KNCTEK GPS/GLONASS Module

SGL-1612 Specification

Version 1.4
2016/01/15

KNCTEK Company LTD.

14F-14, Byucksan Digital Valley 5th, 60-73,
Gasan-dong, Geumcheon-gu
SEOUL, KOREA
TEL: 82-2-839-5701
FAX: 82-2-830-5703
E-Mail: knc3@knctek.co.kr
http://www.knctek.co.kr

SGL-1612 Specification

Revision History

1. 2014-06-02 : Initiated Version 1.0.
2. 2015-02-23 : Updated Version 1.1 for Modified Hardware Interface on page 9 and Definition of Pin Assignment on page 10 about change from NC to VCC_RF of Pin 9 configuration.
3. 2015-05-26 : Updated Version 1.2 for Modified max Operating Temperate Ratings of Technical Specification on page 6 about change from 85 ℃ to 70 ℃.
4. 2015-07-06 : Updated Version 1.3 for Modified max Operating Temperate Ratings of Technical Specification on page 6 about change from 70 ℃ to 85 ℃.
5. 2016-01-15 : Updated Version 1.4 for Specification renewal.

SGL-1612 Operational Manual

INTRODUCTION

The **SGL-1612** is the newest generation of KNCTEK GPS/GLONASS Module. The GPS/GLONASS Module is powered by SkyTraq technology and KNCTEK proprietary navigation algorithm that providing you more stable navigation data. The miniature design is the best choice to be embedded in a portable device like various Trackers, various Vehicle & personal Locaters & Trackers and etc. The excellent sensitivity of **SGL-1612** gets the great performance when going though the urban canyon and foliage environmental condition.

PRODUCT FEATURES

- ✧ GPS, GLONASS, QZSS, SBAS(WAAS, MSAS, EGNOS, GAGAN) supported
- ✧ Total 167 channels: 139 Channels for Acquisition, 28 Channels for Tracking
- ✧ Operable from 3.3V/Typ 41mA for Acquisition and 36mA for Tracking Mode
- ✧ Signal Detection better than -165dBm in Ultra High Tracking Sensitivity
- ✧ Enhanced Cold Acquisition Sensitivity at -148dBm and Reacquisition at -160dBm
- ✧ Fast TTFF <28 seconds in Warm start and 29 seconds for Cold start
- ✧ 4 second TTFF with AGPS
- ✧ Advanced Multipath detection and suppression
- ✧ Jamming detection and mitigation
- ✧ SAEE(Self-aided ephemeris estimation) Supported
- ✧ Excellent Sensitive for Urban Canyon and Foliage Environmental condition
- ✧ NMEA-0183 compliant protocol
- ✧ Automotive-grade Quality GPS solution
- ✧ Small form factor (16X12.2X2.4mm)
- ✧ ODM/OEM development is fully supported Application Engineering
- ✧ RoHS compliant

