 +1.0 -1.0	1.8 +0.5 -0.5	1.5 +0.5 -0.5	9.0 +1.0 -0.5

- The product shall be packed properly not to damaged during transportation and storage.

11-2. REELING QUANTITY
10 inch reel : 8,000 pcs/reel

11-3. TAPING STRUCTURE

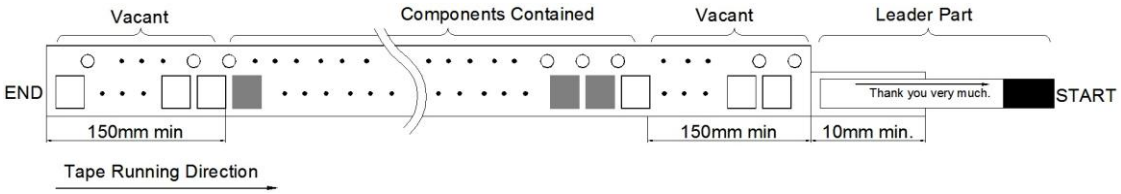
11-3-1. The tape shall be wound around the reel in direction shown below.



11-3-2. BARCODE LABEL

①	MODEL NAME BARCODE
②	Model Name
③	Reel number
④	Quantity / Marking

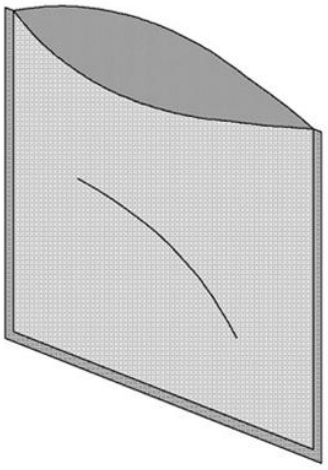
1-3-3. Leader part and vacant position specifications.



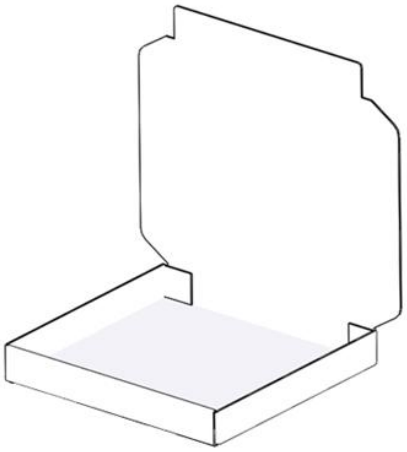
11-4. INNER BOX(Reel Packing) STRUCTURE

Material: Polycarbonate

Material : Polyethylene + Aluminium
Size : 310×370mm^2



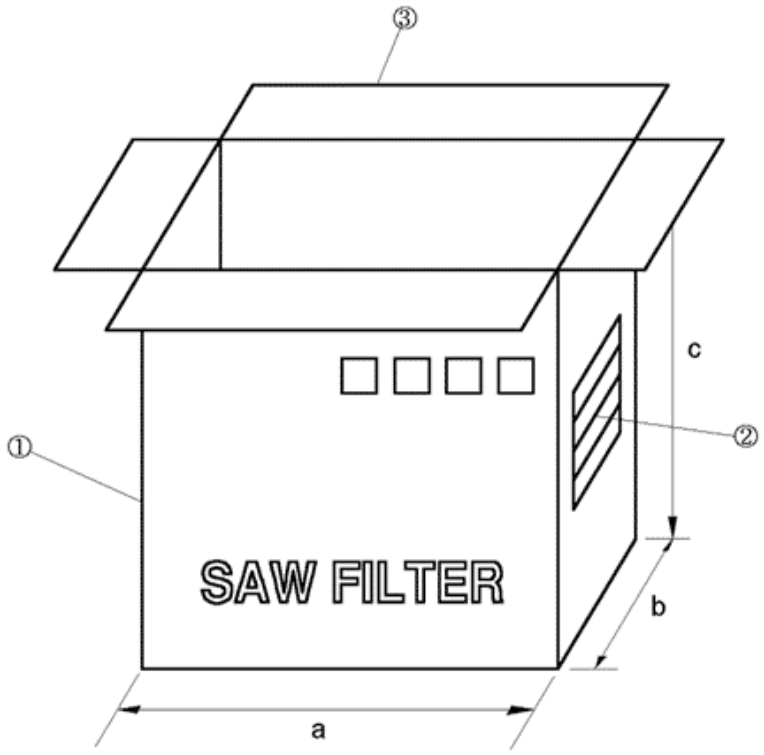
Material : Paper
Size: (D)290×(W)290×(H)42mm3



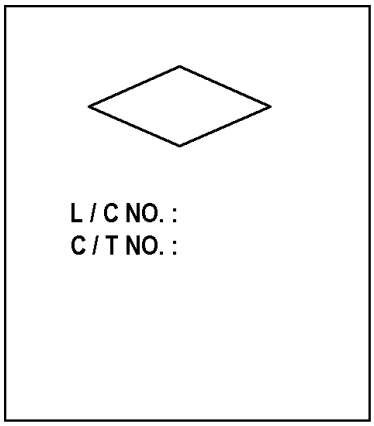
11-5. OUTER BOX STRUCTURE

Material : Paper

TYPE	SIZE(mm)			Inner Box #
	a	b	c	
A	300	270	300	6 boxes



SIDE ①



SIDE ②

MODEL	
Q'TY	EA
USER	
DATE	. .

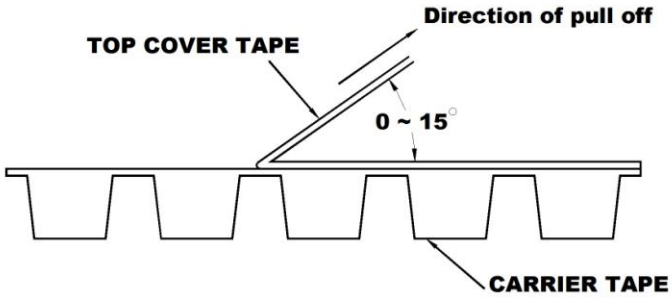
- SIDE is the same as front side.

12. TAPE SPECIFICATIONS

12-1. Tensile Strength of Carrier Tape: 4.4N/mm width

12-2. Top Cover Tape Adhesion (See the below figure)

- pull of angle: 0~15 degree
- speed: 300mm/min.
- force: 20~70g



13. RoHS DATA

13-1. RAW MATERIAL(EPOXY)

SGS

Test Report No. F690101/LF-CTSAYAA18-31468 Issued Date : 2018. 06. 14 Page 1 of 9

NAGASE KOREA
Danam Bldg 23F, 10 Sowol-ro
Jung-gu, Soeul
Korea

The following sample(s) was/were submitted and identified by/on behalf of the client as:-

SGS File No.	: AYAA18-31468
Product Name	: EPOXY SHEET A2029
Item No./Part No.	: N/A
Received Date	: 2018. 06. 05
Test Period	: 2018. 06. 05 to 2018. 06. 14
Test Results	: For further details, please refer to following page(s)

SGS Korea Co., Ltd.

Jeff Jang

Jeff Jang / Chemical Lab Mgr

SGS

Test Report No. F690101/LF-CTSAYAA18-31468 Issued Date : 2018. 06. 14 Page 2 of 9

Sample No. : AYAA18-31468.001
Sample Description : EPOXY SHEET A2029
Item No./Part No. : N/A
Materials : Epoxy Resin

Heavy Metals

Test Items	Unit	Test Method	MDL	Results
Cadmium (Cd)	mg/kg	With reference to IEC 62321-5:2013 (Determination of Cadmium by ICP-OES)	0.5	N.D.
Lead (Pb)	mg/kg	With reference to IEC 62321-5:2013 (Determination of Lead by ICP-OES)	5	N.D.
Mercury (Hg)	mg/kg	With reference to IEC 62321-4:2013 (Determination of Mercury by ICP-OES)	2	N.D.
Hexavalent Chromium (Cr VI)*	mg/kg	With reference to IEC 62321-7-2:2017, determination of Hexavalent Chromium by Colorimetric Method using UV-Vis and/or with reference to IEC 62321-5:2013, determination of Chromium by ICP-OES.	8	N.D.
Antimony (Sb)	mg/kg	With reference to EPA 3052(1996), US EPA 6010B(1996), ICP	10	N.D.
Tin (Sn)	mg/kg	With reference to EPA 3052(1996), US EPA 6010B(1996), ICP	10	N.D.

Flame Retardants-PBBs/PBDEs

Test Items	Unit	Test Method	MDL	Results
Monobromobiphenyl	mg/kg	With reference to IEC 62321-6:2015 (Determination of PBBs and PBDEs by GC-MS)	5	N.D.
Dibromobiphenyl	mg/kg	With reference to IEC 62321-6:2015 (Determination of PBBs and PBDEs by GC-MS)	5	N.D.
Tribromobiphenyl	mg/kg	With reference to IEC 62321-6:2015 (Determination of PBBs and PBDEs by GC-MS)	5	N.D.
Tetrabromobiphenyl	mg/kg	With reference to IEC 62321-6:2015 (Determination of PBBs and PBDEs by GC-MS)	5	N.D.
Pentabromobiphenyl	mg/kg	With reference to IEC 62321-6:2015 (Determination of PBBs and PBDEs by GC-MS)	5	N.D.
Hexabromobiphenyl	mg/kg	With reference to IEC 62321-6:2015 (Determination of PBBs and PBDEs by GC-MS)	5	N.D.
Heptabromobiphenyl	mg/kg	With reference to IEC 62321-6:2015 (Determination of PBBs and PBDEs by GC-MS)	5	N.D.
Octabromobiphenyl	mg/kg	With reference to IEC 62321-6:2015 (Determination of PBBs and PBDEs by GC-MS)	5	N.D.

