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			2007.04.03		Ver 1.0	YJ.SEOL	WH.KIM
			2007.04.24		Ver 1.1	JW.KIM	KC.KANG
			2007.05.21		Ver 1.2	YJ.SEOL	KC.KANG

CONFIDENTIAL

Samsung MultiMode GPS Engine Module Hardware Specification Product No : GPD14B02007

Ver 1.2

This document specifies the electrical, mechanical, and behavioral characteristics of Samsung MultiMode GPS engine module.

SAMSUNG ELECTRO-MECHANICS

TECHNICAL DOCUMENT

NAME

SGEM

(Samsung GPS Engine Module)

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DEPT.	TYPE Tech. Description	GROUP				
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Revision history :			
Revision	**Release date**	**Issuer**	**Change description**
Ver 1.0	2007.4.03	YJ SEOL	
Ver 1.1	2007.4.24	JW KIM	Add Power Supply Information
Ver 1.2	2007.5.21	YJ SEOL	Module includes power of reset.

1. Definitions

SGEM : SAMSUNG Electro-Mechanics GPS Engine Module

2. Product Description

This document specifies the electrical, mechanical and behavioral characteristics of Samsung multimode GPS engine module. Samsung multimode GPS engine module is illustrated in figure 1 below. In a cell phone application, Samsung multimode GPS engine module works under a protocol stack executing on the cell baseband. Samsung multimode GPS engine module accepts GPS assistance information from the cell baseband and performs all signal processing necessary to acquire and determine satellite code phase information (also referred to as pseudo-range), time tags and the code phase information can return. Samsung multimode GPS engine module presents a simple UART serial interface to the cell baseband processor.
A communications protocol is implemented from which the cell baseband processor issues commands to the GPS baseband and obtains responses.
This protocol includes the download of GPS baseband software from internal flash memory, SGEM can be operated Conventional Autonomous mode and Assisted Autonomous mode when aiding information be supported from the server.

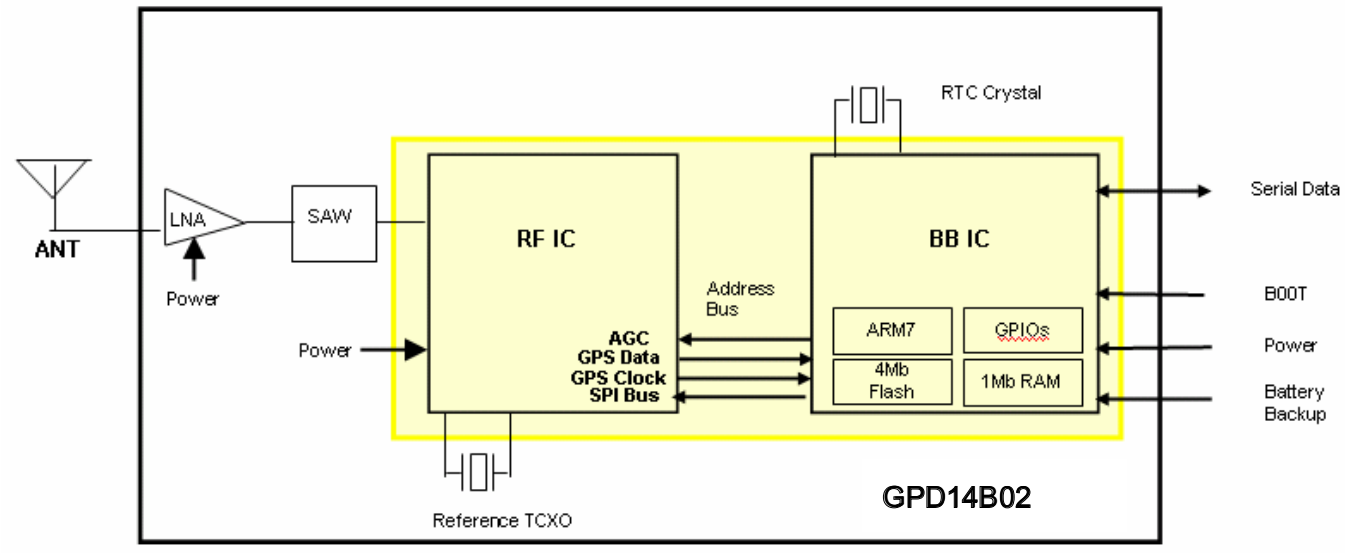


Figure 1. Samsung multimode GPS engine module

3. Supplier's Responsibility

3.1 Reliability

To detect critical process risks, process FMEA will be made and documented by Samsung Electro-mechanics. 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. Product Requirements

4.1 Marking

4.1.1 External label

- Product number, Software version & type should be included.

Note: Please refer to Appendix A for the details.

4.2 Mechanical specification

Table 1. Mechanical specification

Items	Description
Width	13.1 mm
Length	15.9 mm
Height	2.5 mm
Weight	1.03 g

Note: Please refer to Appendix B for the details.

4.3 Electrical connection

36 ports on PCB

4.4 Material requirements

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

4.5 Printed Circuit Board

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.

4.6 Temperature requirements

Table 2. Temperature requirements

Item	Description
Operating temperature	-30°C to +80°C
Storage temperature	-40°C to +85°C

4.7 Electrical requirements

4.7.1 Recommended Input Voltage

Table 3. Recommended Input Voltage

Item	Symbol	Min	TYP	Max	Unit
Power On	VCC	3.0	3.3	5.0	V
Power Off	VCC		0	0.1	V

Note: The reasonable Power supply ripple would be under 50mVpp.

4.7.2 Absolute Maximum Ratings

Table 4. Absolute Maximum Ratings

Item	Symbol	Min	Max	Unit
Power Supply Voltage	VDC	-0.3	6.0	V
Current on any pin to avoid latch-up (latch up compliance : JESD-78 class 1)	ILATCH	-200	+200	mA
ESD protection	VESD	-1000	1000	V
High Level Input Voltage, GPIO and data bus	VIH	2.1	3.1	V
Low Level Input voltage, GPIO and data bus	VIL	-0.3	0.8	V

4.7.3 DC Operating Characteristics for RTC Block

Table 5. Operating Characteristics

Item	Symbol	Min	TYP	Max	Unit
RTC Supply	VDD_RTC	1.8	3.0	5.0	V
Supply Current	IDD_RTC	5	10	15	μA

4.7.4 Power consumption

Table 6. Power consumption

State		Min	TYP	Max	Unit
Operating @ 3V	Navigation	99	110	145	mW
	Tracking	109	120	155	mW
Hibernate		15	35	45	uW

4.7.5 Subsystem Electrical Interface Description

- Cell-BB interface with GPS BB is 2.85V CMOS
  - UARTA and GPIO logic signals implement protocol and control
  - UARTB to facilitate system development and testing

4.7.6 Inputs

All Power inputs have EMI filtering (10nF, 12pF) on the external circuit.
All Power inputs have the external protection circuit and EMI filtering capacitor.

4.7.6.1 BOOTSEL (Boot select)

This pin is for program download.
This pin should be high when the program is downloaded.
If the BOOTSEL is high then the module will boot from the serial port. and
If the BOOTSEL is low then the module will begin execution from the on-board FLASH.
Please have 4.7Kohm pull down resistor for operating mode.

4.7.6.2 RESET

On module include power of reset.
This pin is not available(NC).

4.7.6.3 ECLK (External Clock)

- In case of Conventional Autonomous Mode
This ECLK pin should be pull up.(4.7K~10.0Kohm)
- In case of Assisted Autonomous Mode (AGPS)
The ECLK input is also the input pin for clock correction in AGPS. The frequency stability of this signal should be better than +/- 0.1ppm for best results and free of any externally controlled “steering” during the time of measurement.

4.7.6.4 TIMESYNC

- In case of Conventional Autonomous Mode
This TIMESYNC pin should be pull down.(4.7K~10.0Kohm)
- In case of Assisted Autonomous Mode (AGPS)
This pin is used for time transfer information into the GPS receiver with AGPS code ONLY, and also for alternate applications. When use as a TIMESYNC input, this input pulse is rising edge triggered, and must be 100ns wide as a minimum, and 1ms wide as an approximate maximum.

4.7.6.5 Wake Up

This pin is not available now.
This Wake Up pin should be pull down.(4.7K~10.0Kohm)

4.8.7 Outputs

GPIO should have EMI filtering capacitors (10nF, 18pF/50V) in external circuit for protecting *RF* radiation and keeping SGEM isolated from other devices.

4.8.7.1 PPS

GPS Additional Function (1 Pulse Per Second)

4.8.7.2 GPIO

If you do not use this pin, set the GND.

4.8.7.3 TXA

NMEA message output. From GPS Module To Host (Typ. 2.85V).

4.8.7.4 RXA

NMEA command input. From Host To GPS Module(Typ. Host's I/O Level)

4.8.7.5 TXB, RXB

Port for Debugging, possible NC.
Recommend 12pF of output shut capacitor.

4.8.8 Supply Power

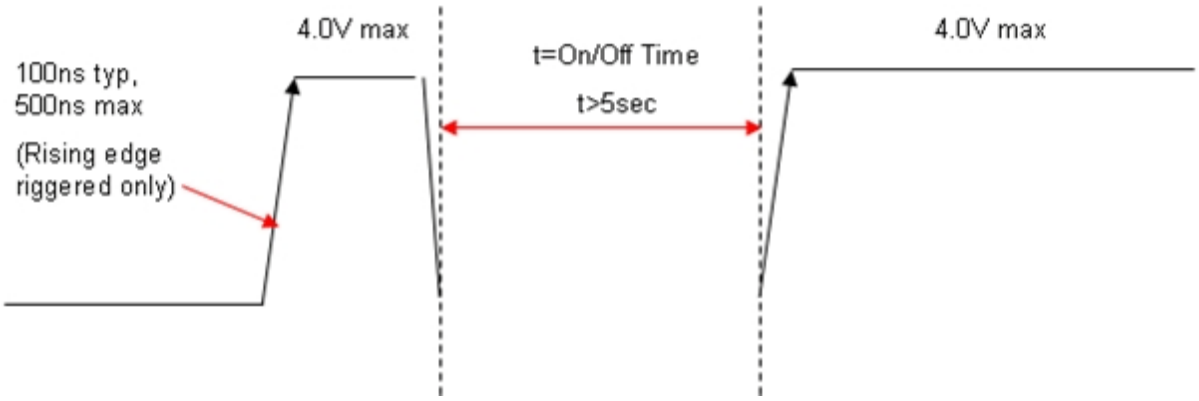
Our Recommend supply power range is 3.6V~5.0V

Recommend Supply Power Characteristic.