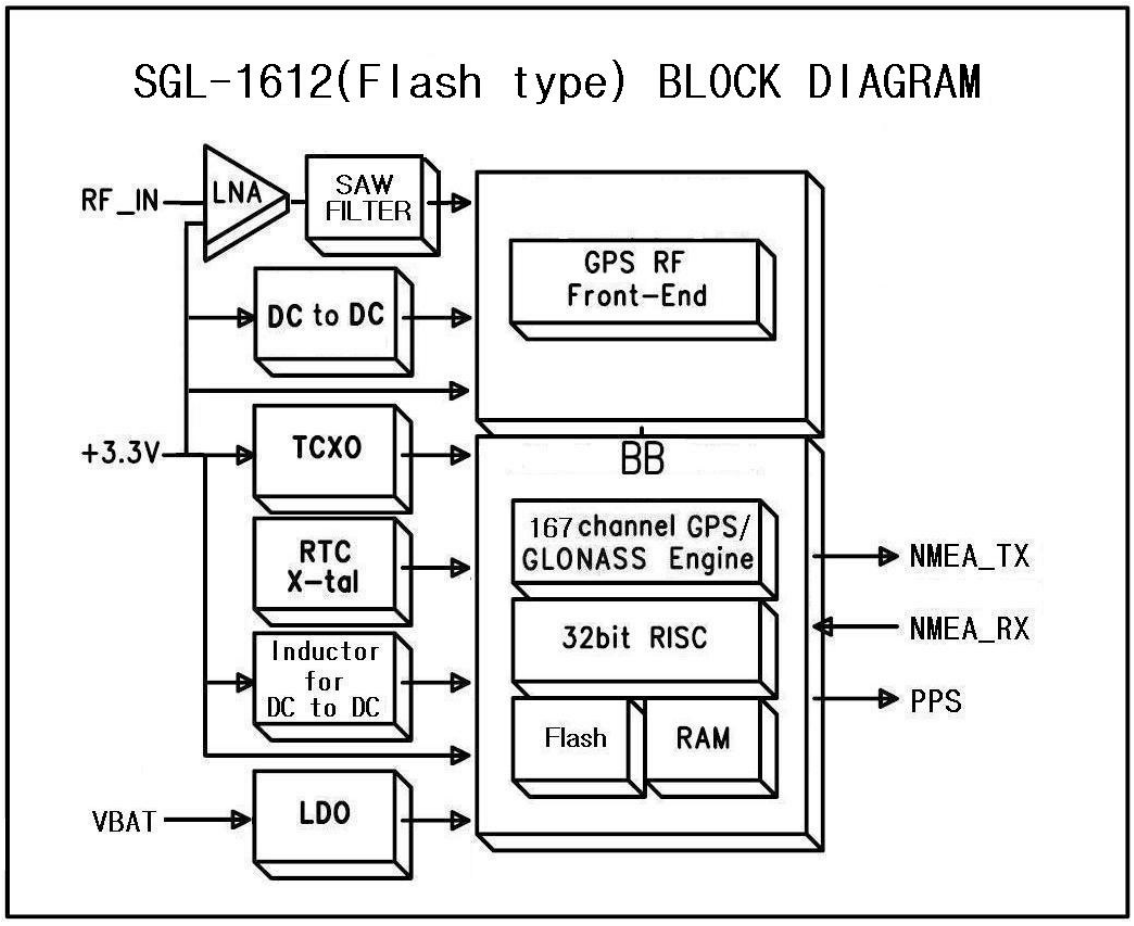
PRODUCT APPLICATION

- ✧ Automotive applications
- ✧ Speed camera detector and Data logger
- ✧ Personal and Car Navigation Devices
- ✧ Marine navigation
- ✧ Timing application and the others

PRODUCT PICTURE

SGL-1612 SYSTEM BLOCK DIAGRAM

The SGL-1612 consists of SkyTraq chipsets Technology, KNCTEK LNA and proprietary software. The system is described as follows.



TECHNICAL SPECIFICATION

1. Electrical Characteristics

1.1 Absolute Maximum Rating

Parameter	Symbol	Min	Max	Units
Power Supply				
Power Supply Volt.	VCC	-0.3	3.6	V
Input Pins				
Input Pin Voltage I/O	RX	-0.3	3.6	V
Backup Battery	Vbat	1.8	3.6	V
Environment				
Operating Temperature	Topr	-30	85	℃
Storage Temperature	Tstg	-40	85	℃
Peak Reflow Soldering Temperature < 10S	Tpeak		260	℃
Humidity			95	%

Note : Absolute maximum ratings are stress ratings only, and functional operation at the maximums is not guaranteed. Stress beyond the limits specified in this table may affect device reliability or cause permanent damage to the device.

For functional operating conditions, please refer to the operating conditions tables as follow.

1.2 Operating Condition

Parameter	Symbol	Condition	Min	Typ	Max	Units
Power supply voltage	Vcc		3.0	3.3	3.6	V
Power Supply voltage ripple	Vcc_PP	Vcc = 3.3V			50	mV
Acquisition current	IccA	Vcc = 3.3V		41		mA
Tracking current	IccT	Vcc = 3.3V		36		mA
Input high voltage	V_{IH}		2.0			V
Input low voltage	V_{IL}				0.8	V
Output high voltage	V_{OH}		2.4			V
Output low voltage	V_{OL}				0.4	V

2. General & Performance Specification

Parameter	Specification		
Receiver Type	GPS/GLONASS, 139 Channel Acquisition, 28 Channel Tracking		
Sensitivity	Tracking	-165dBm	
	Re-acquisition	-160dBm	
	Cold Start	-148dBm	
Accuracy	Position	2.5m CEP	
	Velocity	0.1m/s	
	Timing(PPS)	10ns RMS	
Acquisition Time	Cold Start	29 sec. typical (Open sky[1])	
	Warm Start	28 sec. typical (Open sky)	
	Hot Start	1 sec. typical (Open sky)	
	Reacquisition Time	1 sec(Open sky, re-appear after some seconds)	
	AGPS Support	4 sec. avg	
	SAEE Support	Self-aided ephemeris estimation : 15 sec. avg	
Power Consumption	Tracking	36mA @ 3.3V	
	Acquisition	41mA	
	Back-up	9uA @ 3V	
Navigation Data Update Rate	1Hz_Default	In case of using Binary input : Max 20Hz	
	** Please refer to the Binary Input Message		
Operational Limits	Velocity	Max 515 m/s	
	Altitude	Max 18,000m	
	Acceleration	Less than 4g(39.2m/sec^2)	
Mechanical data	Dimension	16.0 X 12.2 X 2.4mm (+/- 0.3mm)	
	Weight	1.0grams ±5%	
Protocol	NMEA-0183 V3.01	GNGGA	1Hz
		GNGLL	1Hz
		GNGSA	1Hz
		GPGSV	1/3Hz(one time per 3sec)
		GLGSV	1/3Hz
		GNRMC	1Hz
		GNVTG	1Hz
		GNZDA	1Hz