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Test Report No. F690101/LF-CTSAYAA18-31468 Issued Date : 2018. 06. 14 Page 3 of 9

Sample No. : AYAA18-31468.001
Sample Description : EPOXY SHEET A2029
Item No./Part No. : N/A
Materials : Epoxy Resin

Flame Retardants-PBBs/PBDEs

Test Items	Unit	Test Method	MDL	Results
Nonabromobiphenyl	mg/kg	With reference to IEC 62321-6:2015 (Determination of PBBs and PBDEs by GC-MS)	5	N.D.
Decabromobiphenyl	mg/kg	With reference to IEC 62321-6:2015 (Determination of PBBs and PBDEs by GC-MS)	5	N.D.
Monobromodiphenyl ether	mg/kg	With reference to IEC 62321-6:2015 (Determination of PBBs and PBDEs by GC-MS)	5	N.D.
Dibromodiphenyl ether	mg/kg	With reference to IEC 62321-6:2015 (Determination of PBBs and PBDEs by GC-MS)	5	N.D.
Tribromodiphenyl ether	mg/kg	With reference to IEC 62321-6:2015 (Determination of PBBs and PBDEs by GC-MS)	5	N.D.
Tetrabromodiphenyl ether	mg/kg	With reference to IEC 62321-6:2015 (Determination of PBBs and PBDEs by GC-MS)	5	N.D.
Pentabromodiphenyl ether	mg/kg	With reference to IEC 62321-6:2015 (Determination of PBBs and PBDEs by GC-MS)	5	N.D.
Hexabromodiphenyl ether	mg/kg	With reference to IEC 62321-6:2015 (Determination of PBBs and PBDEs by GC-MS)	5	N.D.
Heptabromodiphenyl ether	mg/kg	With reference to IEC 62321-6:2015 (Determination of PBBs and PBDEs by GC-MS)	5	N.D.
Octabromodiphenyl ether	mg/kg	With reference to IEC 62321-6:2015 (Determination of PBBs and PBDEs by GC-MS)	5	N.D.
Nonabromodiphenyl ether	mg/kg	With reference to IEC 62321-6:2015 (Determination of PBBs and PBDEs by GC-MS)	5	N.D.
Decabromodiphenyl ether	mg/kg	With reference to IEC 62321-6:2015 (Determination of PBBs and PBDEs by GC-MS)	5	N.D.

Phthalates

Test Items	Unit	Test Method	MDL	Results
Di-(2-ethylhexyl) phthalate (DEHP)	mg/kg	With reference to IEC 62321-8 ; 2017 , GC/MS	50	N.D.
Di-butyl phthalate (DBP)	mg/kg	With reference to IEC 62321-8 ; 2017 , GC/MS	50	N.D.
Benzyl butyl phthalate (BBP)	mg/kg	With reference to IEC 62321-8 ; 2017 , GC/MS	50	N.D.
Di-isobutyl phthalate (DIBP)	mg/kg	With reference to IEC 62321-8 ; 2017 , GC/MS	50	N.D.

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Test Report No. F690101/LF-CTSAYAA18-31468

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Sample No. : AYAA18-31468.001
Sample Description : EPOXY SHEET A2029
Item No./Part No. : N/A
Materials : Epoxy Resin

Halogen Content

Test Items	Unit	Test Method	MDL	Results
Bromine(Br)	mg/kg	With reference to EN 14582:2016, IC	30	N.D.
Chlorine(Cl)	mg/kg	With reference to EN 14582:2016, IC	30	100
Fluorine(F)	mg/kg	With reference to EN 14582:2016, IC	30	N.D.
Iodine(I)	mg/kg	With reference to EN 14582:2016, IC	50	N.D.

NOTE: (1) N.D. = Not detected.(<MDL)
(2) mg/kg = ppm
(3) MDL = Method Detection Limit
(4) - = No regulation
(5) Negative = Undetectable / Positive = Detectable
(6) ** = Qualitative analysis (No Unit)
(7) * = a. The result of Hexavalent Chromium (Cr(VI)) is "ND" as the result of Chromium (Cr) is "ND", and confirmation test of Hexavalent Chromium (Cr(VI)) is not required.
b. If the Chromium (Cr) content is greater than the MDL of Hexavalent Chromium (Cr(VI)), confirmation test of Hexavalent Chromium (Cr(VI)) is required.

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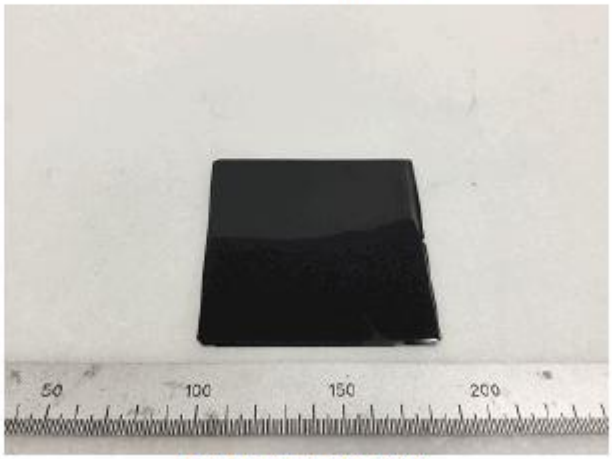
Test Report No. F690101/LF-CTSAYAA18-31468 Issued Date : 2018. 06. 14 Page 5 of 9

Picture of Sample as Received:



AYAA18-31468.001

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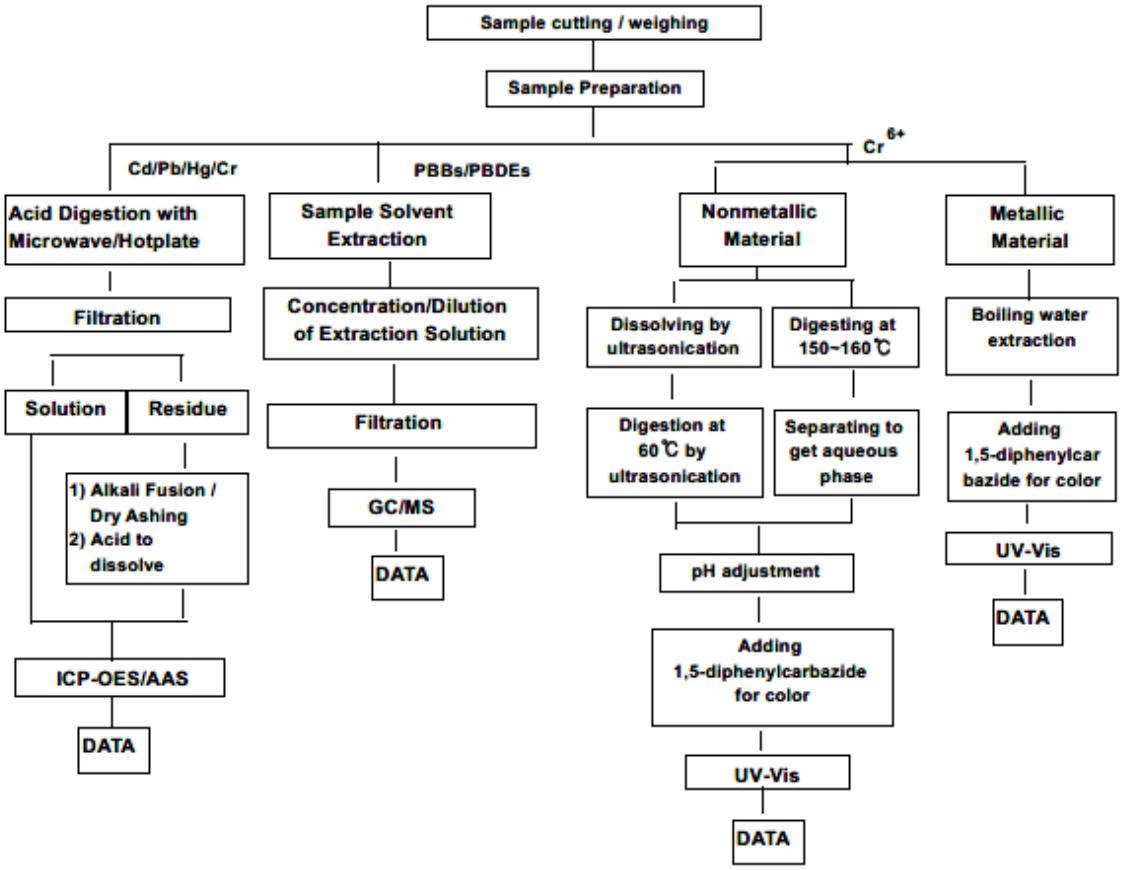
Test Report No. F690101/LF-CTSAYAA18-31468 Issued Date : 2018. 06. 14 Page 6 of 9