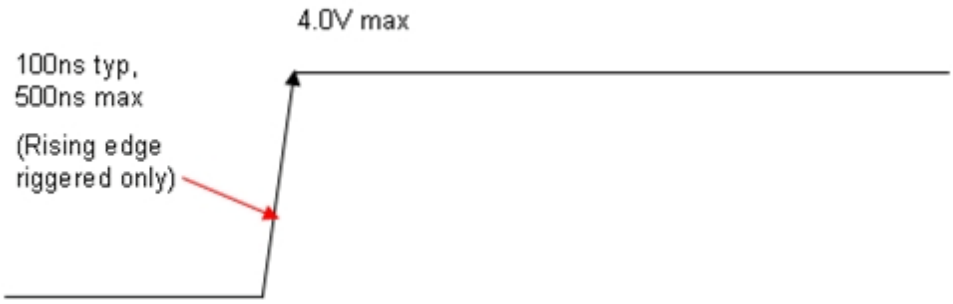
- The initial power supply ripple <10mV$_{PP}$ From DC to 3Mhz
- The initial power supply On/Off Time > 5sec

→ We Do Not Recommend Power Sequence Like This

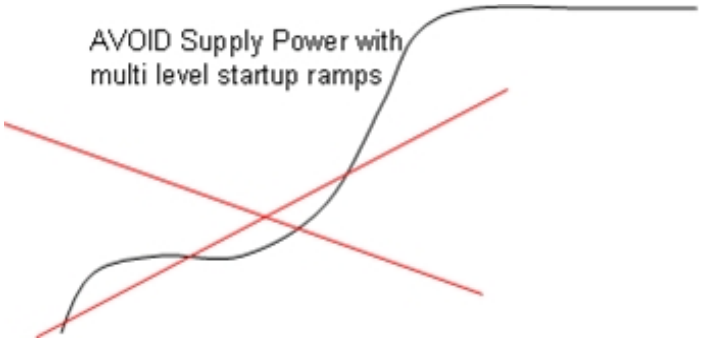
-



Abnormal Power Sequencing



Normal Power Sequencing



**

Please Avoid Multi Level Startup Ramps

4.8.9 Interface

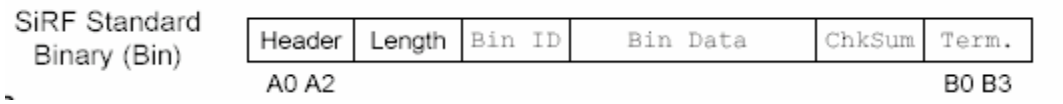
4.8.9.1 Conventional Autonomous mode

- UARTA input / outputs

a. NMEA message

- UARTB input / outputs

a. SiRFBinary message

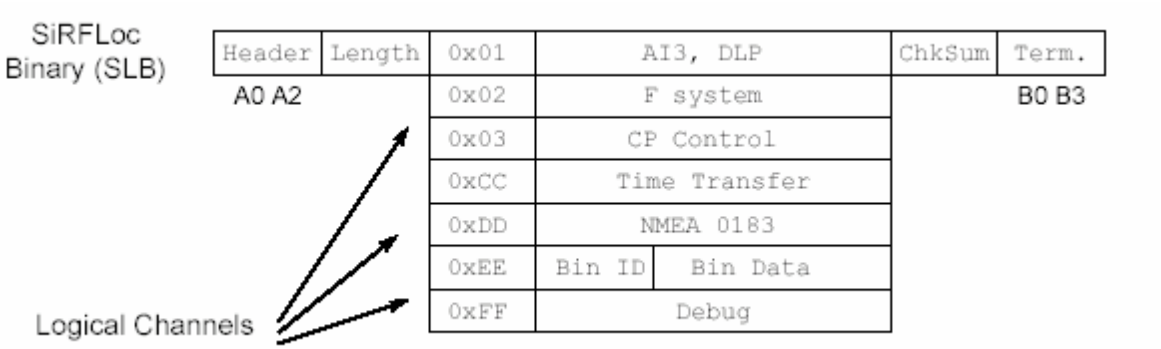


4.8.9.2 Assisted Autonomous mode

- UARTA input / outputs

a. AI3 message
b. F system message
c. CP control message
d. Time Transfer Board message
e. NMEA 0183 message
f. SiRFBinary message
g. Debug message

And these are called to logical channels.



4.8.10 RF Connections

SGEM has a GPS antenna input port.

4.8.11 Performance

4.8.11.1 TTFF (Time to First Fix)

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)

- **Conventional Autonomous mode**
  - Cold < 55 sec(95%) @-130dBm (4 sat fix, 9 sat search)
  - Hot < 10 sec(95%) @-130dBm (4 sat fix, 9 sat search)
- **Assisted mode**
  - Precise Mode < 10 sec(95%) @-145dBm (4 sat fix, 9 sat search)
  - Coarse Mode < 10 sec(95%) @-145dBm (4 sat fix, 9 sat search)
  - Precise Mode < 30 sec(95%) @-152dBm (4 sat fix, 9 sat search)

(* ±2 second time accuracy)

4.8.11.2 Sensitivity

- **Conventional Autonomous mode**
  - (95%) @-130dBm (4 satellite fix, 9 sat search, mask angle : 7degree)

Table 7. Sensitivity

	Min.	Typ.	Max	Units
Acquisition	-	-142	–	dBm
Navigation	-	-156	–	dBm
Tracking	-	-159	–	dBm

- **Assisted mode**
  - Acquisition sensitivity -152 dBm (95%) (4 sat fix, 9 sat search,)

4.8.11.3 Accuracy

- **Static accuracy**
  - CEP 16 meter (4 sat fix, 9 sat search)

  Note: Test condition -130dBm, HDOP<2.5 ,24Hour, static

- **Dynamic accuracy**
  - CEP 20 meter (4 sat fix, 9 sat search)

4.8.12 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.

Table 8. Recommended GPS Antenna

Characteristic	Specification
Polarization	Right-hand circular polarized
Receive frequency	1.57542GHz+/-1.023 MHz
Power supply	2.85VDC
DC current	< 8mA @ 2.85VDC
Total gain	Max +15dBi
Output VSWR	< 2.5

5. Protocol Specification

Samsung GPS receiver supports a subset of the NMEA-0183 standard for interfacing marine electronic devices as defined by the National Marine Electronics Association. The NMEA Reference Manual provides details of NMEA messages developed and defined by Samsung & SiRF. It does not provide information about the complete NMEA-0183 interface standard.

5.1. Output messages

Table 9 lists each of the NMEA output messages specifically developed and defined by Samsung & SiRF for use within Samsung GPS receiver.

Table 9. NMEA Output Messages

Option	Description
GGA	Time, position and fix type data.
GLL	Latitude, longitude, UTC time of position fix and status.
GSA	GPS receiver operating mode, satellites used in the position solution, and DOP values.
GSV	The number of GPS satellites in view satellite ID numbers, elevation,azimuth, and SNR values.
MSS	Signal-to-noise ratio, signal strength, frequency, and bit rate from a radio-beacon receiver.
RMC	Time, date, position, course and speed data.
VTG	Course and speed information relative to the ground.

A full description and definition of the listed NMEA messages are provided by the next sections of this chapter.
Table 9 provides a summary of supported Samsung & SiRF NMEA output messages by the specific Samsung platforms.

Table 10. Supported NMEA output messages

SiRF Software Options				
Message	**GSW2**	**SiRFXTrac**	**GSW3**	**SiRFLoc**
GGA	Yes	Yes	Yes	Yes
GLL	Yes	Yes	Yes	Yes
GSA	Yes	Yes	Yes	Yes
GSV	Yes	Yes	Yes	Yes
MSS	Yes	No	Yes	No
RMC	Yes.	Yes.	Yes.	Yes.
VTG	Yes	Yes	Yes	Yes

- **GGA —Global Positioning System Fixed Data**

Note – Fields marked in red apply only to NMEA version 2.3 (and later) in this NMEA message description.

Table 11 contains the values for the following example:

$GPGGA,161229.487,3723.2475,N,12158.3416,W,1,07,1.0,9.0,M, , , ,0000*18

Table 11. GGA Data Format

Name	Example	Units	Description
Message ID	$GPGGA		GGA protocol header
UTC Time	161229.487		hhmmss.sss
Latitude	3723.2475		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.3416		dddmm.mmmm
E/W Indicator	W		E=east or W=west
Position Fix Indicator	1		See Table 11
Satellites Used	07		Range 0 to 12
HDOP	1.0		Horizontal Dilution of Precision
MSL Altitude1	9.0	Meters	
Units	M	Meters	
Geoid Separation1		Meters	
Units	M	Meters	
Age of Diff. Corr.		Second	Null fields when DGPS is not used
Diff. Ref. Station ID	0000		
Checksum	*18		
<CR><LF>			End of message termination

Samsung GPS receiver does not support geoid corrections. Values are WGS84 ellipsoid heights.

Table 12. Position Fix Indicator

Value	Description
0	Fix not available or invalid
1	GPS SPS Mode, fix valid
2	Differential GPS, SPS Mode, fix valid
3 ~ 5	Not Supported
6	Dead Reckoning Mode, fix valid

Note – A valid position fix indicator is derived from the SiRF Binary M.I.D. 2 position mode 1. See the SiRF Binary Reference Manual.

- **GLL—Geographic Position - Latitude/Longitude**

Note – Fields marked in red apply only to NMEA version 2.3 (and later) in this NMEA message description.

Table 13 contains the values for the following example:

```
$GPGLL,3723.2475,N,12158.3416,W,161229.487,A*2C
```

Table 13. GLL Data Format

Name	Example	Units	Description
Message ID	$GPGGA		GGA protocol header
Latitude	3723.2475		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.3416		dddmm.mmmm
E/W Indicator	W		E=east or W=west
UTC Position	161229.487		hhmmss.sss
Status	A		A=data valid or V=data not valid
Mode	A		A=Autonomous, D=DGPS, E=DR (Only present in NMEA version 3.00)
Checksum	*2C		
<CR><LF>			End of message termination

- **GSA—GNSS DOP and Active Satellites**

Note – Fields marked in red apply only to NMEA version 2.3 (and later) in this NMEA message description.