** [1]Open Sky means no obstructions in the sky

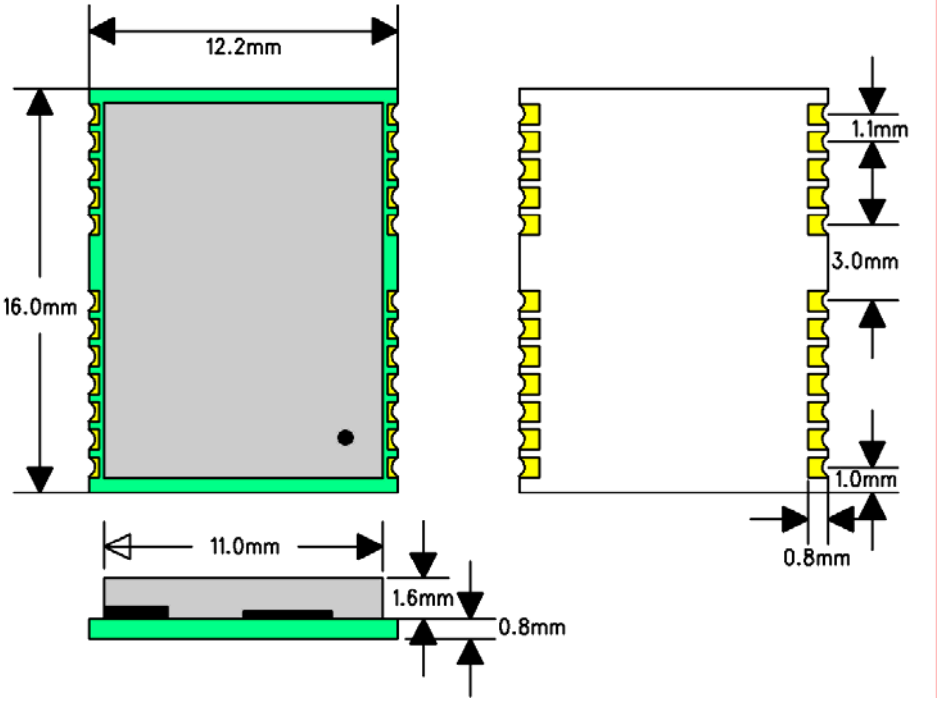
RECOMMENDED GPS/GLONASS ACTIVE EXTERNAL ANTENNA

It's recommended to use a GPS/GLONASS active external antenna with supply voltage of 3.3VDC and a current draw of 15mA maximum. The quality of the GPS/GLONASS active external antenna chosen is of paramount importance for the overall sensitivity of the GPS/GLONASS system. A GPS/GLONASS active external antenna should have a typical gain 20dB and a noise figure ≤ 1.5dB, which applies to more than 90% of the antennas available in the market.

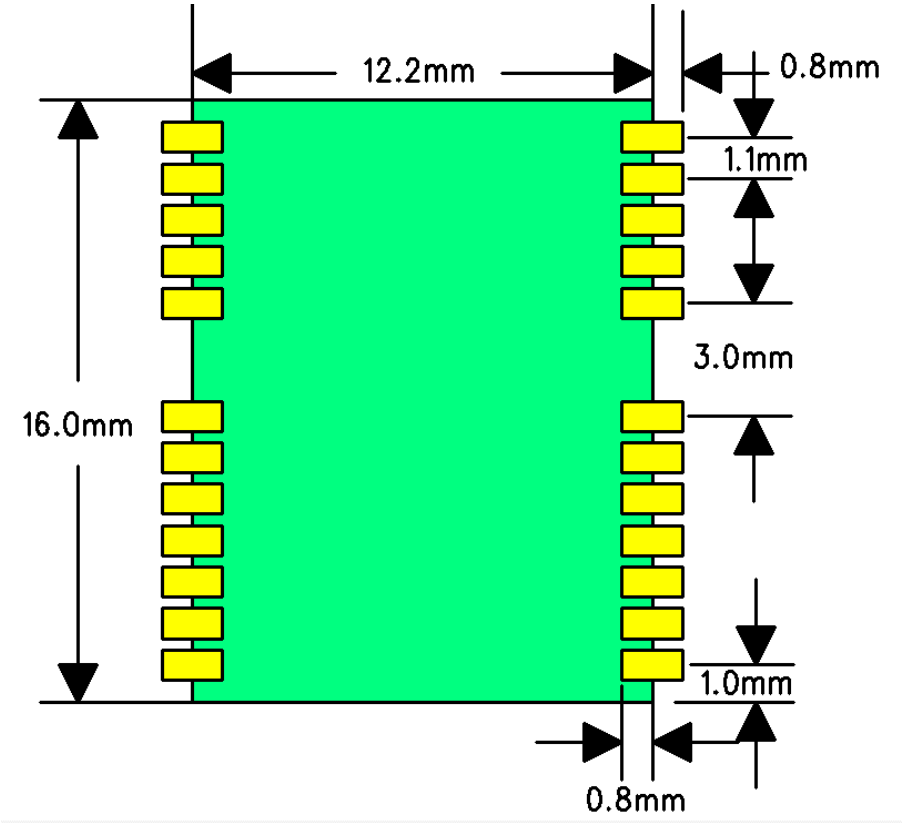
3.3V GPS/GLONASS Active External Antenna Specification