Testing Flow Chart for RoHS:Cd/Pb/Hg/Cr^{6+} /PBBs&PBDEs Testing



The samples were dissolved totally at the acid digestion step of the above flow chart for Cd,Pb,Hg
Section Chief : Minkyu Park

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Flow Chart for Inorganic Elements Testing

Inorganic Elements

Mechanic_Sample

↓

Sample Measurement

↓

Acid Digestion with Microwave/Hotplate

↓

Filtration

↓

Residue

↓

Total Digestion

↓

ICP-AES

↓

DATA

Major Inorganic Heavy Metals	**Antimony(Sb) , Beryllium(Be) , Phosphorus(P) , Arsenic(As) etc.**

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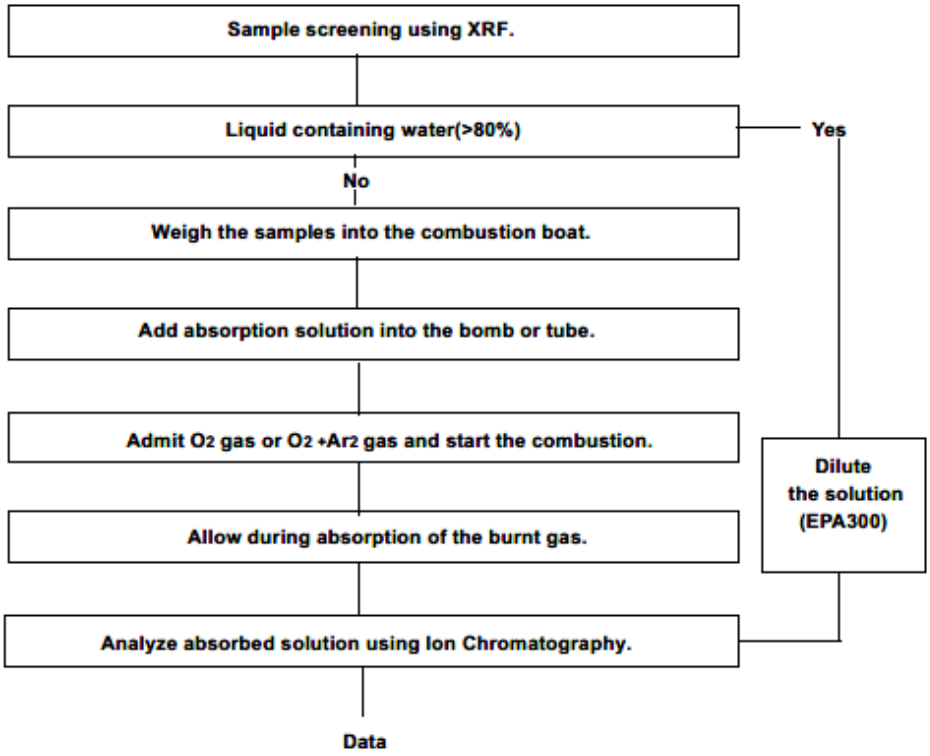
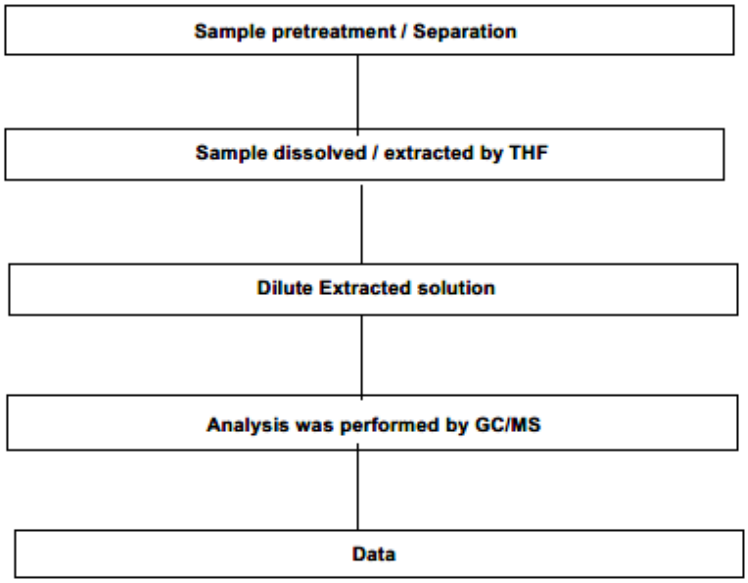
Test Report No. F690101/LF-CTSAYAA18-31468 Issued Date : 2018. 06. 14 Page 8 of 9

Flow Chart for Halogen Test



Flow Chart for Phthalate Test



*** End of Report ***

13-2. RAW MATERIAL(PACKAGE)

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TEST REPORT REPORT NO. JP/2017/111101 DATE: January 12,2018 PAGE: 1 OF 4

KYOCERA CORPORATION

1810 TAKI-CHO SATSUMASENDAI-SHI KAGOSHIMA JAPAN

THE FOLLOWING SAMPLE(S) WAS/WERE SUBMITTED AND IDENTIFIED BY/ON BEHALF OF THE CLIENT AS:
以下のサンプルは顧客により提供され、顧客に代わって確認を行いました:

SAMPLE DESCRIPTION	:	1-01-4-18 KYOCERA:CERAMIC A440
CLIENT REF.NO	:	
SAMPLE RECEIVED	:	2017/11/24
TESTING DATE	:	2017/11/24 TO 2018/01/12

TEST REQUESTED : SELECTED TEST(S) AS REQUESTED BY CLIENT.
分析項目 分析項目は顧客の要求によります。

TEST METHOD(S) : WITH REFERENCE TO LATEST EDITION OF IEC62321 FOR RoHS 6 SUBSTANCES.
分析方法 OTHER CHEMICALS WERE TESTED BY EACH APPROPRIATE METHOD.
RoHS6物質の分析は最新版のIEC62321を参照しました。
それ以外の化学物質についてはそれぞれに最適な方法で分析を行いました。

TEST RESULT(S) : PLEASE REFER TO THE NEXT PAGE(S).
分析結果 以下のページをご参照願います。

大内 幸弘

Yukihiro Ouchi / Quality Manager
SGS Japan Inc., Chemical Laboratory

SGS Japan Inc. YBP East Tower 12F, 134 Godo-cho Hodogaya-ku Yokohama 240-0005, Japan
t +81(0) 45 330 1100 f +81(0) 45 330 1108 URL: www.jp.sgs.com
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TEST REPORT REPORT NO. JP/2017/111101 DATE : January 12,2018 PAGE : 2 OF 4

KYOCERA CORPORATION

1810 TAKI-CHO SATSUMASENDAI-SHI KAGOSHIMA JAPAN

TEST RESULT(S)

ITEM(S)	UNIT	RESULT	METHOD	INST./PLACE	MDL
CADMIUM(Cd)	mg/kg	N.D.	IEC62321-5: 2013	ICP-OES	2
LEAD(Pb)	mg/kg	N.D.	IEC62321-5: 2013	ICP-OES	2
MERCURY(Hg)	mg/kg	N.D.	IEC62321-4: 2013	ICP-OES	2
CHROMIUM VI(Cr(VI))	mg/kg	N.D.	IEC62321-7-1: 2015	UV/VIS	2

NOTES: mg/kg = ppm, N.D. = Not Detected, INST. = INSTRUMENT, MDL = Method Detection Limit

REMARK: Test process and/or expression of test result have been specified by client.
The content of Cr(VI) has been calculated with regard to the sample weight as specified by client.

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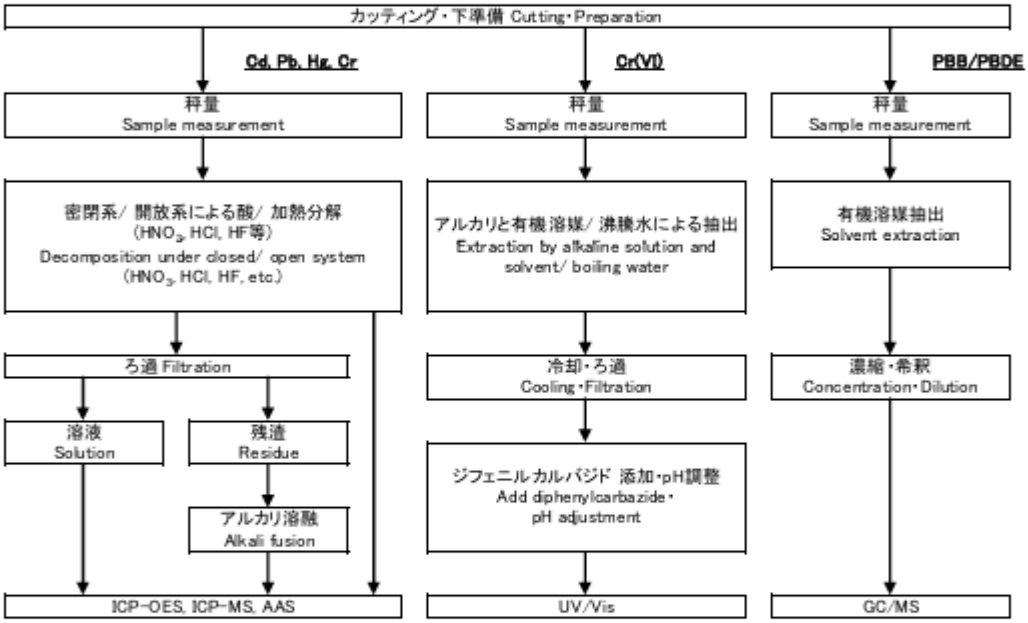
TEST REPORT REPORT NO. JP/2017/111101 DATE: January 12,2018 PAGE: 3 OF 4

