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**CONFIDENTIAL**

# GPS Engine Module

## Product No. : GPM13B03-005

### Hardware Specification

### ver 1.02

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DEPT.

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Tech. Description

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ELECTRO-MECHANICS

**TECHNICAL DOCUMENT**

NAME

**SGEM**

**(Samsung GPS Engine Module)**

[www.DataSheet4U.com](http://www.DataSheet4U.com)

**Revision history**

- 1. 2005.04.12 : Doc ver 1.00 , Original draft
- 2. 2005.04.25 : Doc ver 1.01 ,
- 3. 2005.05.04 : Doc ver 1.02 ,

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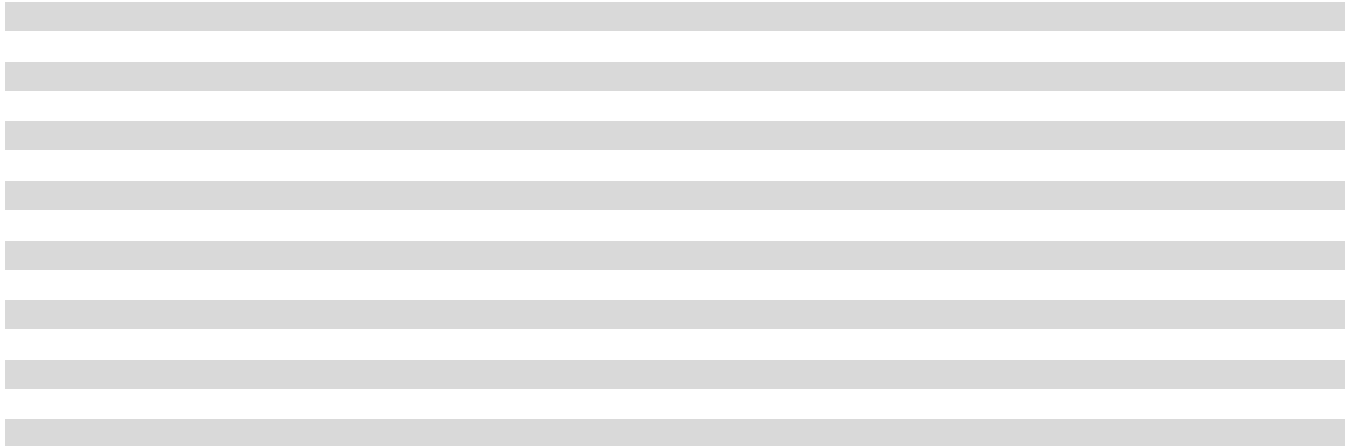
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### 1. Relevant Documents

Marking  
Electromagnetic Compatibility

IN-HOUSE RULES  
TBD

### 2. Definitions

GPS MODULE : SAMSUNG E.M GPS ENGINE MODULE.

### 3. Product Description

This product is GPS Engine Module (SGEM) which tracks GPS satellites to compute current position, velocity and time information.

SGEM interfaces Vehicle electronic processor (navigator, telematic product) or phone call processor to communicate for data and command.

The SGEM shall be available in a 2.95V ~ 5V version.

The SAMSUNG E.M SGEM has 1 LNA amplifiers, voltage regulator, micro-processor and 8M flash, 3 GPIOs (USER can control 1 GPIO), TCXO, 32.768kHz slow clock crystal.

The installation of the SGEM is intended to be inside the application products for protection. To operate SGEM, S/W protocol and external circuit described in this document are needed.

### 4. Supplier's Responsibility

#### 4.1 Life Expectancy

SGEM has MTBF>5000000 hrs with at least 90% confidence.

A prediction of life expectancy according to MIL-HDKB 217F or similar database will be made by Samsung E.M. The result will be discussed with customers.


#### 4.2 Reliability

Design FMEA of SGEM at the part level will be made and documented by Samsung E.M. Design FMEA will include the function of the component, failure mode, failure cause, frequency of failure occurrence, and severity of failure.

To detect critical process risks, process FMEA will be made and documented by the Samsung E.M. Process FMEA will include the function of the component, process stage, failure mode, failure cause, frequency of failure occurrence, severity of failure, and the ability of failure detection.

#### 4.3 Change Control

Request for the change of software, layout and so on should always be made in advance to the customer.

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## 5. Product Requirements

### 5.1 Marking

#### 5.1.1 External label

- In-House Rule
- Logo, Product Date, Product number, Lot Number.

#### 5.1.2 Software

The following data shall be programmed in SGEM.

- Hardware version.
- Additional supplier data (optional).

### 5.2 Mechanical specification

Size : Typ 19.15mm \* 17.65mm \* 2.50mm

Weight: : Typ 1.7g

*Note: Please refer to Appendix B for the details.*

### 5.3 Electrical connection

32 semi-circle ports

*Note: Please see 7. Pin configuration.*

### 5.4 Material requirements

The shield case is made of metallic material for suppressive RF radiation.

### 5.5 Printed circuit board

Circuit board selection to be made by Samsung E.M. with customer's approval. Completed circuits may be selectively coated with an acrylic resin, air / oven cured conformal coating, clear lacquer or corresponding method which gives electrical insulation and sufficient resistance to corrosion

### 5.6 Temperature requirements

- Operating temperature: -30°C to +80°C
- Storage temperature: -40°C to +85°C ( possible to output Data.)
- Max temperature 235°C 10sec

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## 5.7 Electrical protection requirements

Some inputs and outputs of SGEM must be protected against all RF radiation by using external capacitors.

## 5.8 Electrical requirements

### 5.8.1 Power supply

Rated Voltage	Max. 6 VDC
Operating Voltage	VDD 2.95 ~ 3.3 VDC
Test Voltage	3.0 VDC
Power Consumption	Typ 270mW, 90mA @ 3.0VDC (Tracking mode) Typ 24uW , 8uA @ 3.0VDC ( Back-up mode)

**NOTE.** As SGEM includes Dual regulator for the isolation of each power source, the supplied voltage to Voltage input pin should be larger than the used voltage of each regulator. (If there is no specific request from Customer, Standard model will use 2.85V regulator.)

### 5.8.2 Inputs

All inputs have EMI filtering (27pF) on the external circuit except Antenna. All inputs have the external protection circuit and EMI filtering capacitor.

#### 5.8.2.1 Digital Input

##### 5.8.2.1.1 Mode selector

This input is for power management. SGEM can support power management for power saving according to loaded software..

<b>Power Management</b>	<b>X-trac</b>	<b>GSW2</b>	
<b>Trickle Power mode</b>	No	Support	
<b>Advanced Power mangement</b>	No	No	*Only support when user request
<b>Pin connection</b>	MODE_SEL Connect to GPIO 4	MODE_SEL Connect to GPIO 4	* refer to Attaced Application circuit



### 5.8.2.1.2 Boot

This pin is for the factory mode.  
SGEM use this pin for booting the internal flash memory.  
If this pin is high(3Vdc) status, this pin wait to download to internal flash.

**Note: User has to keep GND for normal operation**

### 5.8.2.1.3 Reset

This input is active low.  
Power-on reset time Min 200usec

**Note: User has to get confirmation about reset time and VDD power transient time from SEMCO**

### 5.8.2.1.4 Back\_Up (Battery)

This input is power supply input for back-up power  
Recommand voltage@Pin15 : 1.9V ~ 3.3V.  
Custommers have to consider charging the back-up battery.

**Note: User has to get confirmation about reset time and VDD power transient time from SEMCO**

## 5.8.3 GPIO


Some outputs might have EMI filtering capacitors (27pF/50V) in external circuit for protecting RF radiation and keeping SGEM isolated from other devices.

### 5.8.3.1 GPIO3

This GPIO pin of SGEM is for power management of SGEM.  
These outputs can be used as power controller of system processor.  
\* Only when use SiRF Loc(AGPS system), connect to MODE\_SEL.  
Otherwise keep the no connection.

### 5.8.3.2 GPIO4

This GPIO pin of SGEM is for power management of SGEM.  
These outputs can be used as power controller of system .(Only GSW2)  
\* **Only when use SiRF XTrac and GSW2 software ,connect to MODE\_SEL.  
Otherwise keep the no connection.(Please refer to Application Circuit)**

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### 5.8.3.1 GPIO6

This GPIO is not defined.