Characteristics	Specification
Center Frequency	GPS : 1575.42±1.023MHz, GLONASS : 1602±4MHz
Band Width(-10dB return loss)	10MHz @ each Band
Gain at Zenith	5.0dBi Typical
VSWR	2.0 : 1 Max
Polarization	R.H.C.P
Axial Ratio	3.0dB max
Gain	Typical 25dB (minimum 20dB)
Noise Figure	Less than 1.5dB
Out Band Attenuation	20dB min for ±50MHz
Voltage	3.3 ± 10%VDC or 3.0 ~ 3.6 VDC
Current	< 15 mA

MECHANICAL PIN LAYOUT

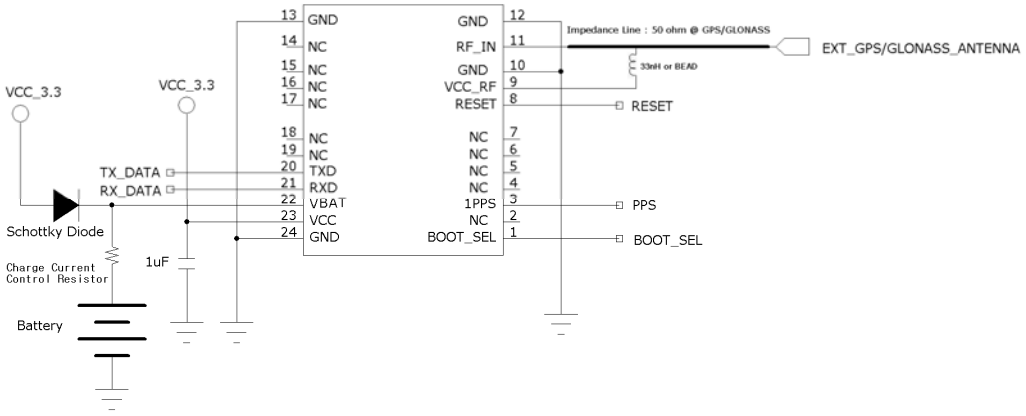


RECOMMENDED LAND PATTERN DIMENSION

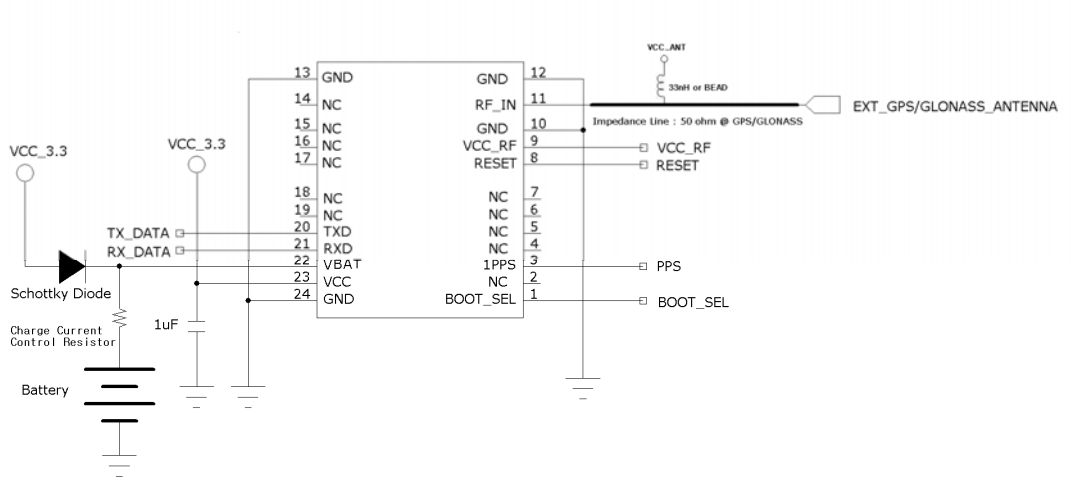


HARDWARE INTERFACE

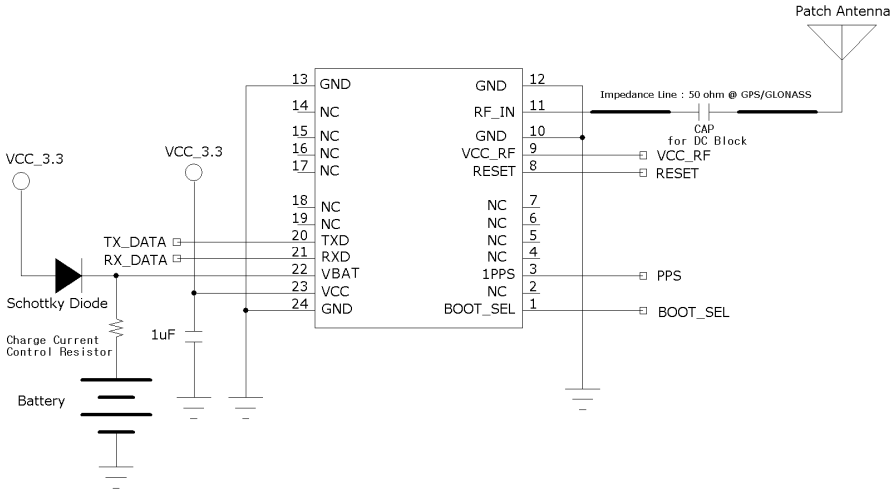
1. Example 1 for GPS/GLONASS External Active Antenna