KYOCERA CORPORATION

1810 TAKI-CHO SATSUMASENDAI-SHI KAGOSHIMA JAPAN

分析フローチャート MEASUREMENT FLOW CHART

1)酸分解前処理において試料を完全分解しています。
The sample was dissolved/ decomposed totally by acid pre-conditioning method according to below flow chart.
2)Cd, Pb, Hg, Cr, Cr(VI), PBB/PBDE
分析担当者 Name of the person in charge of measurement: 及川 聡子 Satoko Oikawa
3)分析責任者 Name of the person responsible for measurement: 大谷 真由美 Mayumi Otani



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TEST REPORT REPORT NO. JP/2017/111101 DATE: January 12,2018 PAGE: 4 OF 4

KYOCERA CORPORATION

1810 TAKI-CHO SATSUMASENDAI-SHI KAGOSHIMA JAPAN

SAMPLE IMAGE

<END>

13-3. RAW MATERIAL(LT WAFER)

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For Question
Please Contact with SGS
www.sgs.com.tw

Test Report No. : CE/2017/A5173 Date : 2017/11/01 Page : 1 of 9

Shin-Etsu Chemical Co.,Ltd.
13-1,Isobe 2-chome, Annnaka-Shi, Gunma, Japan

The following samples was/were submitted and identified by/on behalf of the applicant as :

Sample Submitted By	:	Shin-Etsu Chemical Co.,Ltd.
Sample Description	:	BLT
Lot No	:	79399A
Composition	:	Lithium Tantalate
Sample Receiving Date	:	2017/10/26
Testing Period	:	2017/10/26 TO 2017/11/01

==========

Test Requested :

(1) As specified by client, with reference to RoHS 2011/65/EU Annex II and amending Directive (EU) 2015/863 to determine Cadmium, Lead, Mercury, Cr(VI), PBBs, PBDEs, DBP, BBP, DEHP, DIBP contents in the submitted sample(s).

(2) Please refer to next pages for the other item(s).

Test Result(s) : Please refer to following pages.

Conclusion : (1) Based on the performed tests on submitted sample(s), the test results of Cadmium, Lead, Mercury, Cr(VI), PBBs, PBDEs, DBP, BBP, DEHP, DIBP comply with the limits as set by RoHS and amending Directive (EU) 2015/863.

SGS TAIWAN LTD.

Troy Chang / Manager - Tech
Signed for and on behalf of
SGS TAIWAN LTD.
Chemical Laboratory - Taipei

SGS

Test Report

No. : CE/2017/A5173 Date : 2017/11/01 Page : 2 of 9

Shin-Etsu Chemical Co.,Ltd.
13-1,Isobe 2-chome, Annnaka-Shi, Gunma, Japan

Test Result(s)

PART NAME No.1 : WAFER

Test Item(s)	Unit	Method	MDL	Result No.1	Limit
Cadmium (Cd)	mg/kg	With reference to IEC 62321-5 (2013) and performed by ICP-AES.	2	n.d.	100
Lead (Pb)	mg/kg	With reference to IEC 62321-5 (2013) and performed by ICP-AES.	2	n.d.	1000
Mercury (Hg)	mg/kg	With reference to IEC 62321-4 (2013) and performed by ICP-AES.	2	n.d.	1000
Hexavalent Chromium Cr(VI)	mg/kg	With reference to IEC 62321-7-2 (2017) and performed by UV-VIS.	8	n.d.	1000
Sum of PBBs	mg/kg	With reference to IEC 62321-6 (2015) and performed by GC/MS.	-	n.d.	1000
Monobromobiphenyl	mg/kg		5	n.d.	-
Dibromobiphenyl	mg/kg		5	n.d.	-
Tribromobiphenyl	mg/kg		5	n.d.	-
Tetrabromobiphenyl	mg/kg		5	n.d.	-
Pentabromobiphenyl	mg/kg		5	n.d.	-
Hexabromobiphenyl	mg/kg		5	n.d.	-
Heptabromobiphenyl	mg/kg		5	n.d.	-
Octabromobiphenyl	mg/kg		5	n.d.	-
Nonabromobiphenyl	mg/kg		5	n.d.	-
Decabromobiphenyl	mg/kg		5	n.d.	-
Sum of PBDEs	mg/kg		-	n.d.	1000
Monobromodiphenyl ether	mg/kg		5	n.d.	-
Dibromodiphenyl ether	mg/kg		5	n.d.	-
Tribromodiphenyl ether	mg/kg		5	n.d.	-
Tetrabromodiphenyl ether	mg/kg		5	n.d.	-
Pentabromodiphenyl ether	mg/kg		5	n.d.	-
Hexabromodiphenyl ether	mg/kg		5	n.d.	-
Heptabromodiphenyl ether	mg/kg		5	n.d.	-
Octabromodiphenyl ether	mg/kg		5	n.d.	-
Nonabromodiphenyl ether	mg/kg		5	n.d.	-
Decabromodiphenyl ether	mg/kg		5	n.d.	-

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Test Report

No. : CE/2017/A5173 Date : 2017/11/01 Page : 3 of 9

Shin-Etsu Chemical Co.,Ltd.
13-1,Isobe 2-chome, Annnaka-Shi, Gunma, Japan

Test Item(s)	Unit	Method	MDL	Result No.1	Limit
BBP (Butyl Benzyl phthalate) (CAS No.: 85-68-7)	mg/kg	With reference to IEC 62321-8 (2017). Analysis was performed by GC/MS.	50	n.d.	1000
DBP (Dibutyl phthalate) (CAS No.: 84-74-2)	mg/kg	With reference to IEC 62321-8 (2017). Analysis was performed by GC/MS.	50	n.d.	1000
DEHP (Di- (2-ethylhexyl) phthalate) (CAS No.: 117-81-7)	mg/kg	With reference to IEC 62321-8 (2017). Analysis was performed by GC/MS.	50	n.d.	1000
DIBP (Di-isobutyl phthalate) (CAS No.: 84-69-5)	mg/kg	With reference to IEC 62321-8 (2017). Analysis was performed by GC/MS.	50	n.d.	1000
Halogen-Chlorine (Cl) (CAS No.: 22537-15-1)	mg/kg	With reference to BS EN 14582 (2016). Analysis was performed by IC.	50	n.d.	-
Halogen-Bromine (Br) (CAS No.: 10097-32-2)	mg/kg	With reference to BS EN 14582 (2016). Analysis was performed by IC.	50	n.d.	-
Antimony (Sb)	mg/kg	With reference to US EPA 3052 (1996). Analysis was performed by ICP-AES.	2	n.d.	-
Beryllium (Be)	mg/kg	With reference to US EPA 3052 (1996). Analysis was performed by ICP-AES.	2	n.d.	-

Note :

1. mg/kg = ppm ; 0.1wt% = 1000ppm
2. MDL = Method Detection Limit
3. n.d. = Not Detected = less than MDL
4. " - " = Not Regulated

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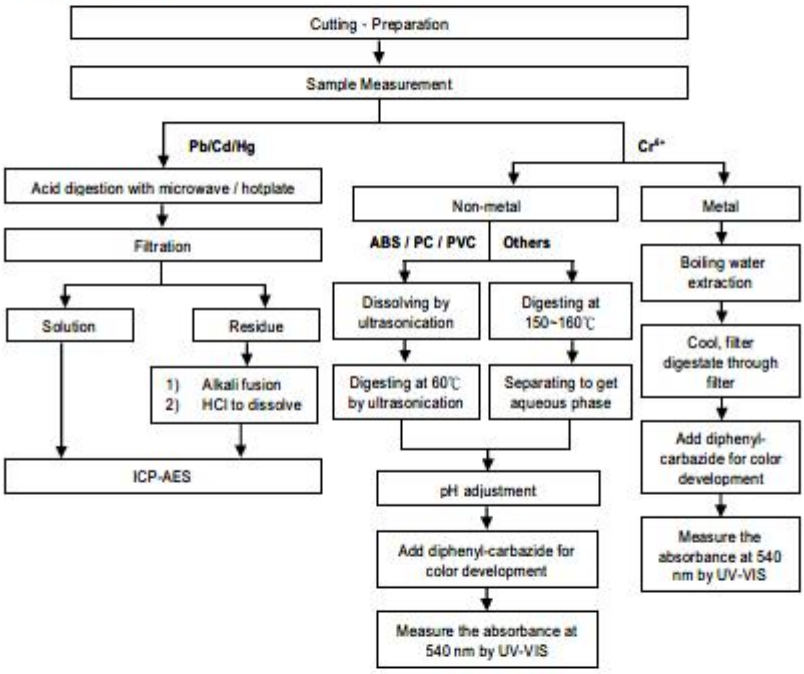
Test Report No. : CE/2017/A5173 Date : 2017/11/01 Page : 4 of 9