Table 14 contains the values for the following example:

$GPGSA, A, 3, 07, 02, 26, 27, 09, 04, 15, , , , , , 1.8, 1.0, 1.5*33

Table 14. GSA Data Format

Name	Example	Units	Description
Message ID	$GPGSA		GSA protocol header
Mode 1	A		See Table 14
Mode 2	3		See Table 15
Satellite Used1	07		SV on Channel 1
Satellite Used1	02		SV on Channel 2
....			…
Satellite Used1			SV on Channel 12
PDOP	1.8		Position Dilution of Precision
HDOP	1.0		Horizontal Dilution of Precision
VDOP	1.5		Vertical Dilution of Precision
Checksum	*33		
<CR><LF>			End of message termination

Table 15. Mode 2

Value	Description
1	Fix Not Available
2	2D (< 4 SV's used)
3	3D (> 3 SV's used)

- **GSV—GNSS Satellites in View**

Table 16 contains the values for the following example:

```
$GPGSV, 2, 1, 07, 07, 79, 048, 42, 02, 51, 062, 43, 26, 36, 256, 42, 27, 27, 138, 42*71
$GPGSV, 2, 2, 07, 09, 23, 313, 42, 04, 19, 159, 41, 15, 12, 041, 42*41
```

Table 16. GSV Data Format

Name	Example	Units	Description
Message ID	$GPGSV		GSV protocol header
Number of Messages1	2		Range 1 to 3
Message Number1	1		Range 1 to 3
Satellites in View	07		
Satellite ID	07		Channel 1 (Range 1 to 32)
Elevation	79		Channel 1 (Maximum 90)
Azimuth	048		Channel 1 (True, Range 0 to 359)
SNR (C/No)	42		Range 0 to 99, null when not tracking
....			....
Satellite ID	27		Channel 4 (Range 1 to 32)
Elevation	27		Channel 4 (Maximum 90)
Azimuth	138		Channel 4 (True, Range 0 to 359)
SNR (C/No)	42		Range 0 to 99, null when not tracking
Checksum	*71		
<CR><LF>			End of message termination

- **MSS—MSK Receiver Signal**

Note – Fields marked in red apply only to NMEA version 2.3 (and later) in this NMEA message description.

Table 17 contains the values for the following example:

```
$GPMSS,55,27,318.0,100,*66
```

Table 17. MSS Data Format

Name	Example	Units	Description
Message ID	$GPMSS		MSS protocol header
Signal Strength	55	DB	SS of tracked frequency
Signal-to-Noise Ratio	27	DB	SNR of tracked frequency
Beacon Frequency	318.0	KHz	Currently tracked frequency
Beacon Bit Rate	100		Bits per second
Channel Number	1		The channel of the beacon being used if a multi-channel beacon receiver is used
Checksum	*57		
<CR><LF>			End of message termination

Note – The MSS NMEA message can only be polled or scheduled using the MSK NMEA input message. See “MSK—MSK Receiver Interface”.

- **RMC—Recommended Minimum Specific GNSS Data**

Note – Fields marked in red apply only to NMEA version 2.3 (and later) in this NMEA message description.

Table 18 contains the values for the following example:

$GPRMC,161229.487,A,3723.2475,N,12158.3416,W,0.13,309.62,120598,,*10

Table 18. RMC Data Format

Name	Example	Units	Description
Message ID	$GPRMC		RMC protocol header
UTC Time	161229.487		hhmmss.sss
Status1	A		A=data valid or V=data not valid
Latitude	3723.2475		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.3416		dddmm.mmmm
E/W Indicator	W		E=east or W=west
Speed Over Ground	0.13	Knots	
Course Over Ground	309.62	Degrees	True
Date	120598		ddmmyy
Magnetic Variation2		Degrees	E=east or W=west
Mode	A		A=Autonomous, D=DGPS, E=DR
Checksum	*10		
<CR><LF>			End of message termination tracking

1. A valid status is derived from the SiRF Binary M.I.D 2 position mode. See the SiRF Binary Reference Manual.
2. Samsung GPS receiver does not support magnetic declination. All “course over ground” data are geodetic WGS84 directions.

- **VTG—Course Over Ground and Ground Speed**

Note – Fields marked in red apply only to NMEA version 2.3 (and later) in this NMEA message description.

Table 19 contains the values for the following example:

$GPVTG,309.62,T, ,M,0.13,N,0.2,K*6E

Table 19. VTG Data Format

Name	Example	Units	Description
Message ID	$GPVTG		VTG protocol header
Course	309.62	Degrees	Measured heading
Reference	T		True
Course		Degrees	Measured heading
Reference	M		Magnetic
Speed	0.13	Knots	Measured horizontal speed
Units	N		Knots
Speed	0.2	Km/hr	Measured horizontal speed
Units	K		Kilometers per hour
Mode	A		A=Autonomous, D=DGPS, E=DR
Checksum	*6E		
<CR> <LF>			End of message termination tracking

Samsung GPS receiver does not support magnetic declination. All “course over ground” data are geodetic WGS84 directions.

5.2. Input Messages

NMEA input messages are provided to allow you to control Samsung GPS Receiver while in NMEA protocol mode.

5.2.1. Transport Message

Table 20. Transport message parameters

Start Sequence	Payload	Checksum	End Sequence
$PSRF<MID>	Data	*CKSUM	<CR><LF>

1. Message Identifier consisting of three numeric characters. Input messages begin at MID 100.
2. Message specific data. Refer to a specific message section for <data>...<data> definition.
3. CKSUM is a two-hex character checksum as defined in the NMEA specification. Use of checksums is required on all input messages.
4. Each message is terminated using Carriage Return (CR) Line Feed (LF) which is \r\n which is hex 0D 0A. Because \r\n are not printable ASCII characters, they are omitted from the example strings, but must be sent to terminate the message and cause the receiver to process that input message.

Note – All fields in all proprietary NMEA messages are required, none are optional. All NMEA messages are comma delimited.

5.2.2. NMEA Input Messages

Table 21. NMEA input messages

Message	MID1	Description
SetSerialPort	100	Set PORT A parameters and protocol
NavigationInitialization	101	Parameters required for start using X/Y/Z2
SetDGPSPort	102	Set PORT B parameters for DGPS input
Query/Rate Control	103	Query standard NMEA message and/or set output rate
LLANavigationInitialization	104	Parameters required for start using Lat/Lon/Alt3
Development Data On/Off	105	Development Data messages On/Off
Poll SW version	109	Poll Samsung & SiRF SW version
Start mode	110	set start mode
MSK Receiver Interface	MSK	Command message to a MSK radio-beacon receiver.

1. Message Identification (MID)
2. Input coordinates must be WGS84.

Note – NMEA input messages 100 to 105 are SiRF proprietary NMEA messages. The MSK NMEA string is as defined by the NMEA 0183 standard.

Table 22 provides a summary of supported Samsung & SiRF NMEA input messages by the specific Samsung platforms.

Table 22. Supported NMEA input messages

Message ID	SiRF Software Options			
	GSW2	SiRFXTrac	GSW3	SiRFLoc
100	Yes	Yes	Yes	Yes
101	Yes	Yes	Yes	Yes
102	Yes	No	Yes	No
103	Yes	Yes	Yes	Yes
104	Yes	Yes	Yes	Yes
105	Yes	Yes	Yes	Yes
109	No	Yes	Yes	No

- **100—SetSerialPort**

This command message is used to set the protocol (SiRF Binary or NMEA) and/or the communication parameters (baud, data bits, stop bits, parity). Generally, this command is used to switch the module back to SiRF Binary protocol mode where a more extensive command message set is available. When a valid message is received, the parameters are stored in battery-backed SRAM and then the Evaluation Receiver restarts using the saved parameters.

Table 23 contains the input values for the following example:

```
Switch to SiRF Binary protocol at 9600,8,N,1
$PSRF100,0,9600,8,1,0*0C
```

Table 23. Set Serial Port Data Format

Name	Example	Units	Description
Message ID	$PSRF100		PSRF100 protocol header
Protocol	0		0=SiRF Binary, 1=NMEA
Baud	9600		4800, 9600, 19200, 38400
Data Bits	8		8, 7
Stop Bits	1		0, 1
Parity	0		0=None, 1=Odd, 2=Even
Checksum	*0C		
<CR><LF>			End of message termination

Note – Samsung GPS receiver does not need protocol switching to SiRF binary or NMEA protocol because Samsung GPS receiver outputs NMEA thru UARTA and SiRF binary thru UARTB. Protocol switching is unavailable because the same protocol, either SiRF binary or NMEA, can not exist on both UARTA & UARTB at the same time. So, Use UARTA for NMEA protocol and use UARTB for SiRF binary protocol. But, Other settings such as Baud, data Bits and so on can be achieved by issuing this command.

- **101—NavigationInitialization**

This command is used to initialize the Evaluation Receiver by providing current position (in X, Y, Z coordinates), clock offset, and time. This enables the Evaluation Receiver to search for the correct satellite signals at the correct signal parameters. Correct initialization parameters enable the Evaluation Receiver to acquire signals quickly.

Table 24 contains the input values for the following example:

Start using known position and time.
$PSRF101, -2686700, -4304200, 3851624, 96000, 497260, 921, 12, 3*1C

Table 24. Navigation Initialization Data Format

Name	Example	Units	Description
Message ID	$PSRF101		PSRF101 protocol identifier
ECEF X	-2686700	meters	X coordinate position
ECEF Y	-4304200	meters	Y coordinate position
ECEF Z	3851624	meters	Z coordinate position
ClkOffset	96000	Hz	Clock Offset of the Evaluation Receiver1
TimeOfWeek	497260	seconds	GPS Time Of Week
WeekNo	921		GPS Week Number
ChannelCount	12		Range 1 to 12
ResetCfg	3		See Table 25 and Table 26
Checksum	*1C		
<CR><LF>			End of message termination

1. Use 0 for last several value if available. If this is unavailable, a default value 96,000 will be used.

Table 25. Reset Configuration – Non SiRFLoc Platforms

Hex	Description
0x01	Hot Start— All data valid
0x02	Warm Start—Ephemeris cleared
0x03	Warm Start (with Init)—Ephemeris cleared, initialization data loaded
0x04	Cold Start—Clears all data in memory
0x08	Clear Memory—Clears all data in memory and resets receiver back to factory defaults

Table 26. Reset Configuration – SiRFLoc Specific

Hex	Description
0x00	Perform a hot start using internal RAM data. No initialization data will be used.
0x01	Use initialization data and begin in start mode. Uncertainties are 5 sec time accuracy and 300 km position accuracy. Ephemeris data in SRAM is used.
0x02	No initialization data is used, ephemeris data is cleared, and warm start performed using remaining data in RAM.
0x03	Initialization data is used, ephemeris data is cleared, and warm start performed using remaining data in RAM.
0x04	No initialization data is used. Position, time and ephemeris are cleared and a cold start is performed.
0x08	No initialization data is used. Internal RAM is cleared and a factory reset is performed.

- **102—SetDGPSPort**

This command is used to control the serial port used to receive RTCM differential corrections. Differential receivers may output corrections using different communication parameters. If a DGPS receiver is used which has different communication parameters, use this command to allow the receiver to correctly decode the data. When a valid message is received, the parameters are stored in battery-backed SRAM and then the receiver restarts using the saved parameters.