2. Example 2 for GPS/GLONASS External Active Antenna



3. Example 1 for GPS/GLONASS Patch Antenna



DEFINITION OF PIN ASSIGNDMENT

PIN	SIGNAL NAME	I/O	DESCRIPTION	CHARACTER
1	BOOT_SEL	I	BOOT MODE SELECTION, Not connection for normal use	
2	NC	-	Not connecting	
3	1PPS	O	1 Pulse per Second	If the position is fixed, the output is ok
4	NC	-	Not connecting	
5	NC	-	Not connecting	
6	NC	-	Not connecting	
7	NC	-	Not connecting	
8	RESET	I	RESET(Active LOW)	Active LOW
9	VCC_RF	O	Voltage output of VCC_RF	Output voltage for Active Antenna
10	GND	GND	Ground	
11	RF_IN	I	GPS/GLONASS SIGNAL INPUT	50Ω Impedance Line @ GPS/GLONASS
12	GND	GND	Ground	
13	GND	GND	Ground	
14	NC	-	Not connecting	
15	NC	-	Not connecting	
16	NC	-	Not connecting	
17	NC	-	Not connecting	
18	NC	-	Not connecting	
19	NC	-	Not connecting	
20	TXD	O	UART TX	NMEA_TX : UART output, 3.3V LVTTL
21	RXD	I	UART RXA	NMEA_RX : UART input,3.3V LVTTL
22	VBAT	I	Backup Battery supply, must not be unconnected	DC +1.8V ~ +3.3V
23	VDD	I	DC Power Supply Voltage input	DC +3.3V ±10%
24	GND	GND	Ground	

BOOT_SEL

This is selection for uploading firmware into empty or corrupted Flash memory from ROM mode.

No connection for normal use.

1PPS

This pin is 1 pulse per second time-mark output and active after position fix. This goes high for about 4msec and 3.3V LVTTL.

1PPS pin must not be pulled-high during power on reset, or it'll enter into debug mode and freeze.

RESET

This is the function to restart the system, If the pin is lied to low. Leave unconnected if not used.

VCC_RF

This is pin for supplying voltage of external GPS/GLONASS Active Antenna. This voltage is the same as RF section.

RF_IN

The Module supports passive & active antennas. The line on the PCB from the antenna(or antenna connector)has to be a controlled line (Micro strip at 50Ω @ GPS/GLONASS signal). The input provides also a bias supply(+3.3V typ.).

TX0

NMEA_TX, UART output, 3.3V LVTTL logic level. This is the main transmit channel and is used to output navigation. The default setup is NMEA Output, 9600bps, 8 data bits, no parity, 1 stop bit. The default sentences are GNGGA, GNGLL, GNGSA, GPGSV, GLGSV, GNRMC, GNVTG, GNZDA.

GNGGA, GNGLL, GNGSA, GNRMC, GNVTG, GNZDA are once per second and GPGSV, GLGSV is once per 3 second.

RX0

NMEA_RX, UART input,3.3V LVTTL logic level. This is the main receiving channel.

This is the main receiving channel and is used to receive software commands to the Engine board from user written software.

VBAT

This is the battery backup supply that powers the SRAM and RTC when main power is removed. The input voltage level is from 2.5V ~ 3.6V. Without an external backup battery or on board battery, engine board will execute a cold start after every turn on. To achieve the faster start-up offered by a hot or warm start, either a backup battery must be connected or battery installed on board. **This pin must be connected by power(normal Input power)for operating, must not be unconnected.**

VDD(DC Power Input)

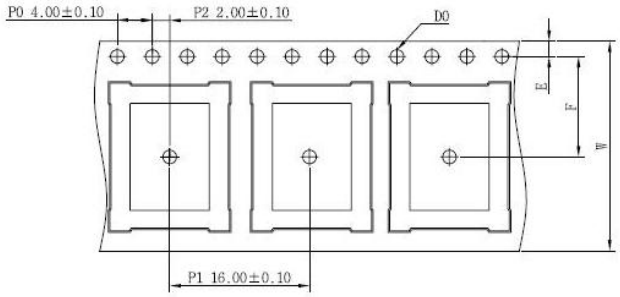
This is the main power supply for the Engine board. The power range is from 3.3V ±10%(the maximum and minimum voltage is 3.0V to 3.6V). Suitable decoupling must be provided by external decoupling circuitry.

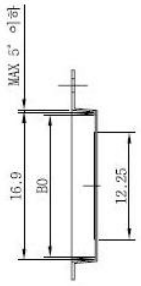
GND

GND provides the ground for the Engine board. Connect all grounds.