This pin can be used as GPIO of system processor.

\* Keep the no connection.

### 5.8.4 RF Connections

SGEM has 32 semi-circle ports. Port 1 is connected to the GPS antenna input.

\* *The antenna input should have the proper impedance matching.*

### 5.8.5 Performance

#### 5.8.5.1. Acquisition Time (TTFF)

The acquisition test is best carried out by allowing the receiver to establish a position fix and then download a full almanac and ephemeris database, which may take up to 1 minute. The acquisition tests can then be carried out in the following order.

#### Hot Start

A Hot start procedure occurs when the receiver is reset without disturbing any data held by the receiver. This can be done by toggling the system power on H/W side or selecting hot start mode in the analyzer software on S/W side.

#### Warm start

A Warm start procedure occurs when the receiver is reset but with invalid ephemeris data. This test is similar to keeping the receiver to be left off overnight, when almanac data, time and last known position are still valid.

#### Cold start

Cold start procedure occurs when the receiver is reset and no aiding data is available. This test is similar to the receiver being powered in the first time. On MDT(phone), this can be achieved by disconnecting the power while the main power (battery) is removed without information. (no store command)

<b>Acquisition Modem</b>	<b>Max</b>	<b>Typ.</b>	<b>Condition</b>
<b>TTFF COLD</b>	90secs	55 secs	Mask Angle : 7Degree
<b>TTFF WARM</b>	45secs	35 secs	-130dBm
<b>TTFF HOT</b>	15secs	8 secs	4 sat fix, 9 sat search

\*\* TTFF Max base on 95% probability, TTFF Typ. Base on 50% probability.

\*\* Location: Open Sky (Mask Angle: 7) and use simulator STR4500, -130dBm signal level  
Table 5.8.5.1-1. Acquisition time (TTFF)

	<b><i>Clock</i></b>	<b><i>Position</i></b>	<b><i>Ephemeris</i></b>	<b><i>Temp comp</i></b>
<b><i>Cold</i></b>	No	No	No	No
<b><i>Warm</i></b>	< 3s error	< 100km error	< 4 hours old	Yes
<b><i>Hot</i></b>	< 3s error	< 100km error	< 25 min old	Yes

Table 5.8.5.1-2. Explanation of condition for TTFF measurement

Condition of Cold, Warm and Hot start are related to ION-101 Reference [12] specification, and are defined by the availability and age of stored information.

### 5.8.5.2 Position accuracy (Horiz.)

Position accuracy verifies SGEM long time static accuracy and stability.

	<b><i>Accuracy</i></b>	<b><i>Unit</i></b>
<b><i>Cold . (67%)</i></b>	Typ. 5	m
<b><i>Warm (67%)</i></b>	Typ. 5	m

\*\* Condition : HDOP<2.5 ,24Hour, static  
Table 5.8.5.3. GPS System Accuracy

### 5.8.5.3 Sensitivity

Sensitivity means the ability of SGEM to track GPS-signal in certain power level.

#### 5.8.5.3.1 Tracking sensitivity

Tracking sensitivity:

	<b><i>Max.</i></b>	<b><i>Unit</i></b>
<b><i>Sensitivity</i></b>	-150	dBm

Table 5.8.5.4.1. Tracking sensitivity  
(1 sat search)

#### 5.8.5.3.2 Navigation Sensitivity

Navigation sensitivity:

	<b><i>Max.</i></b>	<b><i>Unit</i></b>
<b><i>Sensitivity</i></b>	-145	dBm

Table 5.8.5.4.2. Navigation sensitivity  
(3 sat fix)

### 5.8.5.3.3 Acquisition Sensitivity

Acquisition sensitivity:

	<i>Max.</i>	<i>Unit</i>
<b>Sensitivity</b>	-135	dBm

Table 5.8.5.4.3. Acquisition sensitivity  
(4 sat fix, 9 sat search)

### 5.8.6 GPS Antenna Specification (recommended)

It is important that the antenna gets a clear view of the sky and is positioned on a surface level to the horizon for best results. The following specification has to meet for the use with SGEM reference design

<i>Characteristic</i>	<i>Specification</i>
<b>Polarization</b>	Right-hand circular polarized
<b>Receive frequency</b>	1.57542GHz+/-1.023 MHz
<b>Power supply</b>	3V
<b>DC current</b>	< 15mA @ 3V
<b>Total gain</b>	+25dBi
<b>Output VSWR</b>	< 2.3

Table 5.8.6. Typical active antenna characteristics

### 5.8.7 Interfaces

#### 5.8.7.1 Interface Debug Port (Port B)

This port is provided by SGEM through 32 semi-circle ports.

This port outputs SiRF binary Data format

UART driver is capable of transferring and receiving strings of characters via the serial communication port.

**Default Baud-rate is set to 57600 bps.**

This port displays executing commands and support more detail information SGEM does not include RS-232 chip.

*\* To use serial communication, RS-232 chip should be installed in an external circuit.*

*\* Refer to the software spec.*

### 5.8.7.2 Network Port (Port A)

This port is provided by SGEM through 32 semi-circle ports.

This should be RS232 compatible.

This port outputs NMEA 0183Data format (ver.3.0)

UART driver is capable of transferring and receiving strings of characters via the serial communication port.

Max Baud-rate can be used to extend this up to 115200 baud if required.

Default Baud-rate is 9600.

*\* To use serial communication, RS-232 chip should be installed in an external circuit.*

*\* Refer to the software spec.*

## 6. Testing

This section describes environmental requirements and test condition of SGEM.

### 6.1 Test condition

Test can be performed in the following order (6.2 - 6.11)

If there are no special requirements, test conditions below will be applied.

Voltage	3.0V
Ambient temperature	+20°C to +25°C
Air pressure	Atmospheric pressure
No. of samples	TBD

DUT is in the operation mode during each test or after each test.

DUT should be stored in each temperature for at least 2 hours before test begins.

### 6.2 Field trial tests

The supply voltage will be set to the given reference voltage while DUT parameters are being measured. These parameters include call communication Tx and Rx performance, serial port and I/O functionality and all defined function.


The product complies with the following tests over the entire voltage range.

#### 6.2.1 Field trial test, Normal climate

- Temperature: +25°C

#### 6.2.2 Field trial test, Cold environment

- Temperature: -20°C

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### 6.2.3 Field trial test, Hot Environment