Table 27 contains the input values for the following example:

Set DGPS Port to be 9600,8,N,1.
$PSRF102, 9600, 8, 1, 0*12

Table 27. Set DGPS Port Data Format

Name	Example	Units	Description
Message ID	$PSRF102		PSRF102 protocol header
Baud	9600		4800, 9600, 19200, 38400
DataBits	8		8,7
StopBits	1		0,1
Parity	0		0=None, 1=Odd, 2=Even
Checksum	*12		
<CR><LF>			End of message termination

- **103—Query/Rate Control**

This command is used to control the output of standard NMEA messages GGA, GLL, GSA, GSV, RMC, and VTG. Using this command message, standard NMEA messages may be polled once, or setup for periodic output. Checksums may also be enabled or disabled depending on the needs of the receiving program. NMEA message settings are saved in battery-backed memory for each entry when the message is accepted.

Table 28 contains the input values for the following examples:

1. Query the GGA message with checksum enabled
   $PSRF103, 00, 01, 00, 01*25

2. Enable VTG message for a 1 Hz constant output with checksum enabled
   $PSRF103, 05, 00, 01, 01*20

3. Disable VTG message
   $PSRF103, 05, 00, 00, 01*21

Table 28. Query/Rate Control Data Format (See example 1)

Name	Example	Units	Description
Message ID	$PSRF103		PSRF103 protocol header
Msg	00		See table 29.
Mode	01		0=SetRate, 1=Query
Rate	00		Output-Off=0, max=255
CksumEnable	01		0=Disable Checksum, 1=Enable Checksum
Checksum	*25		
<CR><LF>			End of message termination

Table 29. Messages

Value	Description
0	GGA
1	GLL
2	GSA
3	GSV
4	RMC

Note – In TricklePower mode, update rate is specified by the user. When you switch to NMEA protocol, message update rate is also required. The resulting update rate is the product of the TricklePower Update rate and the NMEA update rate (i.e., TricklePower update rate = 2 seconds, NMEA update rate = 5 seconds, resulting update rate is every 10 seconds, (2 X 5 = 10)).

- **104—LLANavigationInitialization**

This command is used to initialize Samsung GPS receiver by providing current position (in latitude, longitude, and altitude coordinates), clock offset, and time. This enables the receiver to search for the correct satellite signals at the correct signal parameters. Correct initialization parameters enable the receiver to acquire signals quickly.

Table 30 contains the input values for the following example:

Start using known position and time.

$PSRF104, 37. 3875111, -121. 97232, 0, 96000, 237759, 1946, 12, 1*07

Table 30. LLA Navigation Initialization Data Format

Name	Example	Units	Description
Message ID	$PSRF104		PSRF104 protocol header
Lat	37.3875111	Degrees	Latitude position (Range 90 to –90)
Lon	-121.97232	Degrees	Longitude position (Range 180 to –180)
Alt	0	Meters	Altitude position
ClkOffset	96000	Hz	Clock Offset of the Evaluation Receiver
TimeOfWeek	237759	Seconds	GPS Time Of Week
WeekNo	1946		Extended GPS Week Number (1024 added)
ChannelCount	12		Range 1 to 12
ResetCfg	1		See Table 31
Checksum	*07		
<CR><LF>			End of message termination

Table 31. LLA Navigation Initialization Data Format

Hex	Description
0x01	Hot Start— All data valid
0x02	Warm Start—Ephemeris cleared
0x03	Warm Start (with Init)—Ephemeris cleared, initialization data loaded
0x04	Cold Start—Clears all data in memory
0x08	Clear Memory—Clears all data in memory and resets receiver back to factory defaults

- **105—Development Data On/Off**

Use this command to enable development data information if you are having trouble getting commands accepted. Invalid commands generate debug information that enables the user to determine the source of the command rejection. Common reasons for input command rejection are invalid checksum or parameter out of specified range.

Table 32 contains the input values for the following examples:

1. Debug On
   $PSRF105, 1*3e

2. Debug Off
   $PSRF105, 0*3e

Table 32. Development Data On/Off Data Format

Name	Example	Units	Description
Message ID	$PSRF105		PSRF105 protocol header
Debug	1		0=Off, 1=On
Checksum	*3e		
<CR><LF>			End of message termination

- **109—PollSWVersion (Samsung Specific NMEA command)**

Use this command to poll sw version. Before issuing PollSWVersion, Debug On mode should be activated by issuing $PSRF105,1*3E first. Then, this command will make Samsung GPS receiver to return its SW version.

Table 33 contains the input values for the following examples:

Poll Sw version
$PSRF109*2f

Table 33. PollSWVersion Data Format

Name	Example	Units	Description
Message ID	$PSRF109		PSRF109 protocol header
Checksum	*2f		
<CR><LF>			End of message termination

- **110—SetStartMode (Samsung Specific NMEA command)**

This command is used to set the start mode of Samsung GPS receiver. The used can set the start mode of the receiver to one of Hot / Warm / Cold / Factory start.

Table 34 contains the input values for the following examples:

1. Set to Hot start mode
   $PSRF110, 1*3a

2. Set to Warm start mode
   $PSRF110, 2*39

3. Set to Warm start mode with initialization data loaded
   $PSRF110, 3*38

4. Set to Cold start mode
   $PSRF110, 4*3f

5. Set to Factory start mode
   $PSRF110, 8*33

Table 34. SetStartMode Data Format

Name	Example	Units	Description
Message ID	$PSRF110		PSRF104 protocol header
StartMode	1		StartMode (1, 2, 3, 4, 8)
Checksum	*3a		
<CR><LF>			End of message termination

Table 35. Reset Configuration

Hex	Description
0x01	Hot Start— All data valid
0x02	Warm Start—Ephemeris cleared
0x03	Warm Start (with Init)—Ephemeris cleared, initialization data loaded
0x04	Cold Start—Clears all data in memory
0x08	Clear Memory—Clears all data in memory and resets receiver back to factory defaults

- **MSK—MSK Receiver Interface**

Table 36 contains the values for the following example:
$GPMSK,318.0,A,100,M,2,*45

Table 36. MSK Data Format

Name	Example	Units	Description
Message ID	$GPMSK		MSK protocol header
Beacon Frequency	318.0	KHz	Frequency to use
Auto/Manual Frequency	A		A : Auto, M : Manual
Beacon Bit Rate	100		Bits per second
Auto/Manual Bit Rate	M		A : Auto, M : Manual
Interval for Sending $--MSS2	2	sec	Sending of MSS messages for status

1. If Auto is specified the previous field value is ignored.
2. When status data is not to be transmitted this field is null.

Note – The NMEA messages supported by the Evaluation Receiver does not provide the ability to change the DGPS source. If you need to change the DGPS source to internal beacon, then this must be done using the SiRF binary protocol and then switched to NMEA.

6. Testing

This section describes environmental requirements and test condition of SGEM.

6.1 Test condition

Test can be performed in the following order (5.2 - 5.3)
If there are no special requirements, test conditions below will be applied.

- Voltage 3.0 ~ 3.3 VDC
- 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

6.2.3 Field trial test, Hot Environment

- Temperature: +70°C

6.3 Reliability TEST

Table 37. Reliability Test

Performance	Characteristic	Unit	Target value	USL	LSL	Management Cpk	Performance
Cold Start	Time that take to Fix after Cold Start	Sec	55	75		1.5	**Cold Start**
Hot Start	Time that take to Fix after Hot Start	Sec	10	10		1.5	**Hot Start**
SN	RF performance confirmation	dB/ Hz	38	40	36	1.5	**SN**

7. SGEM Connector configuration

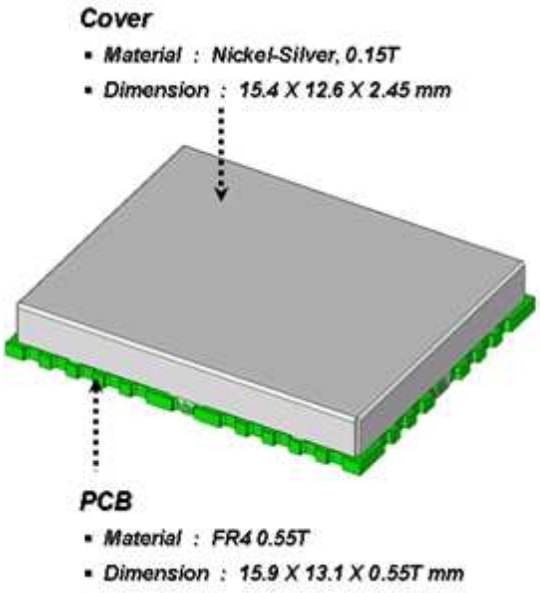
Pin no	Name	Description
1	ANT	GPS RF input, 1575.42MHz, 50ohm,2.85V active antenna Bias output
2	AGND	Analog system ground
3	AGND	Analog system ground
4	AGND	Analog system ground
5	VDD_RTC	BBSRAM Power, Input voltage Typ. 3.0V A reasonably safe value would be ripple of <20mVpp from DC to 3 MHz.
6	GND	Analog system ground (Chassis GND)
7	BOOTSEL	This pin is for program download. This pin should be High when the program is downloaded. If the B/S is High then the module will boot from the serial port. and If the B/S is Low then the module will begin execution from the on-board FLASH. Please set Low during operating Mode
8	AGND	Analog system ground
9	AGND	Analog system ground
10	AGND	Analog system ground
11	VCC	GPS main Supply. Input voltage Typ. 3.3V(3.0V<VCC_GPS<3.5V). A reasonably safe value would be ripple of <50mVpp from DC to 3 MHz.
12	AGND	Analog system ground
13	RESET	On module include power of reset. This pin is not available(NC).
14	AGND	Analog system ground
15	GND	Analog system ground (Chassis GND)
16	ECLK	Pull-up via 4.7K to 10K.(Conventional Autonomous mode) CMOS signal, non-steered during clock correction. ±0.1ppm or less (during correction) 19.2MHz
17	AGND	Analog system ground
18	GPIO	General Purpose Input Output
19	AGND	Analog system ground
20	1PPS	1 Pulse Per Second
21	AGND	Analog system ground
22	AGND	Analog system ground
23	AGND	Analog system ground
24	GND	Analog system ground (Chassis GND)
25	TIMESYNC	Pull-down via 4.7K to 10K.(Conventional Autonomous mode) A timing pulse is triggered on the rising edge – minimum 100 ns wide, maximum ~1 ms.
26	AGND	Analog system ground
27	WAKE_UP	This Pin is not available now. Pull-down via 4.7K to 10K.
28	AGND	Analog system ground
29	AGND	Analog system ground
30	TXA	Serial Port From GPS To Host. 2.85V CMOS Level
31	RXA	Serial Port From Host To GPS. CMOS Level
32	RXB	Auxiliary Serial UART interface, unused (only debugging)
33	GND	Analog system ground (Chassis GND)
34	TXB	Auxiliary Serial UART interface, unused (only debugging)
35	AGND	Analog system ground
36	AGND	Analog system ground

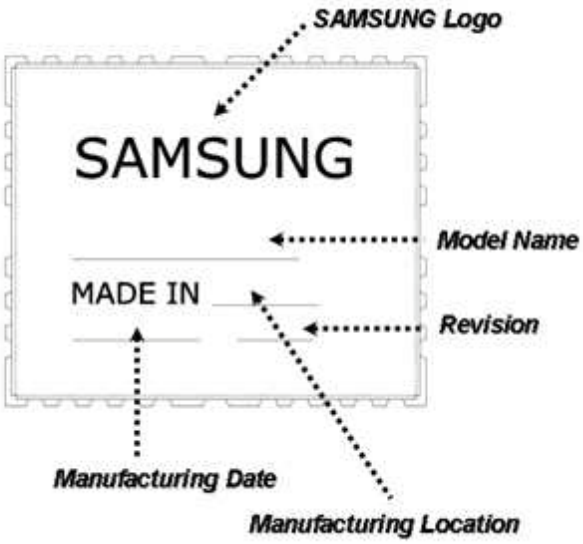
Appendix A. Marking & Lot No.