Shin-Etsu Chemical Co.,Ltd.
13-1,Isobe 2-chome, Annnaka-Shi, Gunma, Japan

Analytical flow chart of Heavy Metal

These samples were dissolved totally by pre-conditioning method according to below flow chart. (Cr^{6+} test method excluded)

- Technician : JR Wang
- Supervisor: Troy Chang



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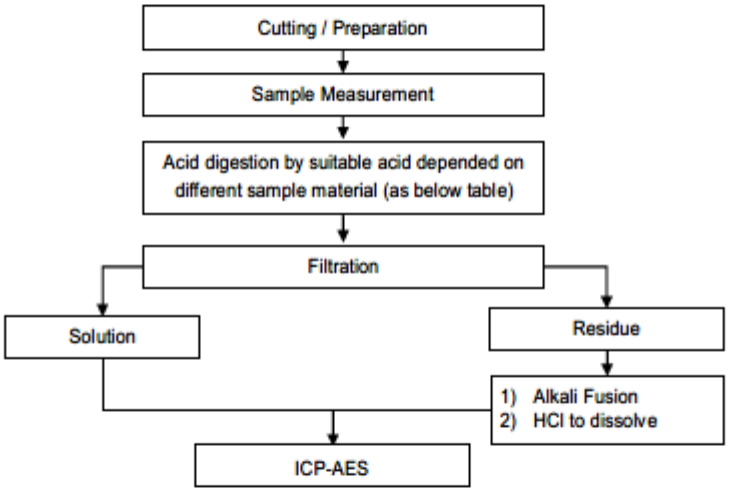
Test Report No. : CE/2017/A5173 Date : 2017/11/01 Page : 5 of 9

Shin-Etsu Chemical Co.,Ltd.
13-1,Isobe 2-chome, Annnaka-Shi, Gunma, Japan

These samples were dissolved totally by pre-conditioning method according to below flow chart.

- Technician: JR Wang
- Supervisor: Troy Chang

Flow Chart of digestion for the elements analysis performed by ICP-AES



Steel, copper, aluminum, solder	Aqua regia, HNO_3, HCl, HF, H_2O_2
Glass	HNO_3/HF
Gold, platinum, palladium, ceramic	Aqua regia
Silver	HNO_3
Plastic	H_2SO_4, H_2O_2, HNO_3, HCl
Others	Added appropriate reagent to total digestion

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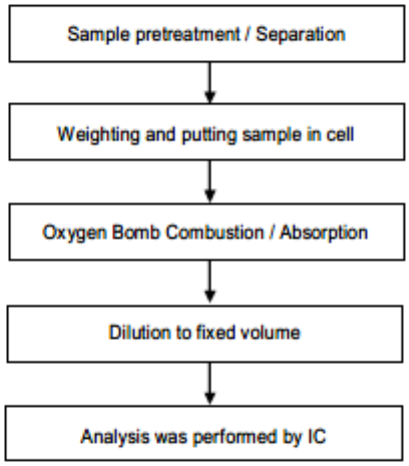
Test Report No. : CE/2017/A5173 Date : 2017/11/01 Page : 6 of 9

Shin-Etsu Chemical Co.,Ltd.
13-1,Isobe 2-chome, Annnaka-Shi, Gunma, Japan

Analytical flow chart - Halogen

- Technician: Rita Chen
- Supervisor: Troy Chang



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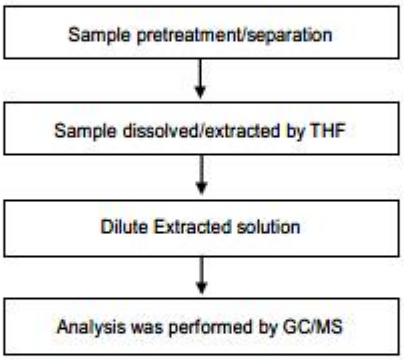
Test Report No. : CE/2017/A5173 Date : 2017/11/01 Page : 7 of 9

Shin-Etsu Chemical Co.,Ltd.
13-1,Isobe 2-chome, Annnaka-Shi, Gunma, Japan

Analytical flow chart - Phthalate

- Technician: Andy Hsu
- Supervisor: Troy Chang

【Test method: IEC 62321-8】



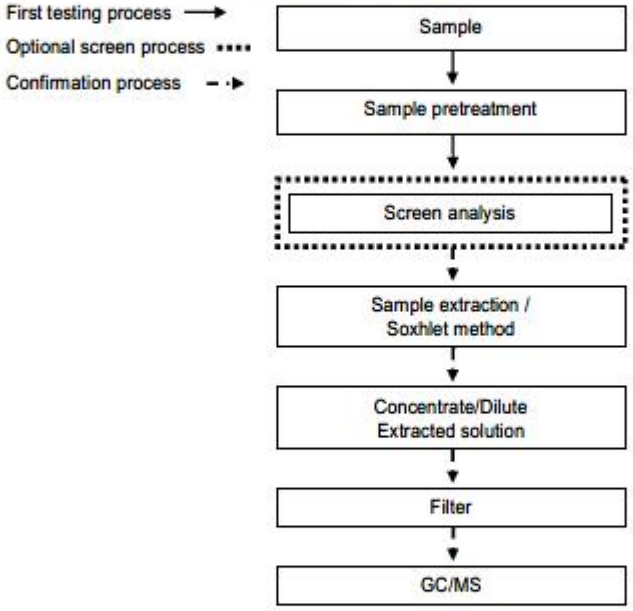
SGS

Test Report No. : CE/2017/A5173 Date : 2017/11/01 Page : 8 of 9

Shin-Etsu Chemical Co.,Ltd.
13-1,Isobe 2-chome, Annnaka-Shi, Gunma, Japan

Analytical flow chart – PBB / PBDE

- Technician : Yaling Tu
- Supervisor: Troy Chang



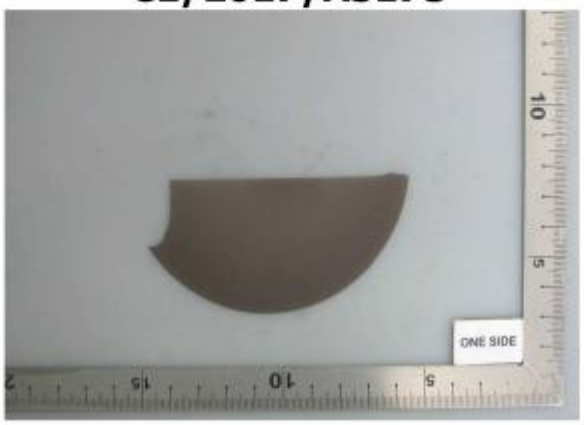
SGS

Test Report No. : CE/2017/A5173 Date : 2017/11/01 Page : 9 of 9

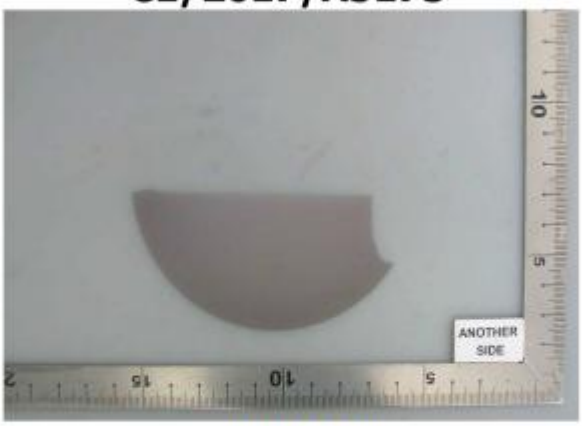
Shin-Etsu Chemical Co.,Ltd.
13-1,Isobe 2-chome, Annnaka-Shi, Gunma, Japan

*** The tested sample / part is marked by an arrow if it's shown on the photo. ***

CE/2017/A5173



CE/2017/A5173



** End of Report **

재료의 순서만 맞추고,
내용은 각 자재에 맞게 사용 바랍니다.
180806

13-4. RAW MATERIAL(GOLD WIRE)

SGS

Test Report No. SHAEC1818655211 Date: 24 Aug 2018 Page 1 of 23

TANAKA ELECTRONICS (HANGZHOU) CO.,LTD.

F1 AREA, WEST NO.19 STREET, NORTH NO.10 STREET, HANGZHOU ECONOMIC&TECHNOLOGICAL DEVELOPMENT ZONE,HANGZHOU

The following sample(s) was/were submitted and identified on behalf of the clients as : Au Bonding Wire

SGS Job No. :	SP18-028471 - SH
Date of Sample Received :	17 Aug 2018
Testing Period :	17 Aug 2018 - 23 Aug 2018
Test Requested :	Selected test(s) as requested by client.
Test Method :	Please refer to next page(s).
Test Results :	Please refer to next page(s).
Conclusion :	Based on the performed tests on submitted sample(s), the results of Cadmium, Lead, Mercury, Hexavalent chromium, Polybrominated biphenyls (PBBs), Polybrominated diphenyl ethers (PBDEs) and Phthalates such as Bis(2-ethylhexyl) phthalate (DEHP), Butyl benzyl phthalate (BBP), Dibutyl phthalate (DBP) and Diisobutyl phthalate (DIBP) comply with the limits as set by RoHS Directive (EU) 2015/863 amending Annex II to Directive 2011/65/EU. When tested as specified, Dimethyl fumarate(DMF) content of the submitted sample comply with Commission Regulation (EU) No 412/2012 and Entry 61 of Annex XVII of REACH Regulation (EC) No 1907/2006

Signed for and on behalf of
SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd.