- Temperature: +70°C

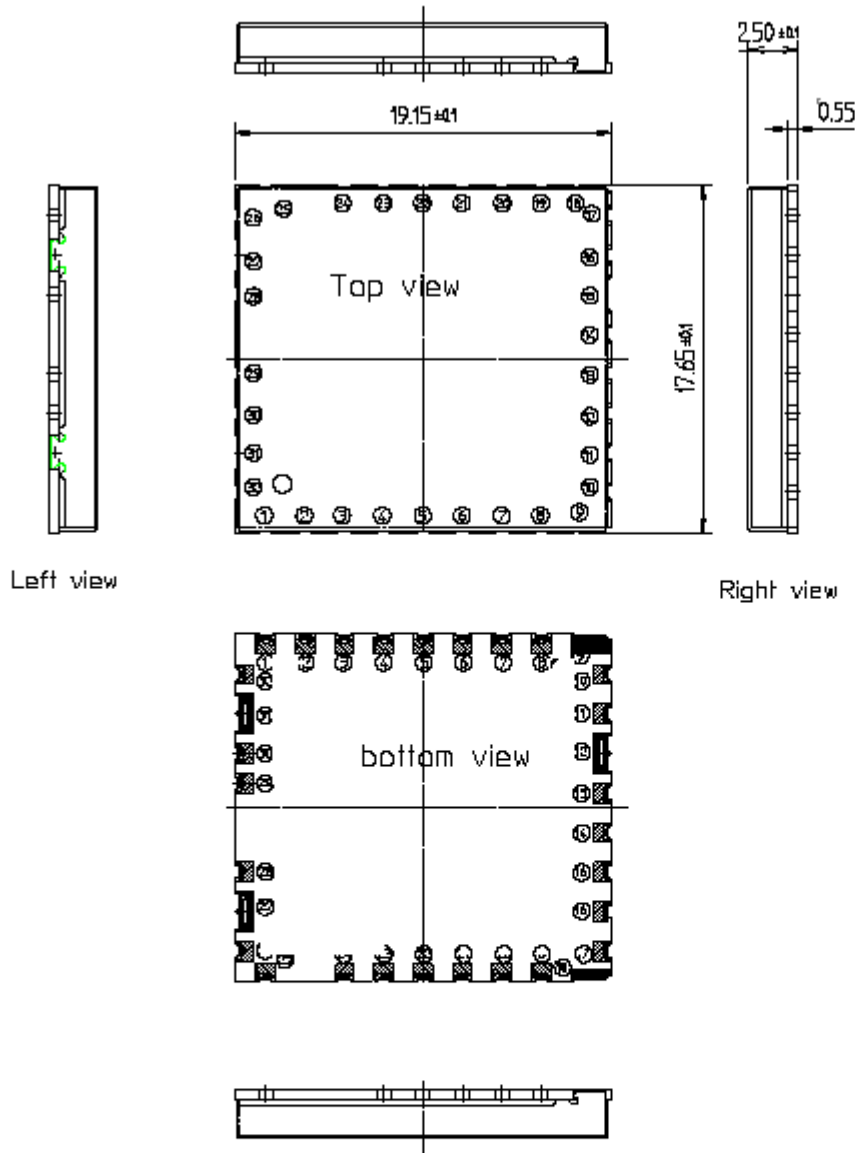
## 7. SGEM Connector configuration

Pin no	Name	Description
1	ANT	Antenna signal input
2	AGND	Analog ground
3	AGND	Analog ground
4	WAKE_UP	External Wake_up <b>(Do Not Use)</b>
5	GPIO 4	Power Control I/O for X-trac & GSW2
6	GPIO 3	Power Control I/O for SiRF Loc <b>(Do Not Use)</b>
7	DGND	Digital ground
8	DGND	Digital ground
9	DGND	Digital ground
10	TXB	CMOS level asynchronous output for Port B
11	RXB	CMOS level asynchronous output for Port B
12	DGND	Digital ground
13	GPIO 6	General purpose I/O 6 Not defined, custom use only
14	TXA	CMOS level asynchronous output for Port A
15	BACK_UP	Vdc for Back Up RTC Function(1.9V<BACK_UP<3.3)
16	RXA	CMOS level asynchronous input for Port A
17	RESET	Reset for System (Reset Timing Min 200usec)
18	AGND	Analog ground
19	VDD	Main power Vcc (3.0V)
20	BOOT	Keep ground for operating mode.
21	DGND	Digital ground
22	DGND	Digital ground
23	DGND	Digital ground
24	MODE_SEL	Power management Pin ( Connect to Pin 5 : GPIO4)
25	DGND	Digital ground
26	DGND	Digital ground
27	AGND	Analog ground
28	AGND	Analog ground
29	AGND	Analog ground
30	AGND	Analog ground
31	AGND	Analog ground
32	AGND	Analog ground



**Appendix B. Foot-print & outline drawing**

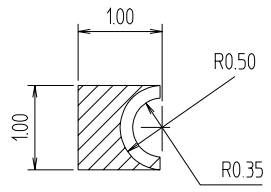
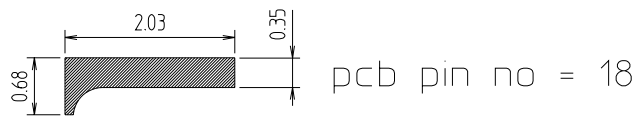
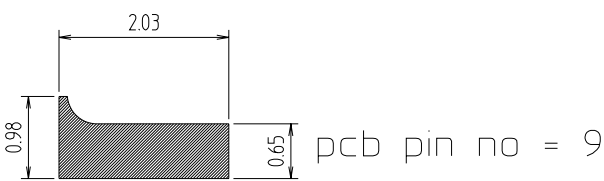
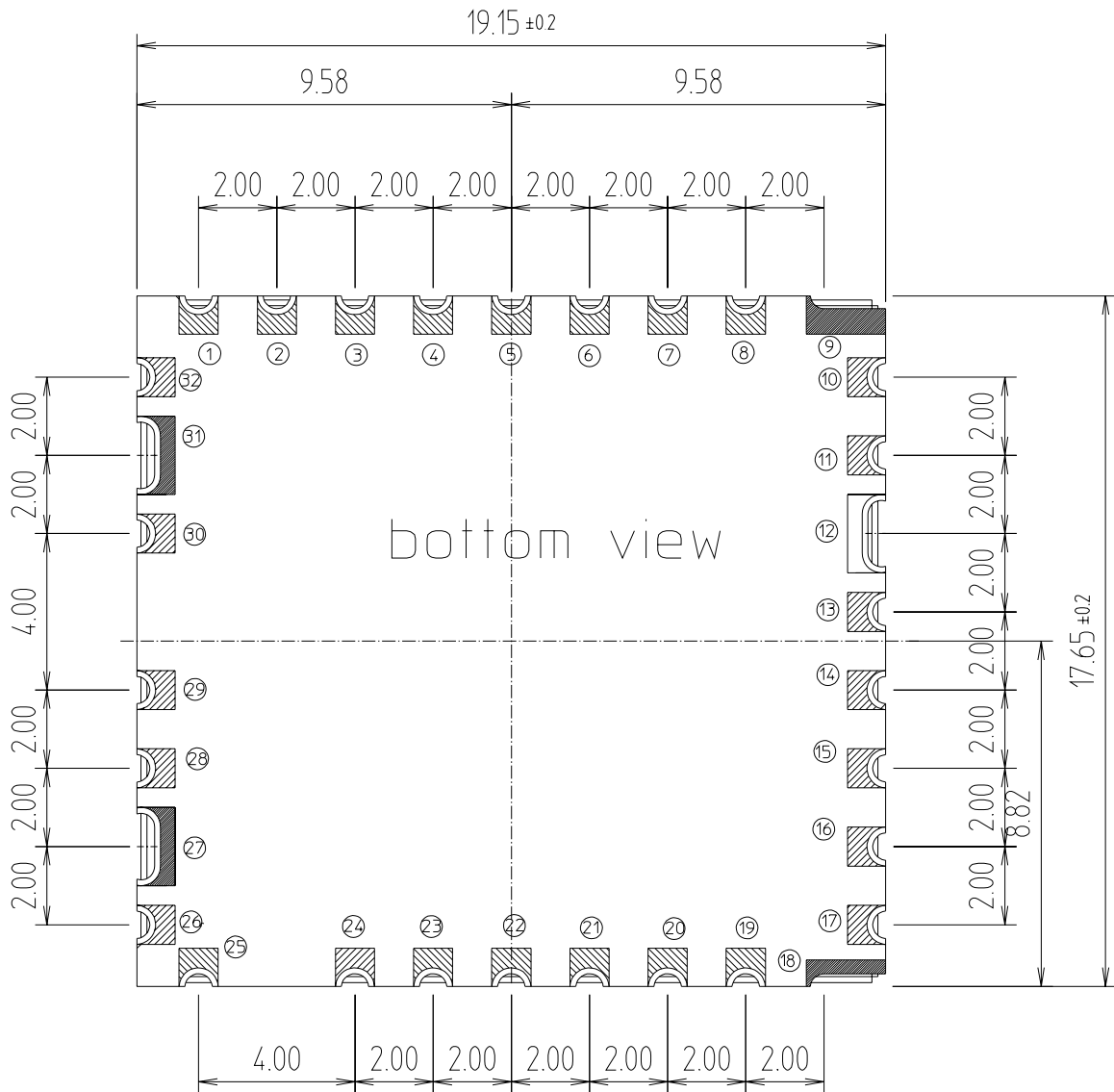
PCB-pin number



NO	NAME
1	ANT
2	AGND
3	AGND
4	WAKE-UP
5	GPI04
6	GPI03
7	DGND
8	DGND
9	DGND
10	TXB
11	RXB
12	DGND
13	GPI06
14	TXD
15	BACK-UP
16	RXD
17	RESET
18	AGND
19	VDD
20	BOOT
21	DGND
22	DGND
23	DGND
24	MODE_SEL
25	DGND
26	DGND
27	AGND
28	AGND
29	AGND
30	AGND
31	AGND
32	AGND