SAMSUNG ①											
G	P	D	1	4	B	0	2	-	0	0	7
②	③	④	⑤	⑥	⑦	⑧	⑨		⑩	⑪	⑫
MADE IN THAILAND											
⑬											
00		00		00		A	A	A	A		
ⓐ		ⓑ		ⓒ		ⓓ	ⓔ	ⓕ	ⓖ		

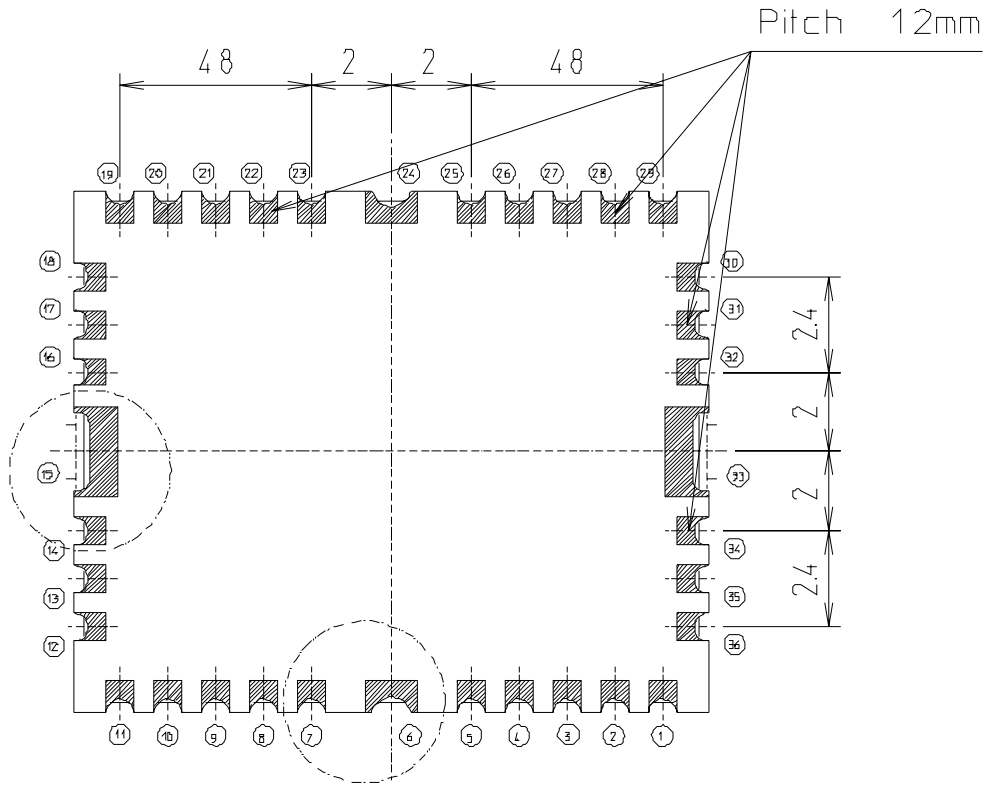
Table 38. Lot number

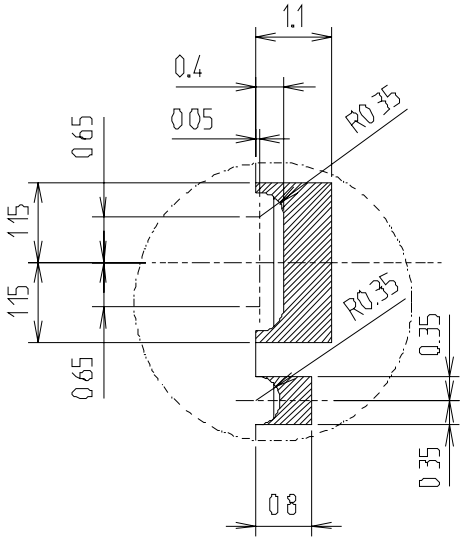
No	Content	Index	Content
1	Manufacturer	A	Year of manufacturing (Year 20XX)
2, 3, 4	Product type (GPD : Multimode GPS engine module)	B	Month of manufacturing (Month 00)
5, 6	Shield cover size, shape	C	Date of manufacturing (Data 00)
7	Chipset	D	Manufacturing line
8, 9	Customer	E	Drawing version
10, 11, 12	S/W version	F	Drawing version
13	Manufacturing site	G	Manufacturing spec revision