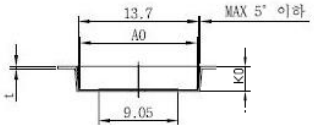
Packing Information

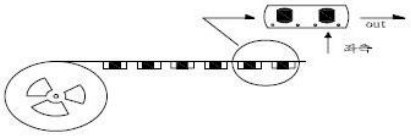
1. Carrier Tape Dimension





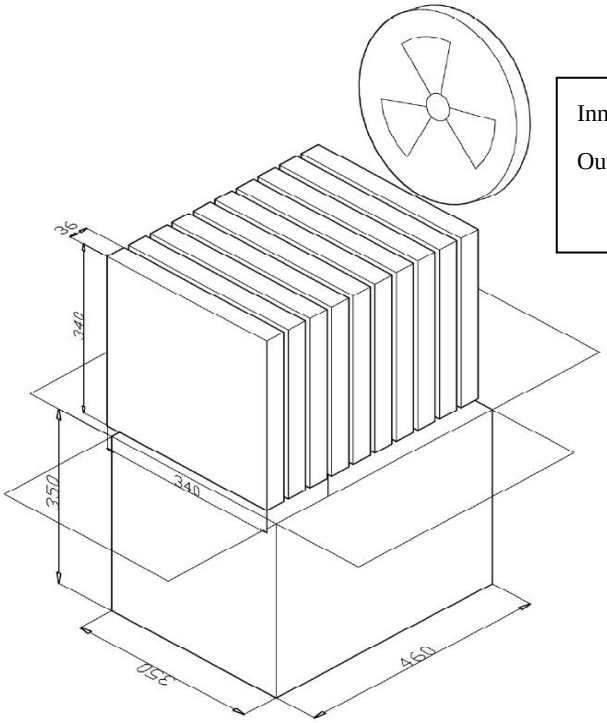
Taping style





A0	13.40±0.10	E	1.75±0.10
B0	16.60±0.10	F	11.50±0.10
K0	2.70±0.10	t	0.30±0.05
D0	1.55±0.05	w	24.00±0.30

2. Inner & Out Box (Carton Box)



Inner Box : 1,500pcs by one Tape & Reel packing

Out Box : Contained 10sets of Inner Boxes.

(Total 15,000pcs)

GPS/GLONASS Receiver User's Tip

1. GPS/GLONASS signal will be affected by weather and environment conditions, thus suggest to use the GPS/GLONASS receiver under less shielding environments to ensure GPS/GLONASS receiver has better receiving performance.
2. When GPS/GLONASS receiver is moving, it will prolong the time to fix the position, so suggest to wait for the satellite signals to be locked at a fixed point when first power-on the GPS receiver to ensure to lock the GPS/GLONASS signal at the shortest time.
3. The following situation will affect the GPS/GLONASS receiving performance:
   a. Solar control filmed windows.
   b. Metal shielded, such as umbrella, or in vehicle.
   c. Among high buildings.
   d. Under bridges or tunnels.
   e. Under high voltage cables or nearby radio wave sources, such as mobile phone base stations.
   f. Bad or heavy cloudy weather.
4. If the satellite signals cannot be locked or encounter receiving problem (while in the urban area), the following steps are suggested:
   a. Please plug the external active antenna into GPS/GLONASS receiver and put the antenna on outdoor or the roof of the vehicle for better receiving performance.
   b. Move to another open space or reposition GPS/GLONASS receiver toward the direction with fewer blockages.
   c. Move the GPS/GLONASS receiver away from the interference resources.
   d. Wait until the weather condition is improved.

While a GPS/GLONASS with a backup battery, the GPS/GLONASS receiver can fix a position immediately at next power-on if the build-in backup battery is full-recharged.

NMEA Protocol Overview

The output protocol supports NMEA-0183 standard. The implemented message include GGA, GLL, GSA, GSV, VTG, RMC, ZDA and GNS messages. The NMEA message output has the following sentence structure:

$aaccc,c-c*hh<CR><LF>

The detail of the sentence structure is explained in Table 1.

Table 1 : The NMEA sentence structure

character	HEX	Description
“$”	24	Start of sentence
Aaccc		Address field. “aa” is the talked identifier. “ccc” identifies the sentence type
“,”	2C	Field delimiter
C-c		Data sentence block
“*”	2A	Checksum delimiter
Hh		Checksum field.
<CR><LF>	0D0A	Ending of sentence. (carriage return, line feed)

Table 2 : Overview of NMEA messages

$GNGGA	Time, position, and fix related data of the receiver.
$GNGLL	Position, time and fix statue.
$GNGSA $GPGSA $GLGSA	Used to represent the ID’s of satellites which are used for position fix. When both and GPS and GLONASS satellites are used in position solution, a $GNGSA sentence is used for GPS satellites and another $GNGSA sentence is used for GLONASS satellites. When only GPS satellites are used for position fix, a single $GPGSA sentence is output. When only GLONASS satellites are used for position fix, a single $GLGSA sentence is output.
$GPGSV $GLGSV	Satellite information about elevation, azimuth and CNR, $GPGSV is used for GPS satellites, while $GLGSV is used of GLONASS satellites
$GNRMC	Time, date, position, course and speed data.
$GNVTG	Course and speed relative to the ground
$GNZDA	UTC, day, month and year and time zone.