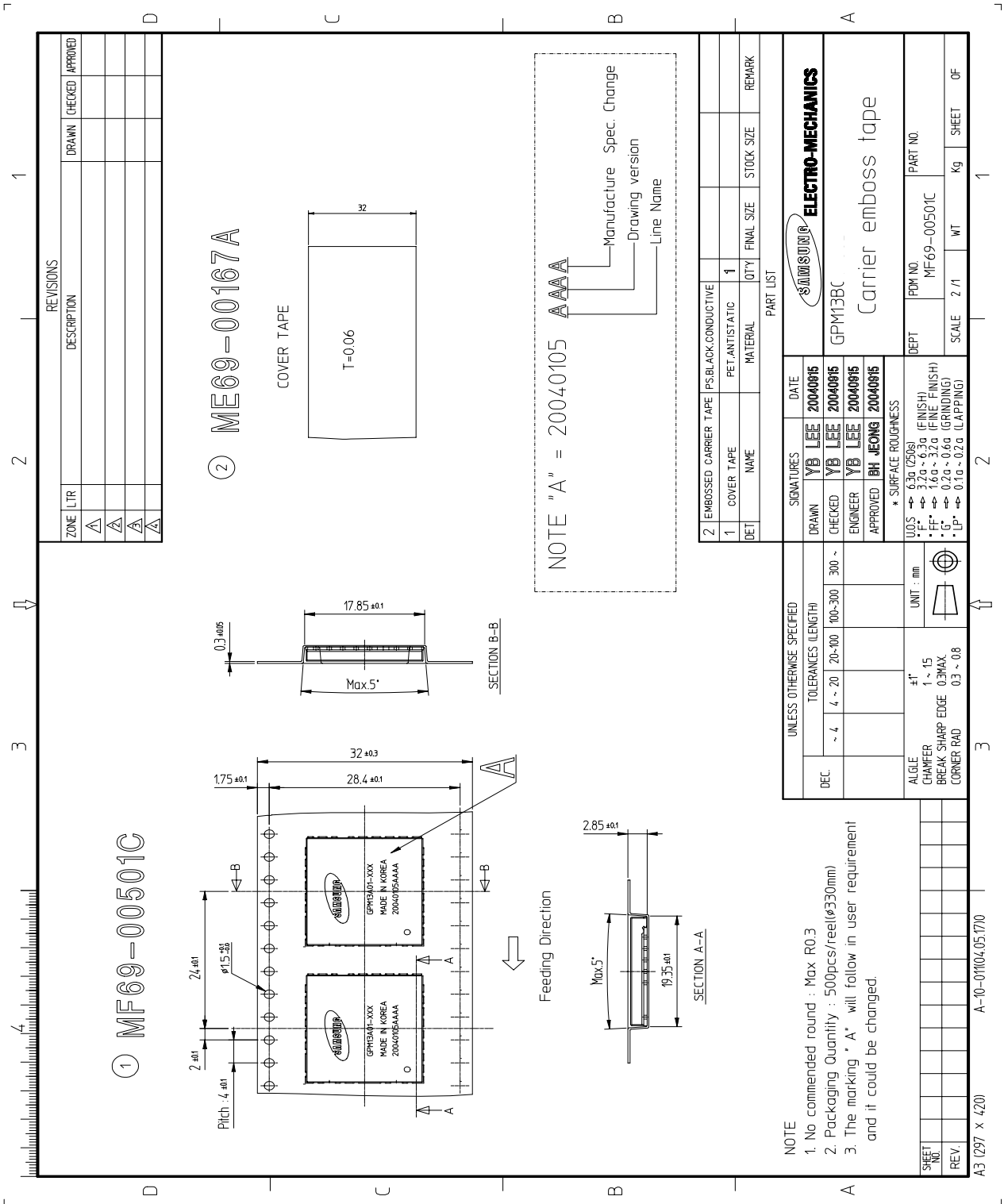






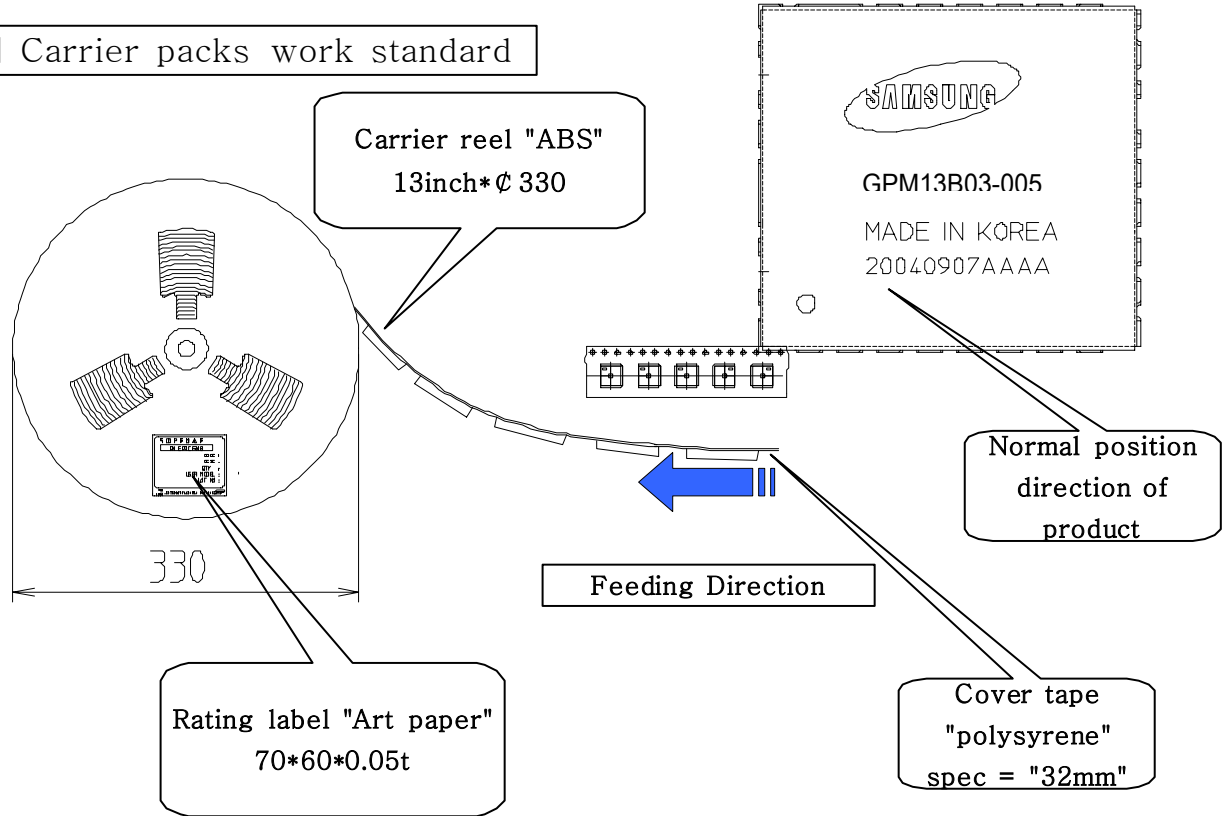
pcb pattern spec

Appendix C. Package Specifications  
Appendix C-1. Taping & reel



**Appendix C-2. Reel packing method**

■ Carrier packs work standard



**Packaging spec = Quantity;500pcs./reel(W330mm)**  
 Surface resistivity =  $1 \times 10^5 \sim 1 \times 10^{11}$

**Bar code contents = 500pc**

**SAMSUNG**

MODEL : GPM13B03-005

bar code

Lot code:20040908/Date code0437

bar code

Qty:500

bar code      MS Level: **3**

SAMSUNG ELECTRO MECHANICS CO. LTD      MADE IN KOREA

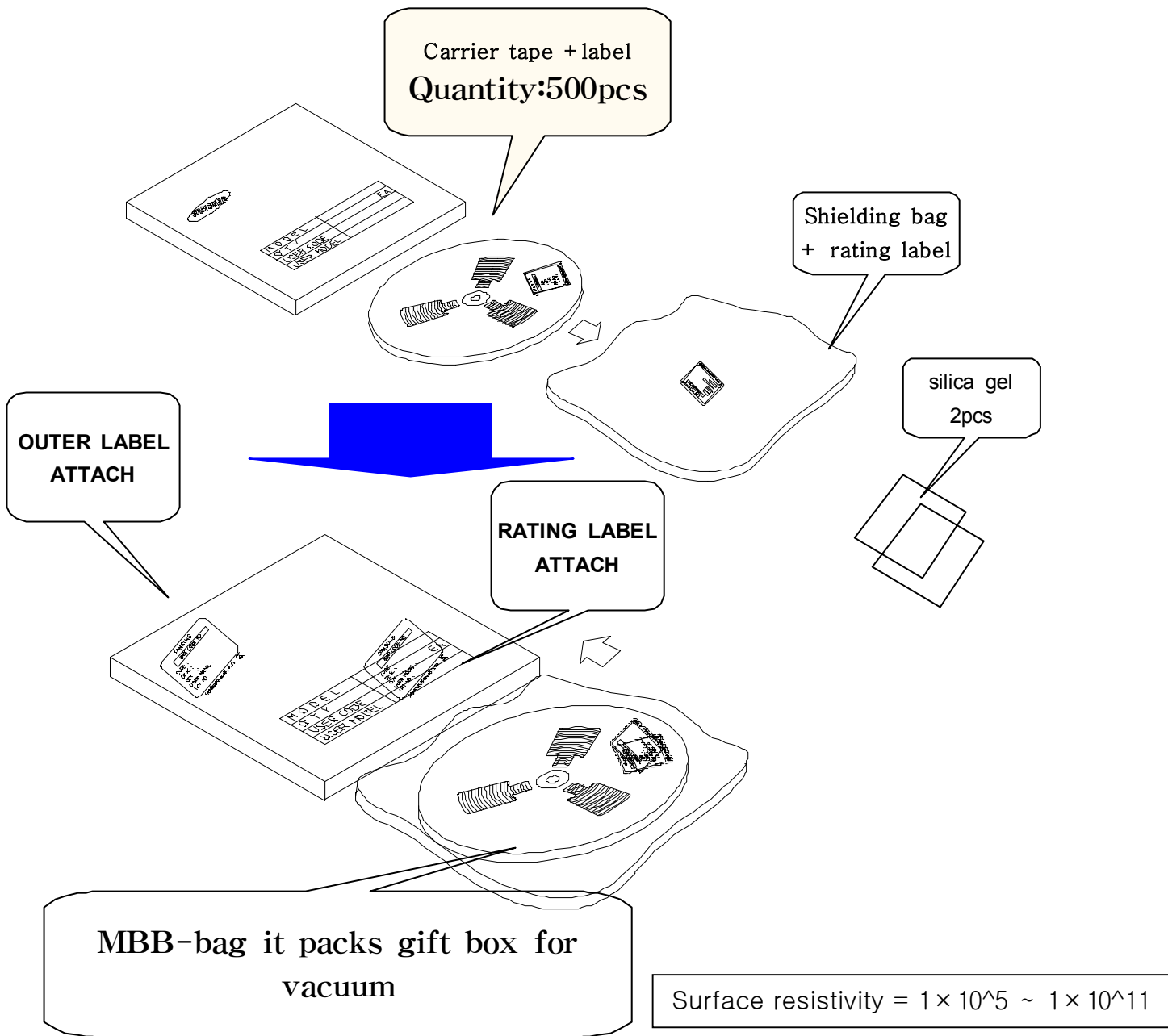
Bar code =  
MODEL = GPM13B03-005

**Bar code contents =20040908/0437 contents contents**

**MSL = 3**

■ It packs the product which is manufactured in the reel(500pcs). The reel it attaches rating label in schedule one location.

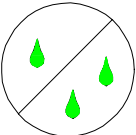
**Appendix C-3. Inner box packing method**



- 1.The product which is packed in the reel in order to protect from moisture and the static electricity, The silica-gel which it inserts in the MBB-bag.
- 2.The label which attaches in the Reel, It attaches in the MBB-bag.