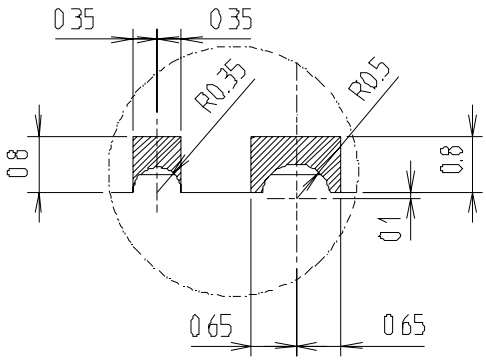




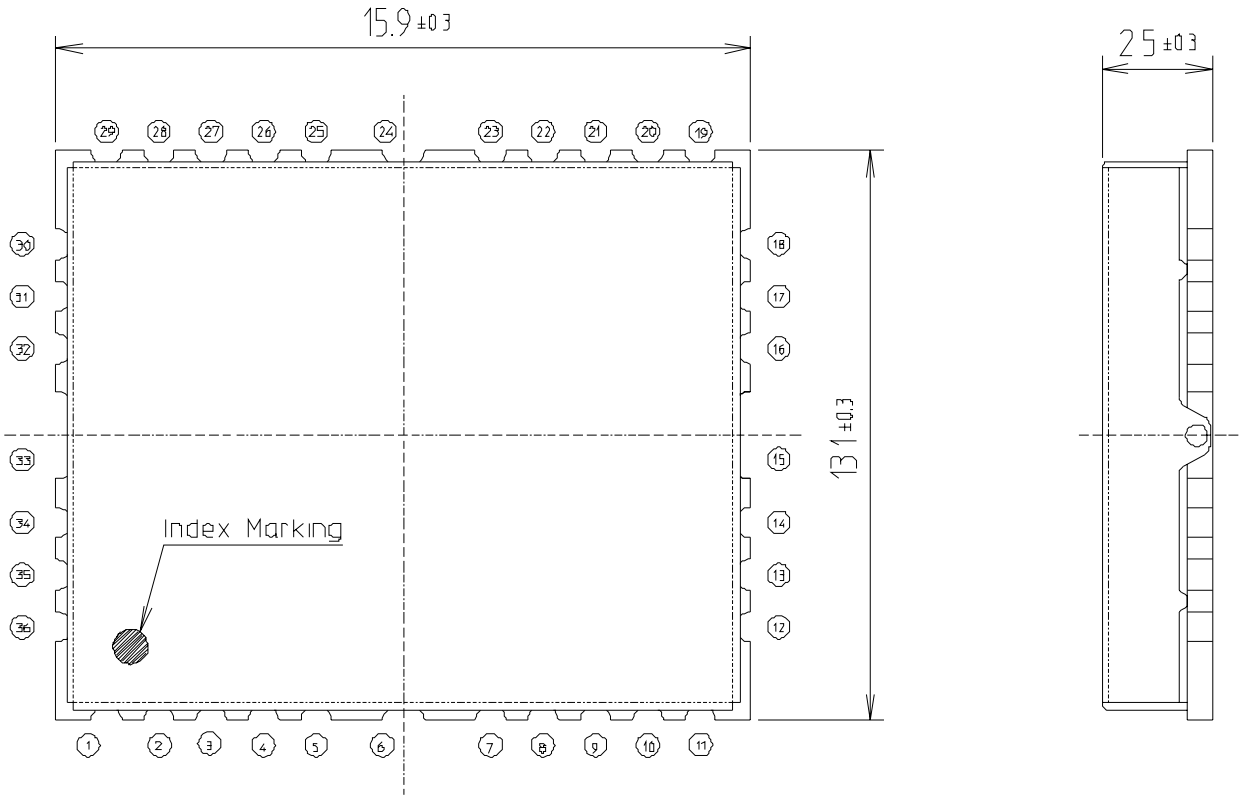
Appendix B. Outline drawing

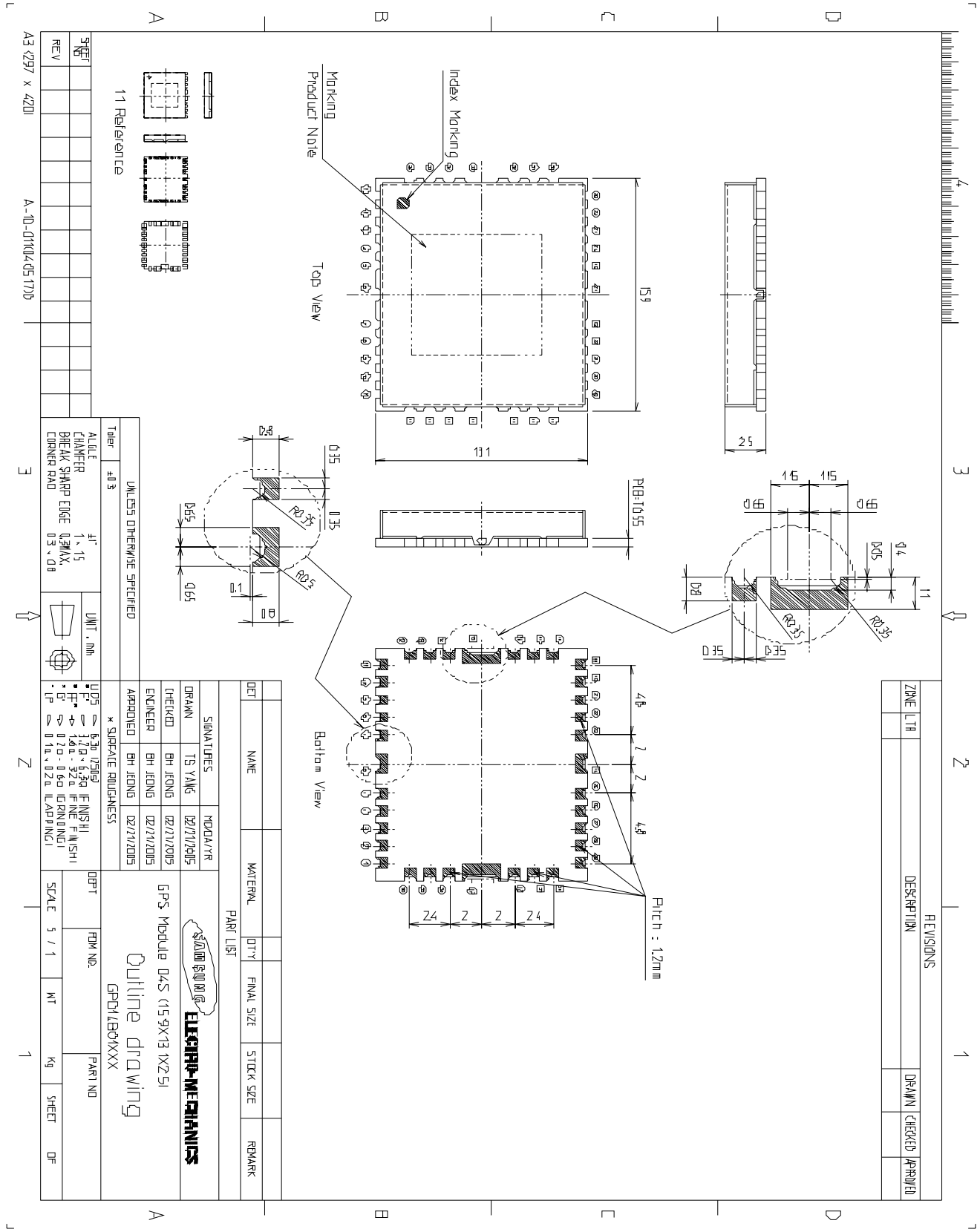






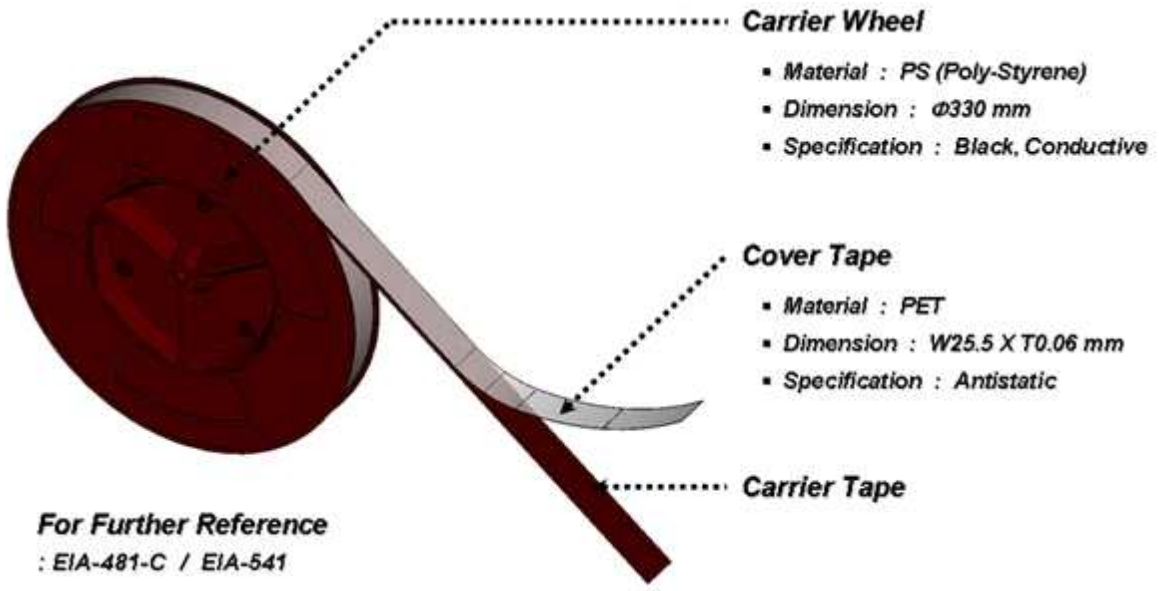
※ General tolerances = ±0.2
Unit : mm


15.9 ±0.3
25 ±0.3
13.1 ±0.3
Index Marking

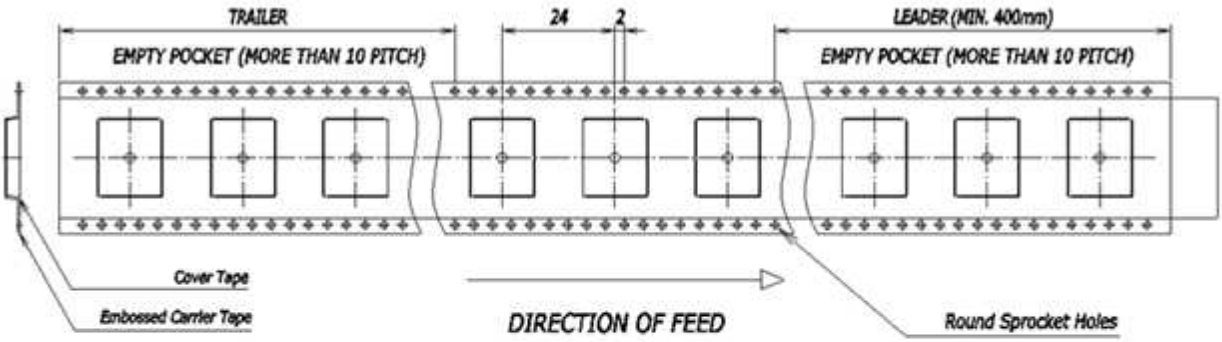

Top View
Bottom View
Index Marking
Product Note
Marking
11 Reference
Pitch : 1.2mm
GPS Module 045 (15.9X13.1X2.5)
Outline drawing
GPS1ZB0*XXX
SAMSUNG ELECTRO-MECHANICS
UNLESS OTHERWISE SPECIFIED
UNIT : mm
REVISIONS
DESCRIPTION
DRAWN
CHECKED
APPROVED
PART LIST
NAME
MATERIAL
QTY
FINAL SIZE
STOCK SIZE
REMARK
SIGNATURES
DRAWN
CHECKED
ENGINEER
APPROVED
TS YANG
BH JEONG
BH JEONG
BH JEONG
MODIA/YR
02/21/2005
02/21/2005
02/21/2005
02/21/2005
SCALE 5 / 1
WT Kg
SHEET OF
DEPT
PART NO.
A3 (297 x 420)
A-1D-011104051710