GGA - Global Positioning System Fix Data

Time, position and fix related data for a GPS receiver.

Structure:

$--GGA,hhmmss.sss,ddmm.mmmm,a,dddmm.mmmm,a,x,xx,x.x,x.x,M,,,,xxxx*hh<CR><LF>

1 2 3 4 5 6 7 8 9 10 11

Example:

$GNGGA,111636.932,2447.0949,N,12100.5223,E,1,11,0.8,118.2,M,,,,0000*02<CR><LF>

Field	Name	Example	Description
1	UTC Time	111636.932	UTC of position in hhmmss.sss format, (000000.000 ~ 235959.999)
2	Latitude	2447.0949	Latitude in ddmm.mmmm format Leading zeros transmitted
3	N/S Indicator	N	Latitude hemisphere indicator, ‘N’ = North, ‘S’ = South
4	Longitude	12100.5223	Longitude in dddmm.mmmm format Leading zeros transmitted
5	E/W Indicator	E	Longitude hemisphere indicator, 'E' = East, 'W' = West
6	GPS quality indicator	1	GPS quality indicator 0: position fix unavailable 1: valid position fix, SPS mode 2: valid position fix, differential GPS mode 3: GPS PPS Mode, fix valid 4: Real Time Kinematic. System used in RTK mode with fixed integers 5: Float RTK. Satellite system used in RTK mode. Floating integers 6: Estimated (dead reckoning) Mode
7	Satellites Used	11	Number of satellites in use, (00 ~ 24)
8	HDOP	0.8	Horizontal dilution of precision, (00.0 ~ 99.9)
9	Altitude	108.2	mean sea level (geoid), (-9999.9 ~ 17999.9)
10	DGPS Station ID	0000	Differential reference station ID, 0000 ~ 1023 NULL when DGPS not used
11	Checksum	02	

GLL – Latitude/Longitude

Latitude and longitude of vessel position, time of position fix and status.

Structure:

$--GLL,ddmm.mmmm,a,dddmm.mmmm,a,hhmmss.sss,A,a*hh<CR><LF>

1 2 3 4 5 6 7 8

Example:

$GNGLL,2447.0944,N,12100.5213,E,112609.932,A,A*57<CR><LF>

Field	Name	Example	Description
1	Latitude	2447.0944	Latitude in ddmm.mmmm format Leading zeros transmitted
2	N/S Indicator	N	Latitude hemisphere indicator ‘N’ = North ‘S’ = South
3	Longitude	12100.5213	Longitude in dddmm.mmmm format Leading zeros transmitted
4	E/W Indicator	E	Longitude hemisphere indicator 'E' = East 'W' = West
5	UTC Time	112609.932	UTC time in hhmmss.sss format (000000.000 ~ 235959.999)
6	Status	A	Status, ‘A’ = Data valid, ‘V’ = Data not valid
7	Mode Indicator	A	Mode indicator ‘N’ = Data not valid ‘A’ = Autonomous mode ‘D’ = Differential mode ‘E’ = Estimated (dead reckoning) mode
8	Checksum	57	

GSA – GNSS DOP and Active Satellites

GPS receiver operating mode, satellites used in the navigation solution reported by the GGA or GNS sentence and DOP values.

Structure:

$--GSA,A,x,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,x.x,x.x,x.x*hh<CR><LF>

1 2 3 3 3 3 3 3 3 3 3 3 3 3 4 5 6 7

Example:

$GPGSA,A,3,05,12,21,22,30,09,18,06,14,01,31,,1.2,0.8,0.9*36<CR><LF>

Field	Name	Example	Description
1	Mode	A	Mode 'M' = Manual, forced to operate in 2D or 3D mode 'A' = Automatic, allowed to automatically switch 2D/3D
2	Mode	3	Fix type 1 = Fix not available 2 = 2D 3 = 3D
3	Satellite used 1~16	05,12,21,22,30,09,18,06,14,01,31,,	Satellite ID number, 01 ~ 32 are for GPS; 33 ~ 64 are for WASS(PRN minus 87); 65 ~ 96 are for GLONASS(64 plus slot numbers); 193 ~ 197 are for QZSS. Maximally 12 satellites are included in each GSA sentence.
4	PDOP	1.2	Position dilution of precision (00.0 to 99.9)
5	HDOP	0.8	Horizontal dilution of precision (00.0 to 99.9)
6	VDOP	0.9	Vertical dilution of precision (00.0 to 99.9)
7	Checksum	36	

GSV – GNSS Satellites in View

Number of satellites (SV) in view, satellite ID numbers, elevation, azimuth, and SNR value. Four satellites maximum per transmission.