Jenny Yao

Jenny Yao
Approved Signatory

SGS

Test Report

No. SHAEC1818655211 Date: 24 Aug 2018 Page 2 of 23

Test Results :

Test Part Description :

Specimen No.	SGS Sample ID	Description
SN1	SHA18-186552.005	Golden metal wire

Remarks :

(1) 1 mg/kg = 1 ppm = 0.0001%
(2) MDL = Method Detection Limit
(3) ND = Not Detected (< MDL)
(4) "-" = Not Regulated

RoHS Directive (EU) 2015/863 amending Annex II to Directive 2011/65/EU

Test Method : With reference to IEC 62321-4:2013+AMD1:2017, IEC62321-5:2013, IEC62321-7-1:2015, IEC 62321-6:2015 and IEC62321-8:2017, analyzed by ICP-OES, UV-Vis and GC-MS.

Test Item(s)	Limit	Unit	MDL	005
Cadmium (Cd)	100	mg/kg	2	ND
Lead (Pb)	1000	mg/kg	2	ND
Mercury (Hg)	1000	mg/kg	2	ND
Hexavalent Chromium (Cr(VI))▾	-	µg/cm²	0.10	ND
Sum of PBBs	1000	mg/kg	-	ND
Monobromobiphenyl	-	mg/kg	5	ND
Dibromobiphenyl	-	mg/kg	5	ND
Tribromobiphenyl	-	mg/kg	5	ND
Tetrabromobiphenyl	-	mg/kg	5	ND
Pentabromobiphenyl	-	mg/kg	5	ND
Hexabromobiphenyl	-	mg/kg	5	ND
Heptabromobiphenyl	-	mg/kg	5	ND
Octabromobiphenyl	-	mg/kg	5	ND
Nonabromobiphenyl	-	mg/kg	5	ND
Decabromobiphenyl	-	mg/kg	5	ND
Sum of PBDEs	1000	mg/kg	-	ND
Monobromodiphenyl ether	-	mg/kg	5	ND
Dibromodiphenyl ether	-	mg/kg	5	ND
Tribromodiphenyl ether	-	mg/kg	5	ND
Tetrabromodiphenyl ether	-	mg/kg	5	ND

SGS

Test Report No. SHAEC1818655211 Date: 24 Aug 2018 Page 3 of 23

Test Item(s)	Limit	Unit	MDL	005
Pentabromodiphenyl ether	-	mg/kg	5	ND
Hexabromodiphenyl ether	-	mg/kg	5	ND
Heptabromodiphenyl ether	-	mg/kg	5	ND
Octabromodiphenyl ether	-	mg/kg	5	ND
Nonabromodiphenyl ether	-	mg/kg	5	ND
Decabromodiphenyl ether	-	mg/kg	5	ND
Di-butyl Phthalate (DBP)	1000	mg/kg	50	ND
Benzyl Butyl Phthalate (BBP)	1000	mg/kg	50	ND
Di-2-Ethyl Hexyl Phthalate (DEHP)	1000	mg/kg	50	ND
Diisobutyl Phthalates (DIBP)	1000	mg/kg	50	ND

Notes :

(1)The maximum permissible limit is quoted from RoHS Directive (EU) 2015/863.
IEC 62321 series is equivalent to EN 62321 series
http://www.cenelec.eu/dyn/www/f?p=104:30:1742232870351101::::FSP_ORG_ID,FSP_LANG_ID:1258637,25

(2)▾ = a. The sample is positive for CrVI if the CrVI concentration is greater than 0.13 μg/cm². The sample coating is considered to contain CrVI
b. The sample is negative for CrVI if CrVI is ND (concentration less than 0.10 μg/cm²). The coating is considered a non-CrVI based coating
c. The result between 0.10 μg/cm² and 0.13 μg/cm² is considered to be inconclusive - unavoidable coating variations may influence the determination
Information on storage conditions and production date of the tested sample is unavailable and thus Cr(VI) results represent status of the sample at the time of testing.

Element(s)

Test Method : With reference to US EPA Method 3050B:1996, analysis was performed by ICP-OES.

Test Item(s)	CAS NO.	Unit	MDL	005
Beryllium (Be)		mg/kg	5	ND
Beryllium oxide (BeO) ◆		mg/kg	15	ND
Antimony (Sb)		mg/kg	10	ND
Antimony trioxide (Sb_2O_3)◆		mg/kg	12	ND
Arsenic (As)		mg/kg	10	ND
Diarsenic trioxide (As_2O_3) ◆	1327-53-3	mg/kg	10	ND
Diarsenic pentaoxide (As_2O_5) ◆	1303-28-2	mg/kg	10	ND

Notes :

(1) ◆ Calculated concentration of BeO is based on the identified Be

Calculated concentration of Sb_2O_3 is based on the identified Sb
Calculated concentration of diarsenic pentaoxide and diarsenic trioxide are based on the identified arsenic and lead

Halogen

Test Method : With reference to EN 14582: 2016 , analysis was performed by IC.

Test Item(s)	Unit	MDL	005
Fluorine (F)	mg/kg	50	ND
Chlorine (Cl)	mg/kg	50	ND
Bromine (Br)	mg/kg	50	ND
Iodine (I)	mg/kg	50	ND

Organic-tin compounds

Test Method : With reference to ISO 17353: 2004 with carbamate, analysis was performed by GC-MS.

Test Item(s)	Unit	MDL	005
Tributyl tin (TBT)	mg/kg	0.02	ND
Dibutyl tin (DBT)	mg/kg	0.02	ND
Dioctyl tin (DOT)	mg/kg	0.02	ND
Tripropyltin (TPT)	mg/kg	0.02	ND
Bis(tributyltin) oxide (TBTO) ✦	mg/kg	0.02	ND

Notes :
(1) ✦Calculated concentration of TBTO is based on the identified TBT.

Polychlorinated Naphthalenes (PCNs)

Test Method : With reference to US EPA 8081B: 2007, analysis was performed by GC-MS

Test Item(s)	Unit	MDL	005
2-Chlorinated Naphthalene	mg/kg	5	ND
1,4-Dichlorinated Naphthalene	mg/kg	5	ND
1,5-Dichlorinated Naphthalene	mg/kg	5	ND
1,2-Dichlorinated Naphthalene	mg/kg	5	ND
1,8-Dichlorinated Naphthalene	mg/kg	5	ND
1,2,3-Trichlorinated Naphthalene	mg/kg	5	ND

SGS

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Test Item(s)	Unit	MDL	005
1,2,3,4-Tetrachlorinated Naphthalene	mg/kg	5	ND
1,2,3,4,6-Pentachlorinated Naphthalene	mg/kg	5	ND
Octa-chlorinaed Naphthalene	mg/kg	5	ND
1-Chlorinated Naphthalene	mg/kg	5	ND

Short-chain Chlorinated Paraffin (SCCP) and Medium-chain Chlorinated Paraffin (MCCP)

Test Method : With reference to US EPA 3550C: 2007, analysis was performed by GC-ECD / GC-NCI-MS

Test Item(s)	Unit	MDL	005
Short-chain Chlorinated Paraffin (SCCP) (C_{10}-C_{13})	mg/kg	50	ND
Medium-chain Chlorinated Paraffin (MCCP) (C_{14}-C_{17})	mg/kg	50	ND

Red Phosphorus

Test Method : SGS in house method(SHTC- CHEM- SOP -342-T), Analysis was performed by ICP-OES and Pyrolysis-GC/MS

Test Item(s)	Unit	MDL	005
Red Phosphorus	mg/kg	500	ND

Notes :

For Positive result, the testing result is based on the worst-case scenario, and confirmed by Pyrolysis-GC-MS.

Tetrabromobisphenol A (TBBP-A)

Test Method : With reference to US EPA 3540C: 1996, analysis was performed by GC-MS.

Test Item(s)	Unit	MDL	005
Tetrabromobisphenol A (TBBP-A)	mg/kg	10	ND

SGS

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PVC (Polyvinyl chloride)

Test Method : In-house method (SHTC-CHEM-SOP-115-T), analysis was performed by FTIR/HATR.

Test Item(s)	CAS NO.	Unit	MDL	005
PVC	9002-86-2	-	-	Negative

Notes :
(1) Negative=Undetectable,Positive=Detectable

Commission Regulation (EU) No 412/2012 and Entry 61 of Annex XVII of REACH Regulation (EC) No 1907/2006 - Dimethyl fumarate(DMF)

Test Method : Solvent extraction, analysis was performed by GC-MS.

Test Item(s)	Limit	Unit	MDL	005
Dimethyl fumarate(DMF)	0.1	mg/kg	0.1	ND

Bisphenol-A

Test Method : With reference to US EPA 3550C: 2007, analysis was performed by HPLC-DAD-MS.