Appendix C. Package Specifications

Appendix C-1. *Part Lists of Carrier Packing*

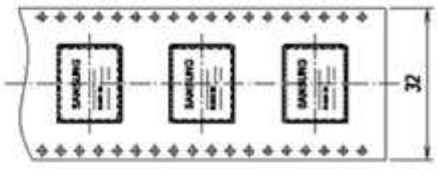


Appendix C-2. *Carrier Tape Packing*

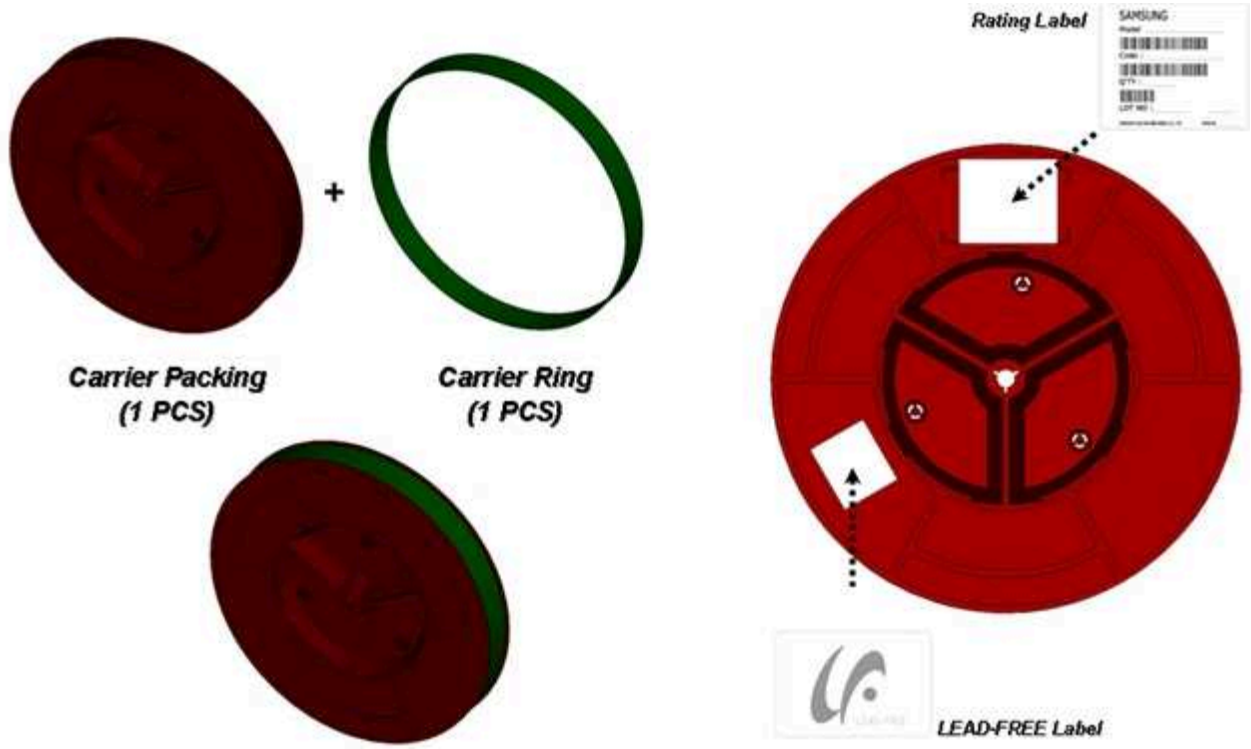


Carrier Tape

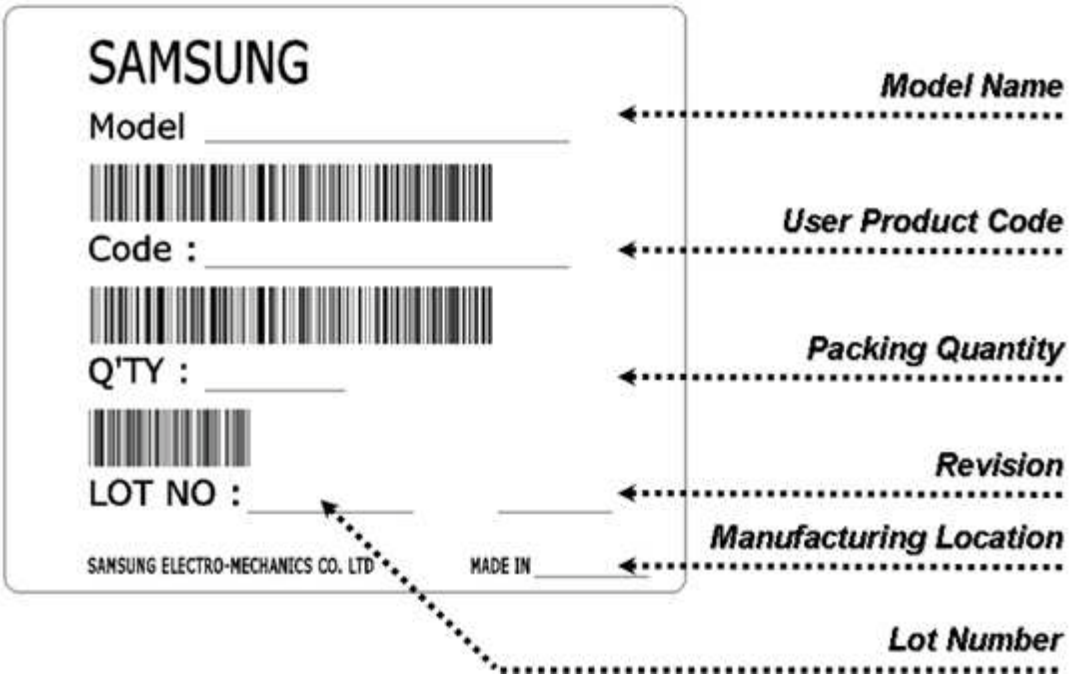
- Material : PS (Poly-Styrene)
- Dimension : W32 X T0.3 mm
- Specification : Black, Conductive
- Q'TY : MAX. 500 Modules / 1 Carrier Wheel



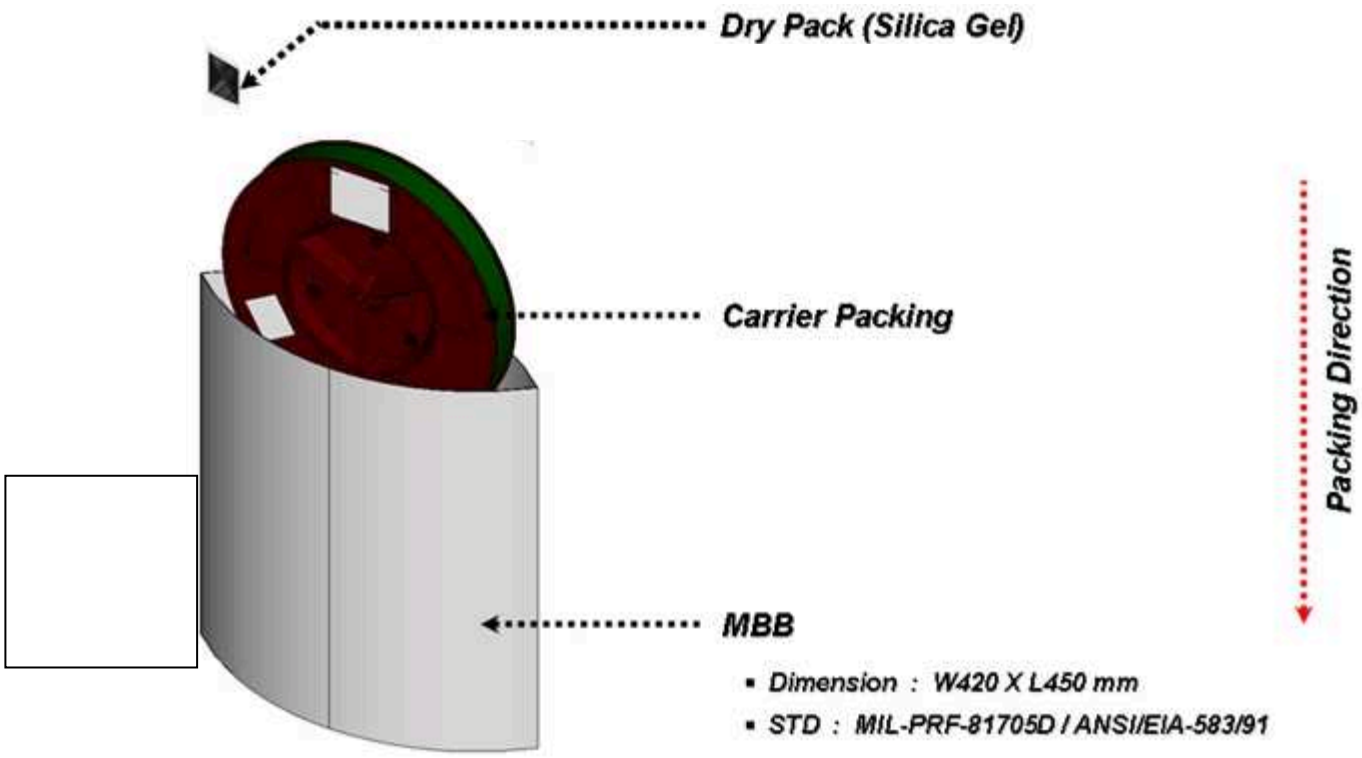
Appendix C-3. *Carrier Packing and Label Attachment*