Structure:

$--GSV,x,x,xx,xx,xx,xxx,xx,…,xx,xx,xxx,xx *hh<CR><LF>

1 2 3 4 5 6 7 4 5 6 7 8

Example:

$GPGSV,4,1,16,05,54,069,45,12,44,061,44,21,07,184,46,22,78,289,47*72<CR><LF>

$GPGSV,4,2,16,30,65,118,45,09,12,047,37,18,62,157,47,06,08,144,45*7C<CR><LF>

$GPGSV,4,3,16,14,39,330,42,01,06,299,38,31,30,256,44,32,36,320,47*7B<CR><LF>

$GPGSV,4,4,16,42,64,169,45,50,74,261,44,21,07,184,46,193,68,189,47*72<CR><LF>

Field	Name	Example	Description
1	Number of message	4	Total number of GSV messages to be transmitted (1-4)
2	Sequence number	1	Sequence number of current GSV message
3	Satellites in view	16	Total number of satellites in view (00 ~ 16)
4	Satellite ID	05	Satellite ID number, 01 ~ 32 are for GPS; 33 ~ 64 are for WASS(PRN minus 87); 65 ~ 96 are for GLONASS(64 plus slot numbers); 193 ~ 197 are for QZSS. Maximally 4 satellites are included in each GSV sentence.
5	Elevation	54	Satellite elevation in degrees, (00 ~ 90)
6	Azimuth	069	Satellite azimuth angle in degrees, (000 ~ 359)
7	SNR	45	C/No in dB (00 ~ 99) Null when not tracking
8	Checksum	72	

RMC – Recommended Minimum Specific GNSS Data

Time, date, position, course and speed data provided by a GNSS navigation receiver.

Structure:

$--RMC,hhmmss.sss,A,dddmm.mmmm,a,dddmm.mmmm,a,x.x,x.x,ddmmyy,,,a*hh<CR><LF>

1 2 3 4 5 6 7 8 9 10 11

Example:

$GNRMC,111636.932,A,2447.0949,N,12100.5223,E,000.0,000.0,030407,,,A*61<CR><LF>

Field	Name	Example	Description
1	UTC time	0111636.932	UTC time in hhmmss.sss format (000000.000 ~ 235959.999)
2	Status	A	Status 'V' = Navigation receiver warning 'A' = Data Valid
3	Latitude	2447.0949	Latitude in dddmm.mmmm format Leading zeros transmitted
4	N/S indicator	N	Latitude hemisphere indicator 'N' = North 'S' = South
5	Longitude	12100.5223	Longitude in dddmm.mmmm format Leading zeros transmitted
6	E/W Indicator	E	Longitude hemisphere indicator 'E' = East 'W' = West
7	Speed over ground	000.0	Speed over ground in knots (000.0 ~ 999.9)
8	Course over ground	000.0	Course over ground in degrees (000.0 ~ 359.9)
9	UTC Date	030407	UTC date of position fix, ddmmyy format
10	Mode indicator	A	Mode indicator 'N' = Data not valid 'A' = Autonomous mode 'D' = Differential mode 'E' = Estimated (dead reckoning) mode
11	checksum	61	

VTG – Course Over Ground and Ground Speed

The Actual course and speed relative to the ground.

Structure:

$--VTG,x.x,T,,M,x.x,N,x.x,K,a*hh<CR><LF>

1 2 3 4 5

Example:

$GNVTG, 000.0,T,,M,000.0,N,0000.0,K,A*3D<CR><LF>

Field	Name	Example	Description
1	Course	000.0	True course over ground in degrees (000.0 ~ 359.9)
2	Speed	000.0	Speed over ground in knots (000.0 ~ 999.9)
3	Speed	0000.0	Speed over ground in kilometers per hour (0000.0 ~ 1800.0)
4	Mode	A	Mode indicator 'N' = not valid 'A' = Autonomous mode 'D' = Differential mode 'E' = Estimated (dead reckoning) mode
5	Checksum	3D	

ZDA – Time & Date

UTC, day, month, year and local time zone.

Structure:

$--ZDA,hhmmss.sss,xx,xx,xxxx,xx,xx*hh<CR><LF>

1 2 3 4 5 6 7

Example:

$GPZDA,052633.376,13,07,2012,00,00*51<CR><LF>

Field	Name	Example	Description
1	UTC time	0111636.932	UTC time in hhmmss.sss format (000000.000 ~ 235959.999)
2	Day	13	Day, 01 to 31
3	Month	07	Month, 01 to 12
4	Year	2012	Year in yyyy format
5	Local zone hours	00	Local zone hours, 00 to +/- 13 hrs
6	Local zone minutes	00	Local zone minutes, 00 to +59
7	checksum	51	

Contact Information Section

Contact : knc3@knctek.co.kr

Web Site: www.knctek.co.kr

Headquarter:

14F-14, 60-73 Byucksan Digital Valley 5th,
Gasan-dong, Geumcheon-gu
SEOUL, KOREA
TEL: 82-2-839-5701
FAX: 82-2-830-5703