- 3.The label which attaches in the Reel, it attaches on the surface the box.



**Appendix C-4-1. The gist of a MSD/LSD label**



**CAUTION**

This bag contains  
MOISTURE-SENSITIVE DEVICES

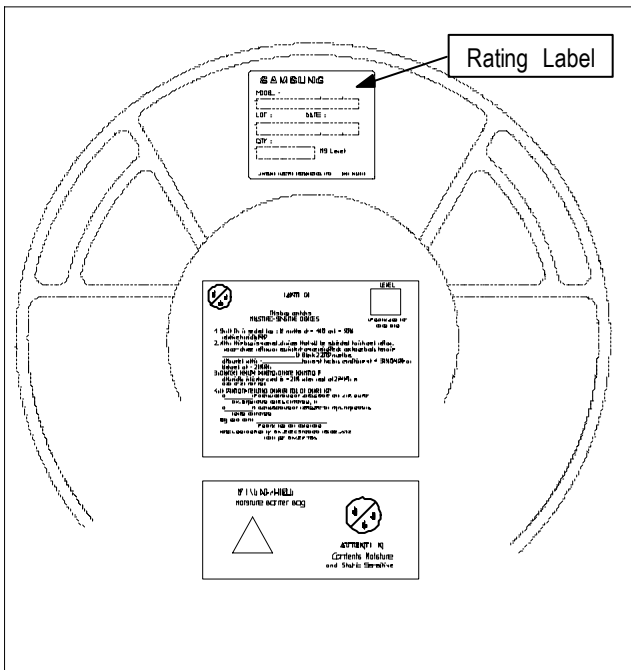
LEVEL


If Blank see bar code label

1. Shelf life in sealed bag : 12 months at < 40°C and < 90% relative humidity(RH)
2. After this bag is opened, devices that will be subjected to infrared reflow, vapor-phase reflow, or equivalent processing(Peak package body temp is \_\_\_\_\_ (If Blank 220°C) must be:
  - a) Mounted within : \_\_\_\_\_ hours at factory conditions of ≤ 30°C/60% or
  - b) stored at < 20%RH.
3. Devices require baking, before mounting, if
  - a) Humidity indicator card is > 20% when read at 23±5°C, or
  - b) 2a or 2b not met.
4. If baking is required, devices may be baked for
  - a) \_\_\_\_\_ (if blank:192)hours at 40°C±5°C/0°C and <5% RH for low-temperature device containers, or
  - b) \_\_\_\_\_ (if blank:24)hours at 125°C±5°C for high-temperature device containers

Bag seal Date: \_\_\_\_\_  
If Blank see bar code label

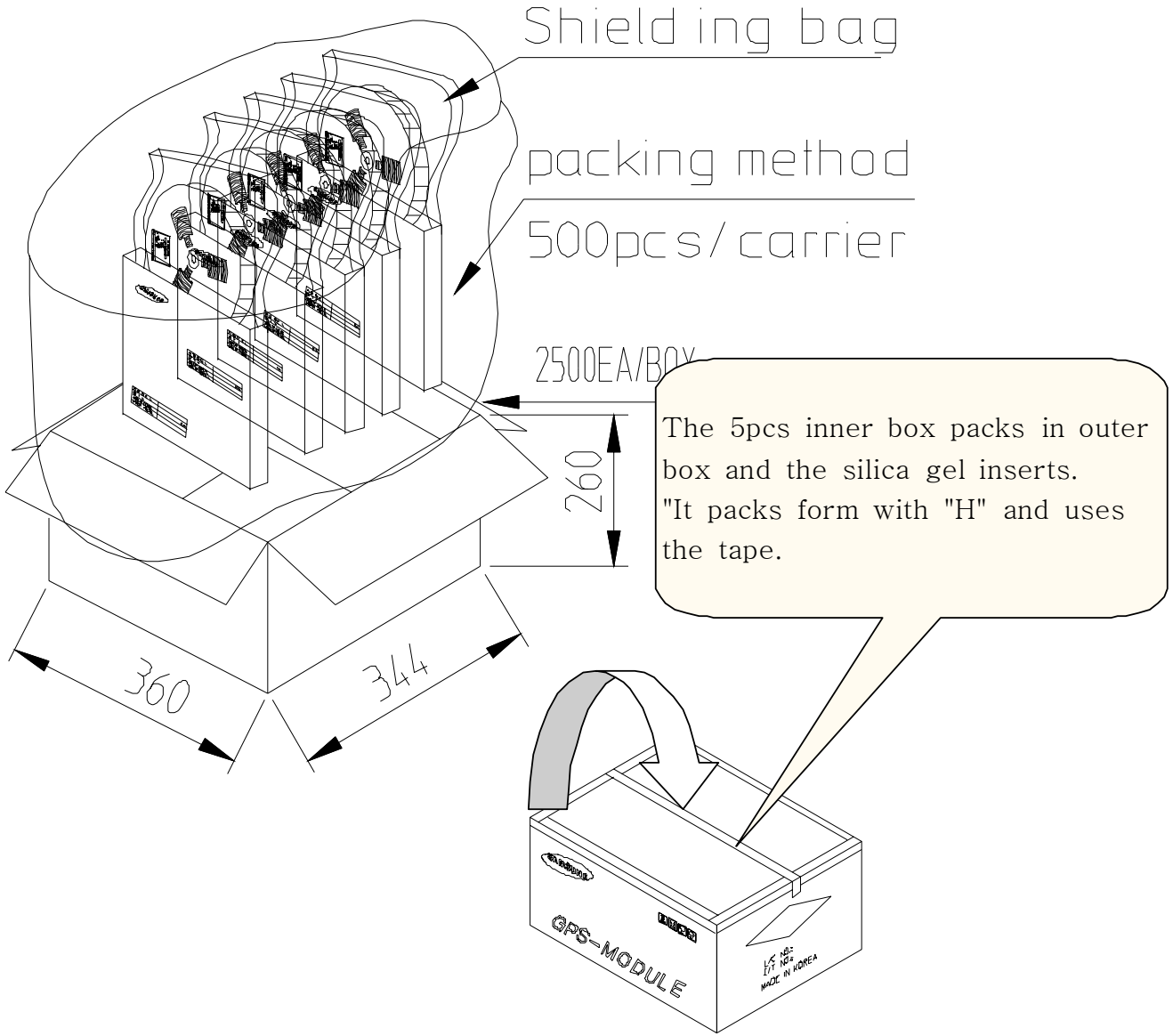
Note: Level defined by EIA JEDEC Standard JESD22-A112 label per EIA/JEP 113A