Test Item(s)	Unit	MDL	005
Bisphenol-A	mg/kg	1	ND

Polychlorinated Terphenyls (PCTs)

Test Method : With reference to US EPA 8082A: 2007, analysis was performed by GC-MS

Test Item(s)	Unit	MDL	005
Aroclor 5432	mg/kg	5	ND
Aroclor 5442	mg/kg	5	ND

Hexabromocyclododecane (HBCDD)

Test Method : With reference to IEC 62321:2008, analysis was performed by GC-MS.

SGS

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Test Item(s)	Unit	MDL	005
Hexabromocyclododecane (HBCDD)	mg/kg	10	ND

Polychlorinated Biphenyls (PCBs)

Test Method : With reference to US EPA 8082A: 2007, analysis was performed by GC-MS

Test Item(s)	CAS NO.	Unit	MDL	005
2,4,4'-Trichlorobiphenyl (PCB 28)	7012-37-5	mg/kg	0.5	ND
2,2',5,5'-Tetrachloro-biphenyl (PCB 52)	35693-99-3	mg/kg	0.5	ND
2,2',4,5,5'-Pentachloro-biphenyl (PCB 101)	37680-73-2	mg/kg	0.5	ND
2,3',4,4',5-Pentachlorobiphenyl (PCB 118)	31508-00-6	mg/kg	0.5	ND
2,2',3,4,4',5'-Hexachloro-biphenyl (PCB 138)	35065-28-2	mg/kg	0.5	ND
2,2',4,4',5,5'-Hexachloro-biphenyl (PCB 153)	35065-27-1	mg/kg	0.5	ND
2,2',3,4,4',5,5'-Heptachlorobiphenyl (PCB 180)	35065-29-3	mg/kg	0.5	ND

Phthalates Content

Test Method : With reference to IEC 62321-8:2017, determination of phthalates by GC-MS.

Test Item(s)	CAS NO.	Unit	MDL	005
Diisononyl Phthalate (DINP)	28553-12-0 /68515-48-0	mg/kg	50	ND
Di-n-pentyl Phthalates (DnPP)	131-18-0	mg/kg	50	ND
Di-n-octyl Phthalate (DNOP)	117-84-0	mg/kg	50	ND
Diisodecyl Phthalate (DIDP)	26761-40-0 /68515-49-1	mg/kg	50	ND
Dihexyl Phthalates (DnHP)	84-75-3	mg/kg	50	ND
1,2-Benzenedicarboxylic acid, di-C7-11-branched and linear alkyl esters(DHNUP)	68515-42-4	mg/kg	50	ND
Bis(2-methoxyethyl) Phthalate (DMEP)	117-82-8	mg/kg	50	ND
Diisoheptyl phthalate (DIHP)	71888-89-6	mg/kg	50	ND

PFOS (Perfluorooctane Sulfonates) and Perfluorooctanoic Acid (PFOA)

Test Method : With reference to CEN/TS 15968:2010, analysis was performed by LC-MS.

SGS

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Test Item(s)	Limit	Unit	MDL	005
Perfluorooctane Sulfonates (PFOS)^	1000	mg/kg	10	ND
Perfluorooctanoic Acid (PFOA)	-	mg/kg	10	ND

Notes :

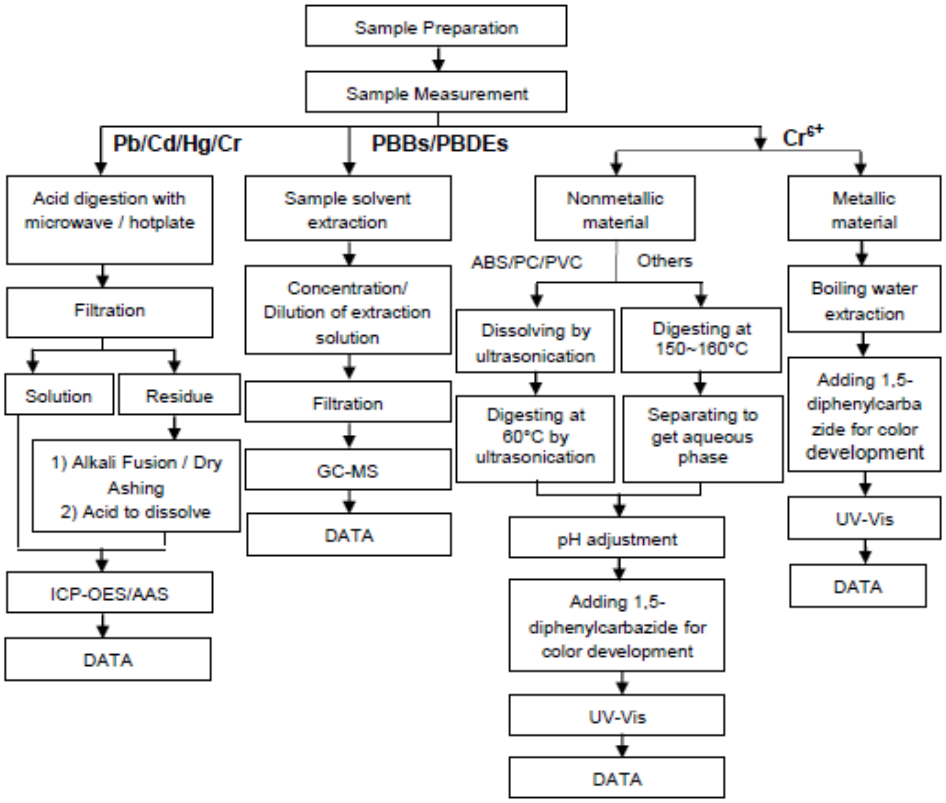
(1) Max. limit specified by commission regulation (EU) No. 757/2010 amending regulation (EC) No 850/2004.

(2) ^ PFOS refer to Perfluorooctanesulfonic acid and its derivatives including Perfluoroctanesulfonic acid, Perfluoroctane sulfonamide, N-Methylperfluoroctane sulfonamide, N-Ethylperfluoroctane sulfonamide, N-Methylperfluoroctane sulfonamidoethanol and N-Ethylperfluoroctane sulfonamidoethanol.

ATTACHMENTS

Pb/Cd/Hg/Cr^{6+}/PBBs/PBDEs Testing Flow Chart

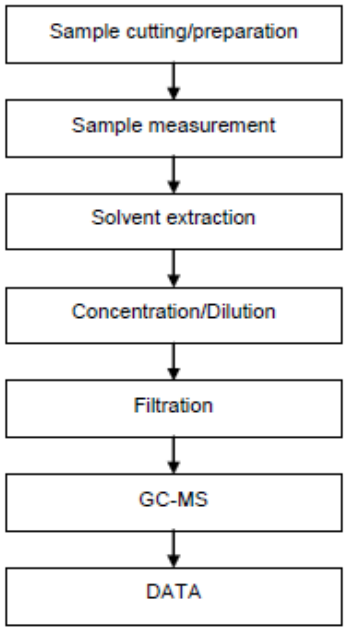
1) Name of the person who made testing: Meria Jin/Gary Xu/ Xiaolong Yang/Sielina Song
2) Name of the person in charge of testing: Jan Shi/Myra Ma/Luna Xu/Shara Wang
3) These samples were dissolved totally by pre-conditioning method according to below flow chart.
(Cr^{6+} and PBBs/PBDEs test method excluded)



ATTACHMENTS

Phthalates Testing Flow Chart

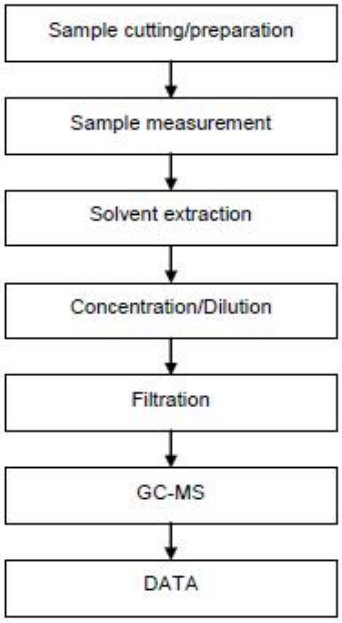
1) Name of the person who made testing: Sherlock Gao
2) Name of the person in charge of testing: Jessy Huang



ATTACHMENTS

HBCDD Testing Flow Chart

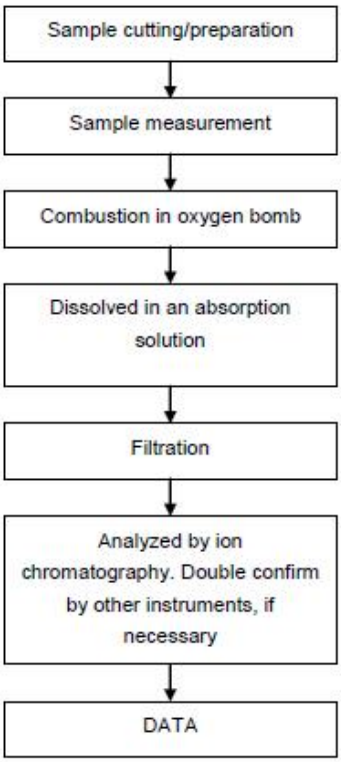
1) Name of the person who made testing: Gary Xu
2) Name of the person in charge of testing: Myra ma