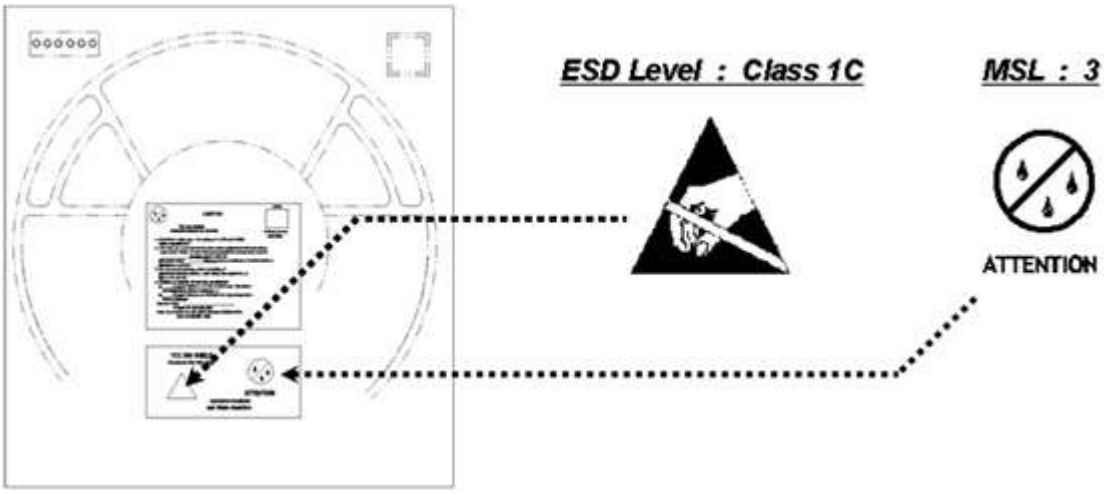


Appendix C-4. *Description of Rating Label (70mm X 60mm)*

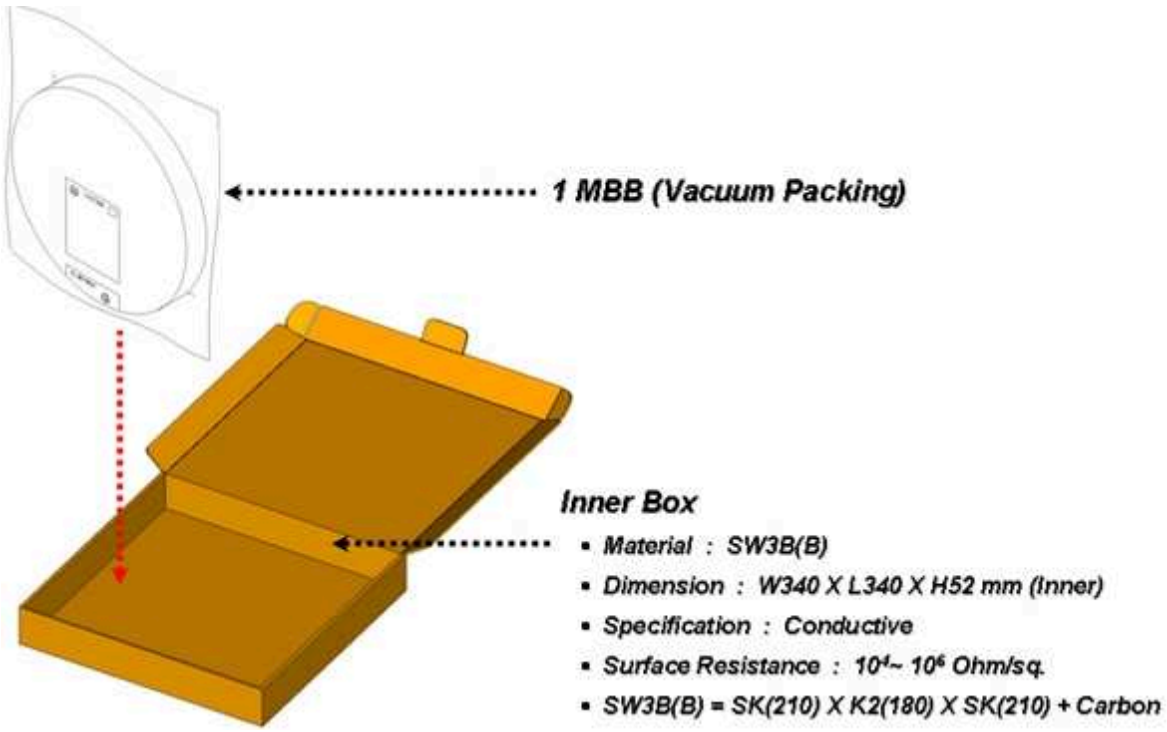


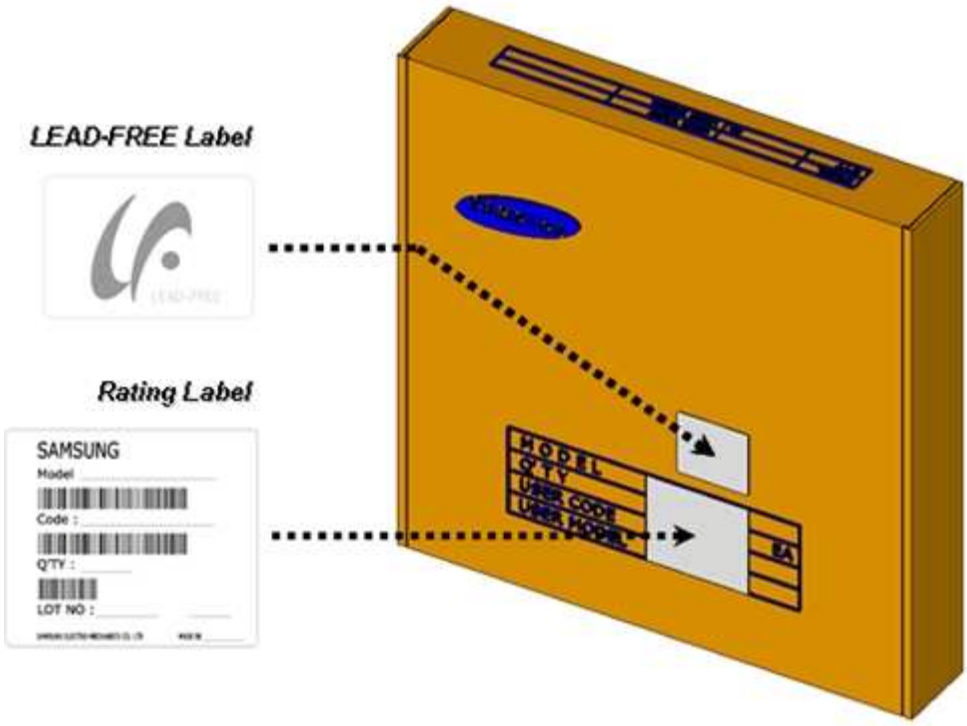
Appendix C-5. MBB Packing



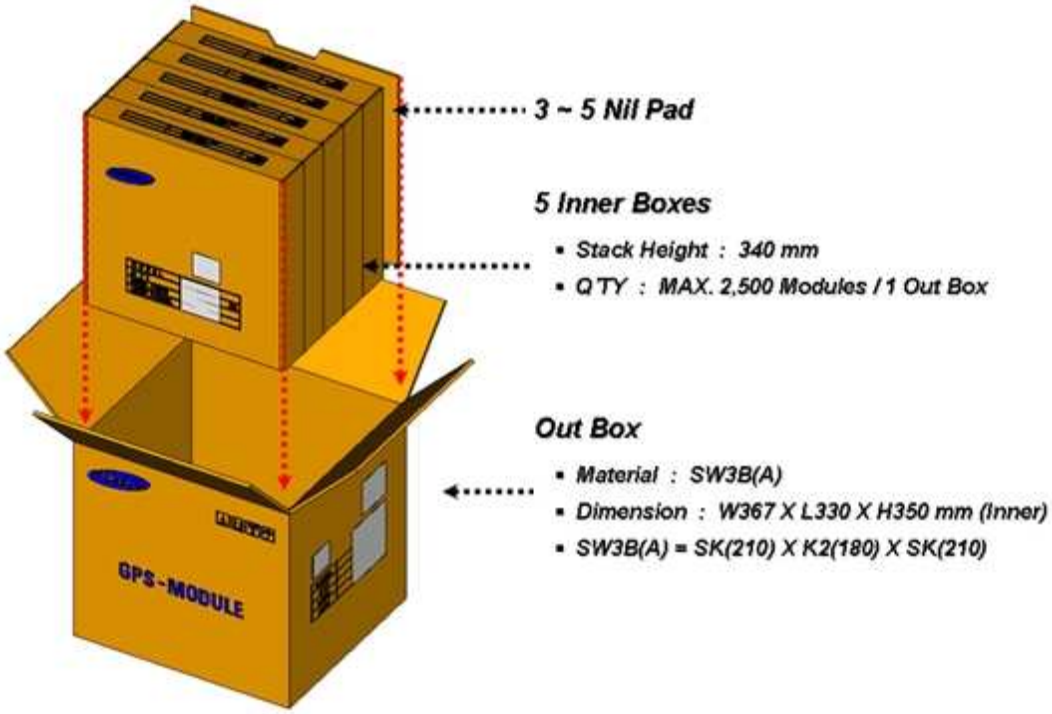


Appendix C-6. *Inner Box Packing*

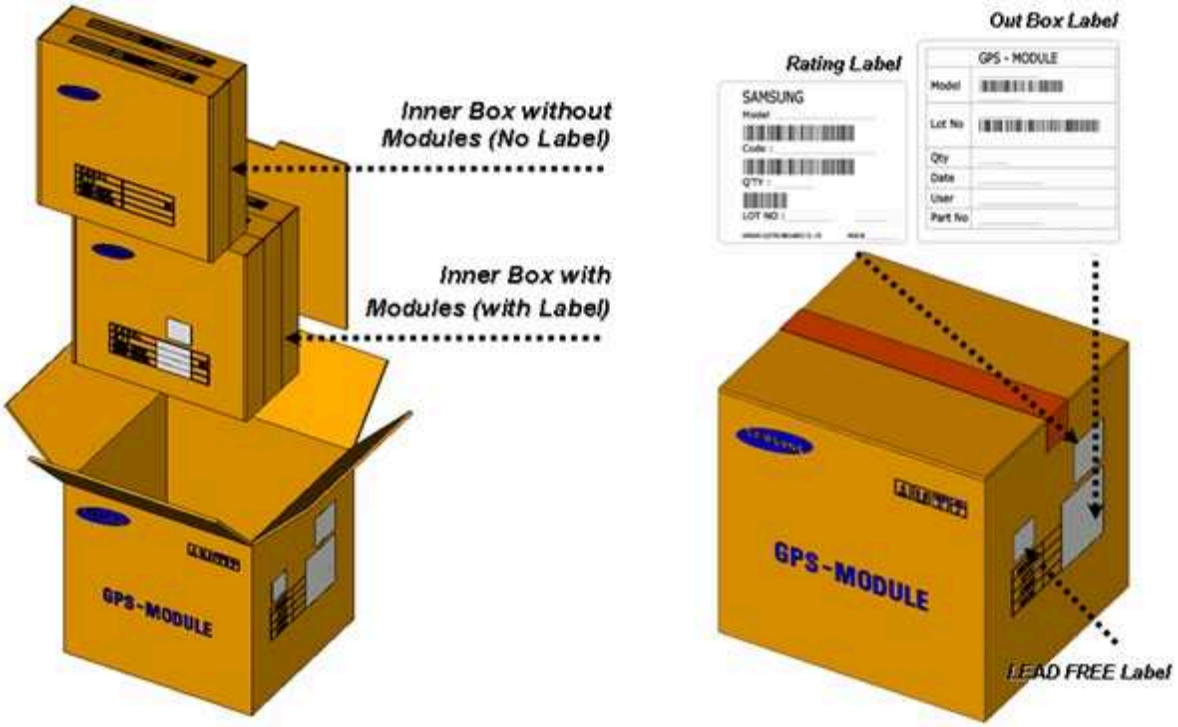




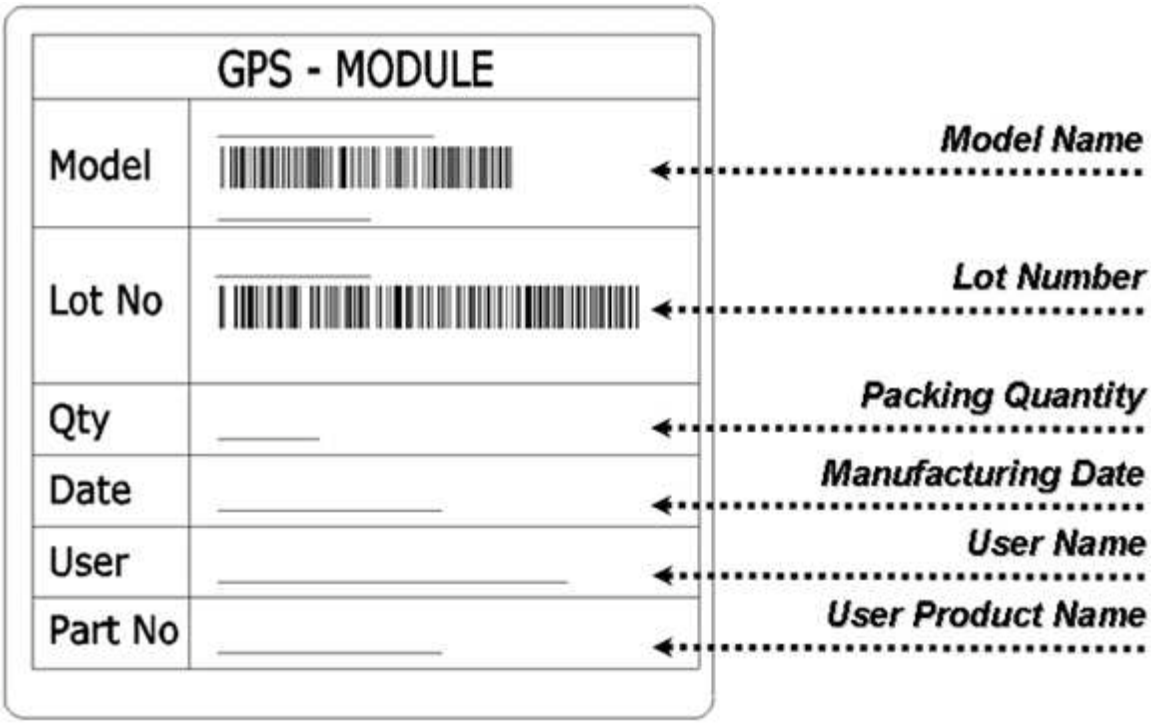
Appendix C-7. *Out Box Packing*



- Non-fully packing



Appendix C-8. *Description of Out Box Label (100mm X 100mm)*



Appendix D. SEMCO Profile