	LEVEL	Notice Mark	Attached
ESD	Class 1C		Yes
MSL	3	 <b>ATTENTION</b>	Yes

※ For Further Reference : EIA-481-C / EIA-541

**Appendix C-5.Outer Box Packaging Quantity**



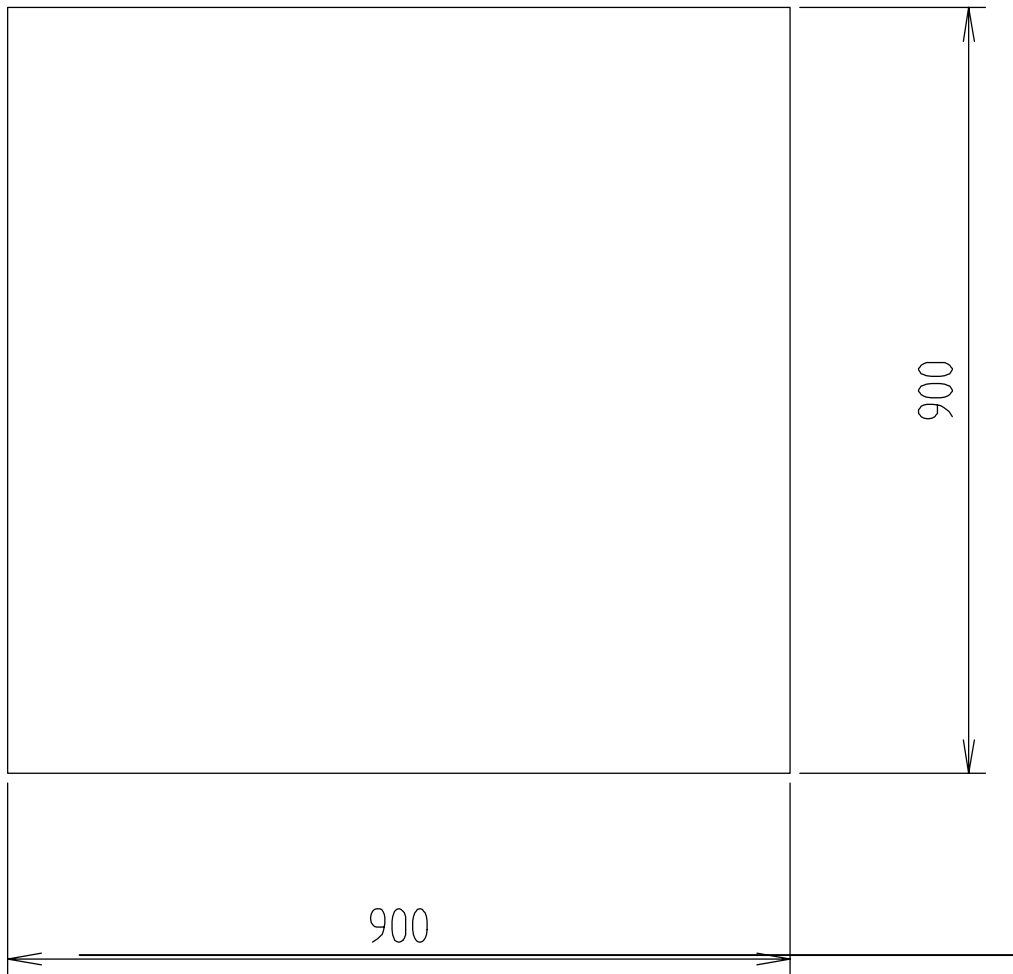
**Out box packaging spec = inner box 500 pcs \* 5set**  
**Quantity ; 2500pcs (Max)**



**Appendix C-6.Vinyl bag (Static electricity prevention)**

VINYL BAG

(Static electricity prevention)



**Appendix C-7.Inner Box Packaging**

- 1.wooden form empty car ±1mm it does in within
- 2.The flood control khway is line flood control
- 3.Quality of material:SW3B(A):SK(210)/K2(180)SK(210)
- 4.Explosion burglar = 12.4 Kg/cm<sup>2</sup> ↑

1. Internal Injury BOX

PRINT SPEC 1/1

**NOTES,**

1. Wooden form empty car ±1mm it does in within
2. Quality of material : challenge characterisic:corro<sup>2</sup> <math>10^4</math> C<sup>2</sup>/sq
3. explosion burglar : 12.4 Kg/cm<sup>2</sup>

PRINT SPEC 1/1

NO	NAME	QUANTITY	MATERIAL	COMPLETION DIM	REMARK
1	M-BOX	1	SW3B(A)	340*315*340	

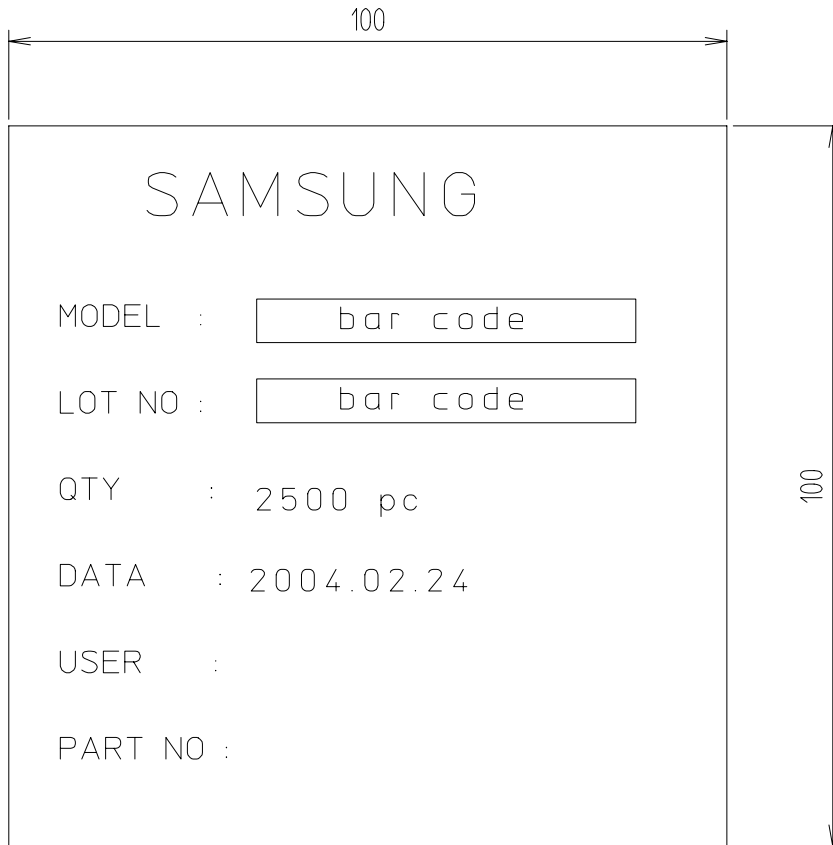
DATE	SIGN	INSPECT	REVISION RECORD	REMARK