ATTACHMENTS

Halogen Testing (oxygen bomb) Flow Chart

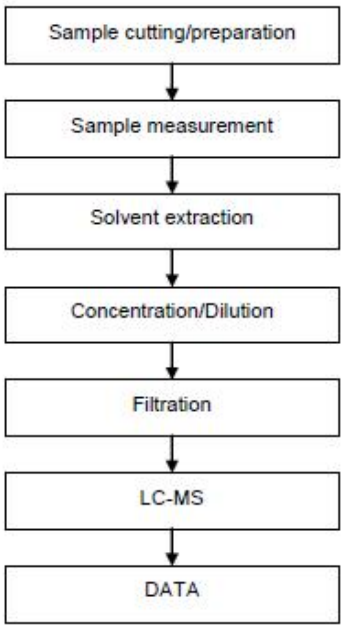
1) Name of the person who made testing: Kevin Xu
2) Name of the person in charge of testing: Anne Huang



ATTACHMENTS

PFOS/PFOA Testing Flow Chart

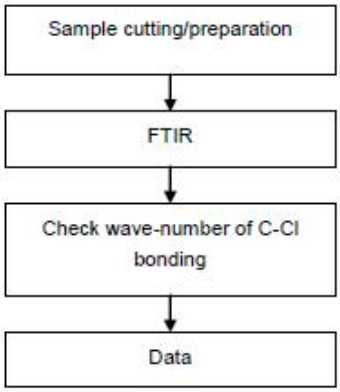
1) Name of the person who made testing: Richer Yu
2) Name of the person in charge of testing: Jessy Huang



ATTACHMENTS

PVC Testing Flow Chart

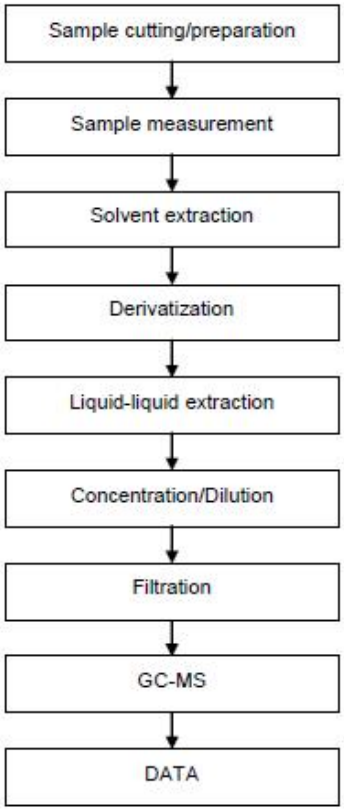
1) Name of the person who made testing: Sally Liang
2) Name of the person in charge of testing: Grace Chen



ATTACHMENTS

Organotin Testing Flow Chart

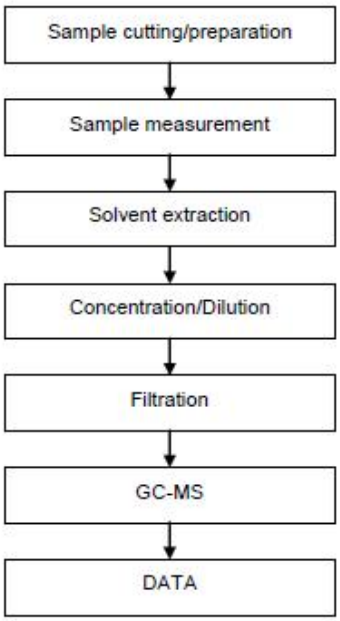
1) Name of the person who made testing: Alex Deng
2) Name of the person in charge of testing: Myra ma



ATTACHMENTS

PCB/ PCT/ PCN Testing Flow Chart

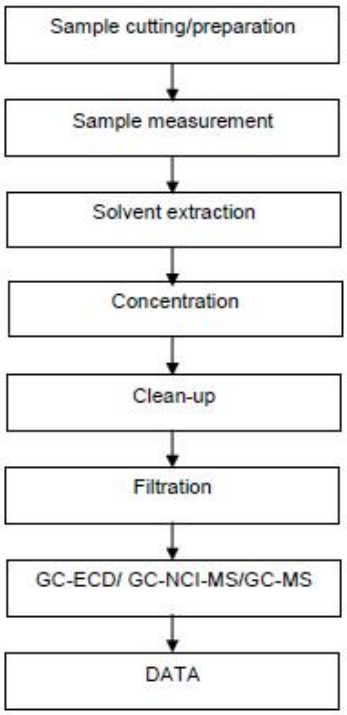
1) Name of the person who made testing: Jenny Zhang
2) Name of the person in charge of testing: Brin Feng



ATTACHMENTS

SCCP/MCCP Testing Flow Chart

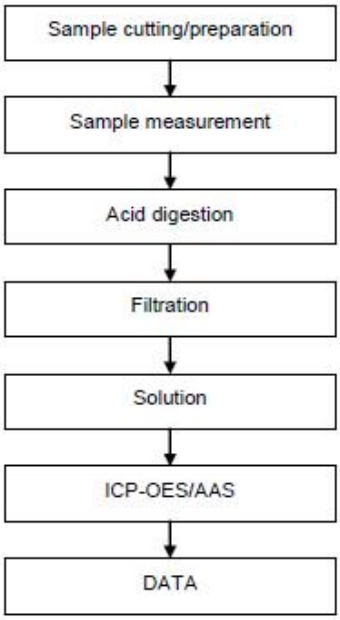
1) Name of the person who made testing: Jenny Zhang
2) Name of the person in charge of testing: Brin Feng



ATTACHMENTS

Elements Testing Flow Chart

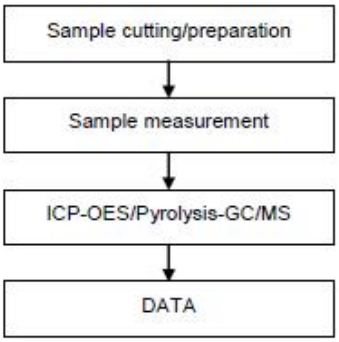
1) Name of the person who made testing: Meria Jin/Sielina Song
2) Name of the person in charge of testing: Luna Xu/Jan Shi



ATTACHMENTS

Red Phosphorus Testing Flow Chart

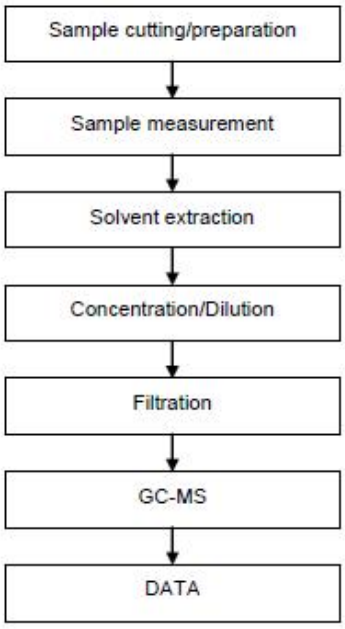
1) Name of the person who made testing: Sally Liang
2) Name of the person in charge of testing: Grace Chen



ATTACHMENTS

DMF (Dimethyl fumarate) Testing Flow Chart

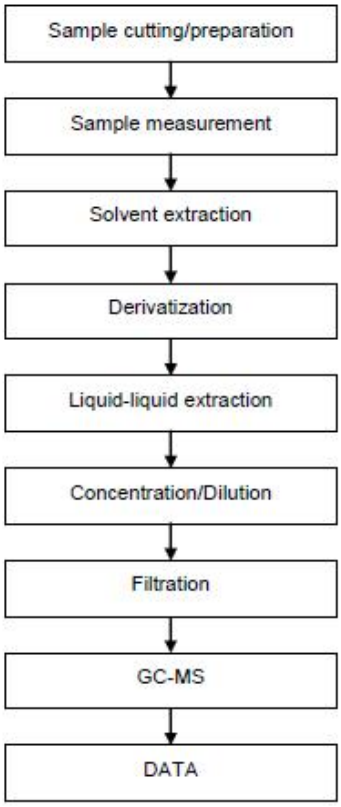
1) Name of the person who made testing: Alex Deng
2) Name of the person in charge of testing: Myra ma



ATTACHMENTS

TBBP-A Testing Flow Chart

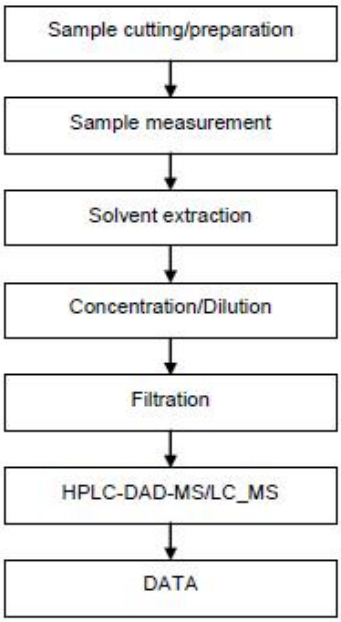
1) Name of the person who made testing: Gary Xu
2) Name of the person in charge of testing: Myra ma



ATTACHMENTS

BPA Testing Flow Chart

1) Name of the person who made testing: Richer Yu
2) Name of the person in charge of testing: Jessy Huang



SGS

Test Report No. SHAEC1818655211 Date: 24 Aug 2018 Page 23 of 23

Sample photo:

SHA18-186552.005

SGS authenticate the photo on original report only

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