GPS-Module

A3 (20242971)

**Appendix C-8.Outer Box and Inner Box Affix label**

**Outer box print label spl**

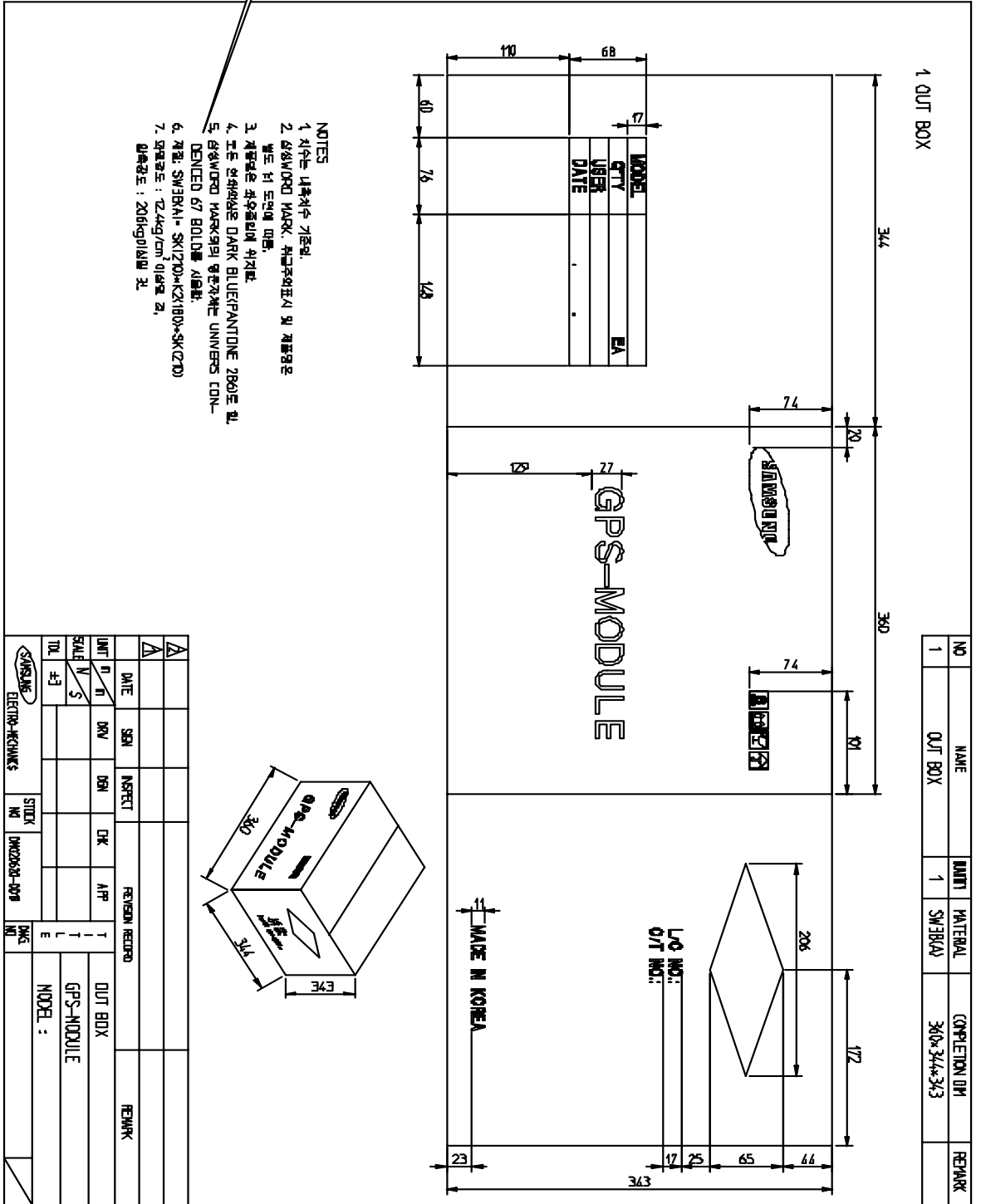


Print color spec : Black

- ※ Our use label it is reference explanation**
- 1. outer box it is affix**
- 2. Model-name change it is possible**
- 3. The packing number it is change possible**

**Appendix C-9. Outer Box Packaging Quantity**

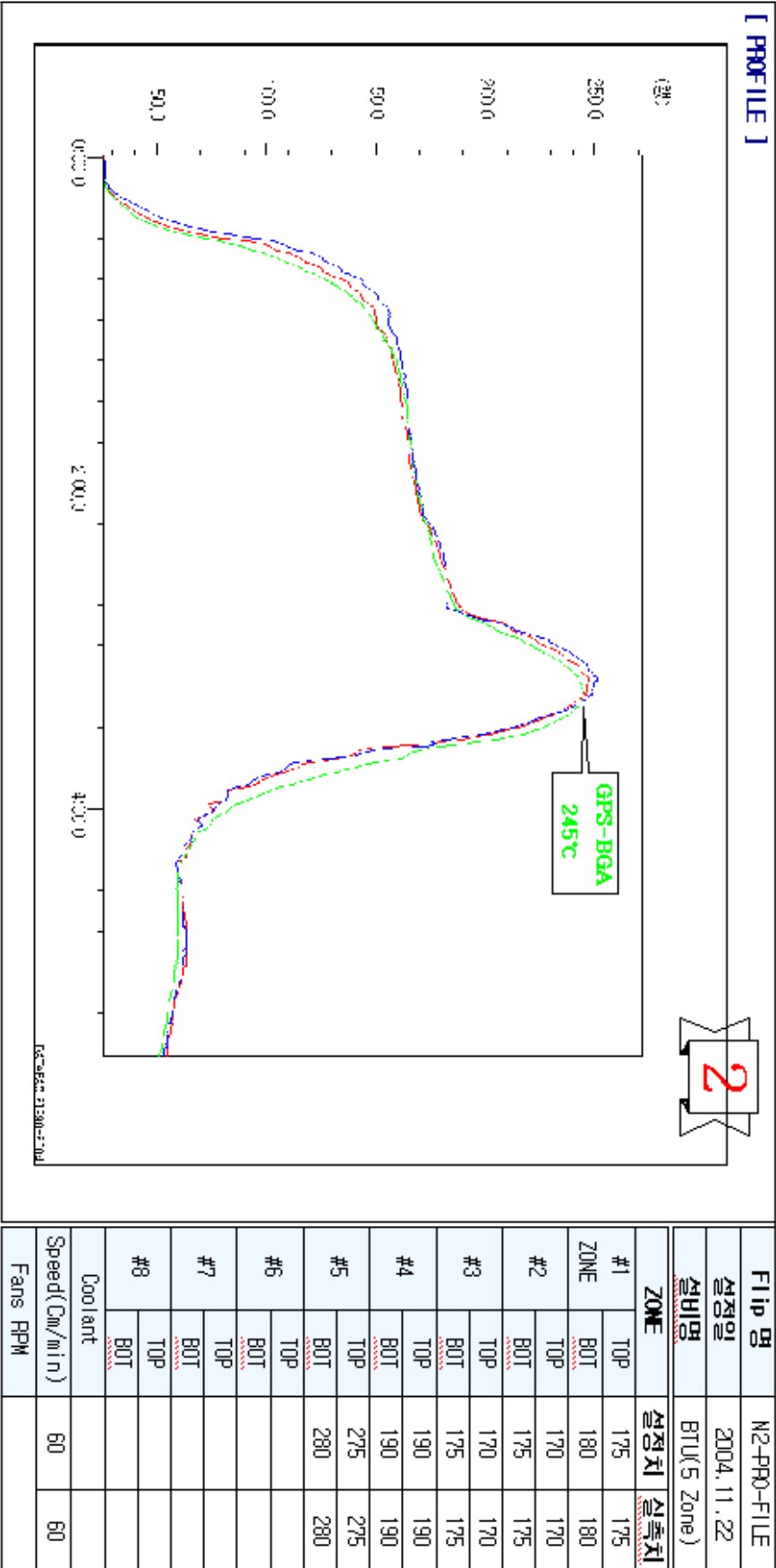
- 1. wooden form empty car  $\pm 1$ mm it does in within
- 2. The flood control khway is line flood control
- 3. Quality of material: SW3B(A):SK(210)/K2(180)SK(210)
- 4. Explosion burglar = 12.4 Kg/cm<sup>2</sup> ↑



Appendix D. SEMCO Reflow Oven Profile

REFLOW OVEN 온도 PROFILE

심성전기 DM(SI) RS를 제조(SMT)



SOLDER 조성(합금)		반Pb-Free( SnAgCu )		멀티Solder( )		저온Solder( )		기타( )		
구분	온도 구간	DRY ZONE	PREHEAT(SINK) ZONE	REFLOW ZONE	PEAK ZONE	비고				
설정온도(°C)	0~150°C	150°C~183°C	220°C이상	251°C						
경과시간(min)	60sec	96sec	32sec							
적용제품	<input type="checkbox"/> MULTI <input type="checkbox"/> CATY <input type="checkbox"/> TM_BLOCK <input type="checkbox"/> RF_MOD <input type="checkbox"/> RF_UNIT <input checked="" type="checkbox"/> BLUETOOTH <input type="checkbox"/> BLUE_Q <input checked="" type="checkbox"/> GPS <input checked="" type="checkbox"/> MOBILE_TU <input type="checkbox"/> 기타( )									

[ 본 양식(SHEET) 이외 사용이 절대 불가함. 공용 SHEET 개정일: 2004년 05월 07일 작성자: 조재현 ]

접수번호 050427

# 시험 성적서

회사명	삼성전기(주) / DM 사업부	의뢰자	과분호
주소	경기도 수원시 영통구 매탄3동 314		
접수일자	2005년 04월 18일	시험일자	2005년 04월 18일 ~ 2005년 04월 21일
시험대상품목 코드, 불질, 시험명	GPS-Module		
시험항목	Cd, Pb, Hg, Cr <sup>VI</sup> , PBDEs, PBBs		
시험방법	ISO 4749, ISO 5966, KS D 1900, ISO 3613, LF Method (LFMS)		
시험기기	Varian 220FS, Agilent 8453 UV-Vis Spectrophotometer, Leco AMA 254, Agilent 6890 GC/5973N MSD		
시험목적	환경유해물질검사		
시험결과	"을서 기술"		
시험자	김지선, 황유미, 최수진	기술책임자	권오영

※ 특이사항: 이렇없음.



2005년 04월 21일  
주식회사 랩프런티어



- 본 시험성적서는 의뢰자가 제출한 시험에 대한 결과입니다.
- 본 시험성적서는 사전 및 소송 용도로 사용할 수 없습니다.
- 시험성적서 책임금은 신청 및 기술책임자의 승인 후 가능하며 발급수수료가 있습니다.
- 'S' 표시는 위탁시험 결과입니다.

접수번호	050427
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음지

1. Cd, Pb, Hg, Cr<sup>6+</sup>

No.	Sample name	Conc. of elements, % (m/m)			
		Cd	Pb	Hg	Cr <sup>6+</sup>
1	GPS-Module	ND	1.47	ND	ND

\* ND(Reporting limit, RL) : below RL.

- RL : Cd : 0.1mg/kg

Hg : 0.01mg/kg

Cr<sup>6+</sup> : 2.0mg/kg

2. PBBs(Polybrominated Biphenyls)

(Unit : µg/g)

Sample Name	Mono-	Di-	Tri-	Tetra-	Penta-	Hexa-	Deca-
GPS-Module	ND	ND	ND	ND	ND	ND	ND

3. PBDEs(Polybrominated Diphenyl Ethers)

(Unit : µg/g)

Sample Name	Mono-	Di-	Tri-	Tetra-	Penta-	Hexa-	Hepta-	Octa-	Nona-	Deca-
GPS-Module	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

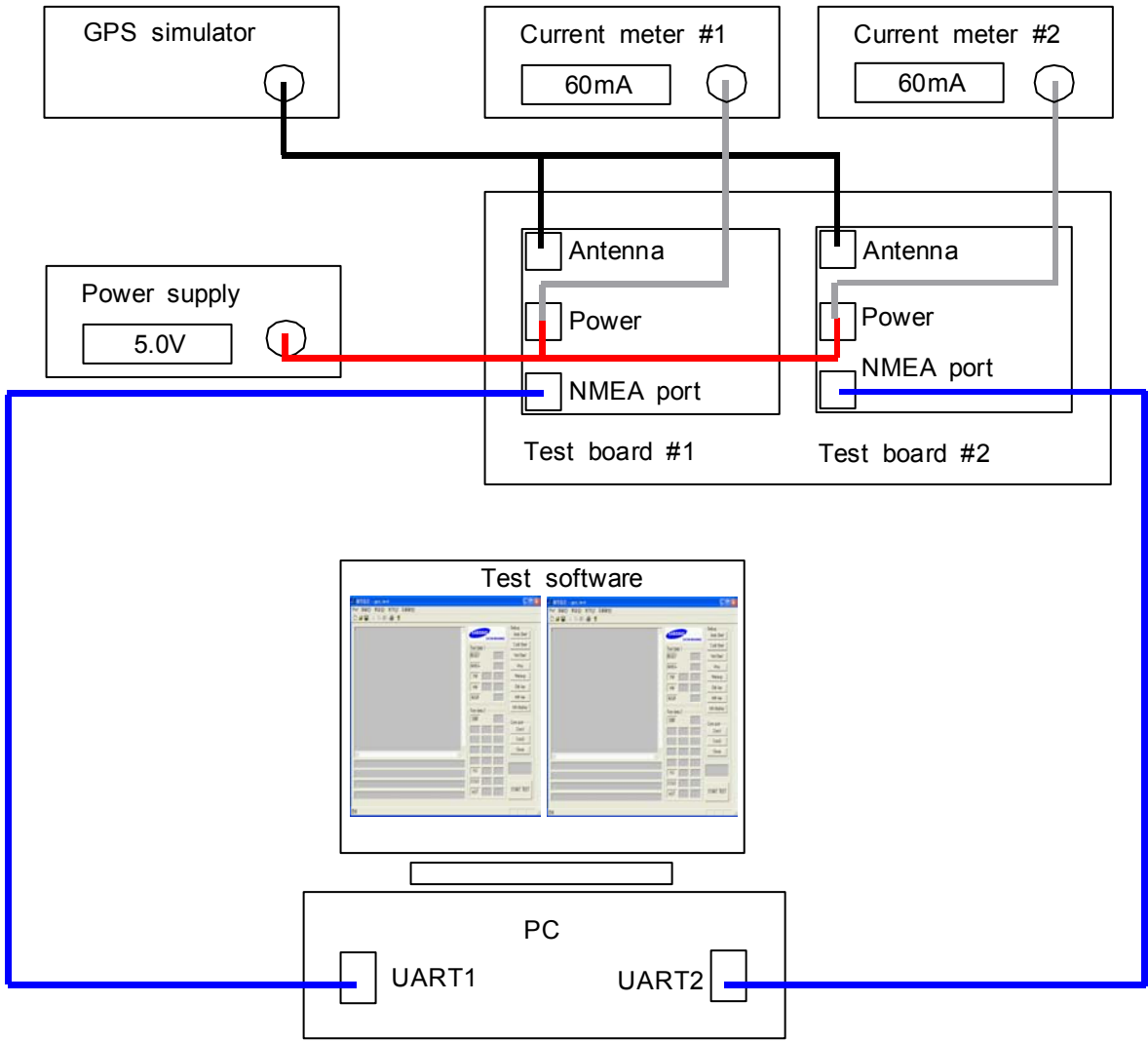
\* ND(Not Detection) : below LOD

- LOD : PBDEs : 0.10 µg/ml.

PBBs : 0.10 µg/ml.

DecaBDE, DecaBB : 1.0 µg/ml.

**Appendix F. Test method**



**GPS Simulator**  
**SPIRENT : STR 4500**



**Appendix G. Test flow chart**

