## KNCTEK GPS/GLONASS Mouse

# SGM-2528GL Specification

Version 1.1
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**

# SGM-2528GL Specification

# Revision History

1. 2014-06-02 : Initiated Version 1.0
2. 2016-01-15 : Updated Version 1.1 for Specification renewal.

# SGM-2528GL Operational Manual

## INTRODUCTION

The **SGM-2528GL** is the newest generation of KNCTEK GPS/GLONASS. The GPS/GLONASS Mouse 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 various Trackers, various Vehicle & personal Locaters & Trackers and etc. The excellent sensitivity of **SGM-2528GL** 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 64mA for Acquisition and 54mA 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
- ✧ Multipath detection and suppression
- ✧ Jamming detection and mitigation
- ✧ AGPS and SAEE( Self-aided ephemeris estimation) Supported
- ✧ Excellent Sensitive for Urban Canyon and Foliage Environmental condition
- ✧ NMEA-0183 compliant protocol
- ✧ Automotive-grade Quality GPS/GLONASS solution
- ✧ Small form factor(30 x 42.5 x 13.2mm)
- ✧ ODM/OEM development is fully supported Application Engineering
- ✧ GPS/GLONASS Fixed Status Display LED Indicator
- ✧ RoHS compliant

## PRODUCT APPLICATION

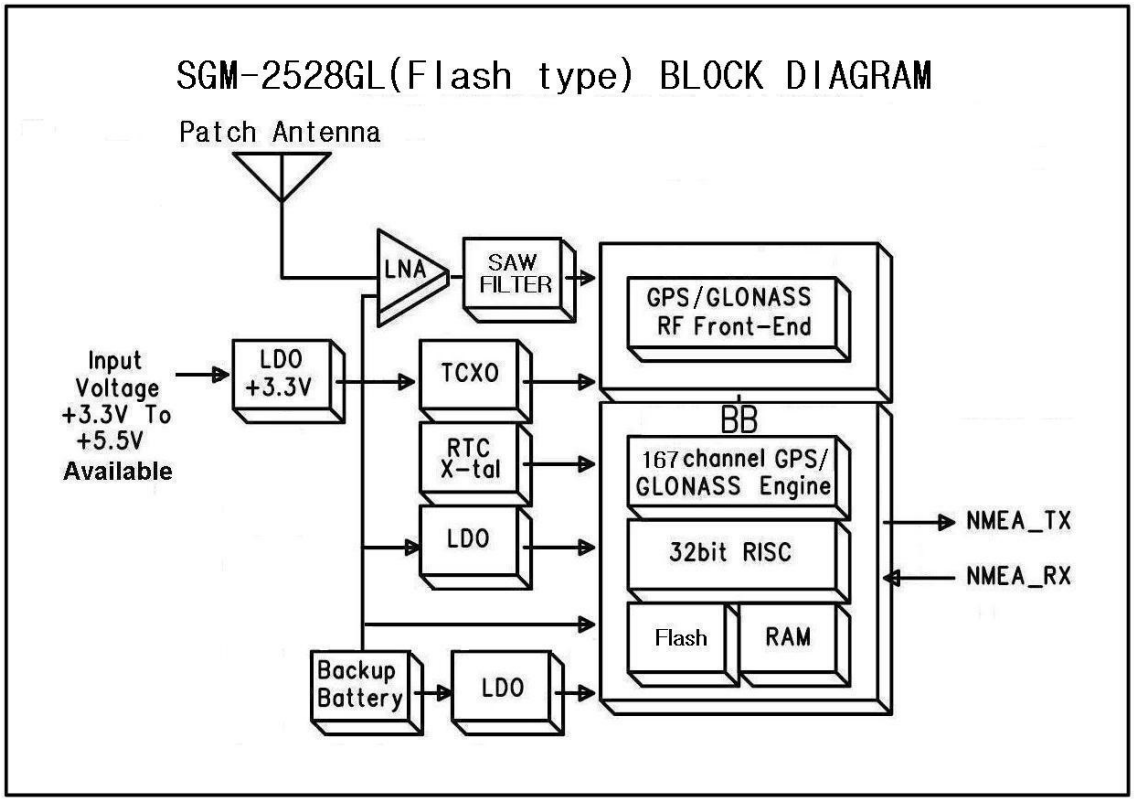
- ✧ Automotive applications
- ✧ Speed camera detector
- ✧ Personal and Car navigation
- ✧ Marine navigation

✧ Timing application and the others

## PRODUCT PICTURE


## SGM-2528GL SYSTEM BLOCK DIAGRAM

The SGM-2528GL 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 | 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 | ˚C |
| Storage Temperature | Tstg | -40 | 85 | ˚C |
| Backup Battery operating temperature[1] | Tbat | -20 | 65 | ˚C |
| Humidity | | | 95 | % |

** [1] Backup Battery operating temperature depends on Battery characteristics

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 | | 3.3 | 5.0 | 5.5 | V |
| Power Supply voltage ripple | Vcc_PP | Vcc = 5.0V | | | 50 | mV |
| Acquisition current | IccA | Vcc = 3.3V | | 64 | | mA |
| Tracking current | IccT | Vcc = 3.3V | | 54 | | 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 |
| | SA-GPS Support | Self-aided ephemeris estimation : 15 sec. avg |
| Power Consumption | Tracking | 54mA @ 3.3V |
| | Acquisition | 64mA |
| | 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 | 30X42.5X13.2mm |
| | Weight(with case and cable) | 55grams ±5%(3M Cable) |
| 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

## ORDERING INFORMATION

Cable for customer request : Refer to page 10 for connector type
(Default: TTL output/9,600baud)

## HARDWARE INTERFACE

### Pin Description

| PIN | SIGNAL NAME | I/O | DESCRIPTION | CHARACTER |
|---|---|---|---|---|
| 1 | VCC | P | DC Power Supply Voltage input | DC 3.3V to 5V ± 10% |
| 2 | TXD | O | NMEA_TX : UART Output | 3.3V LVTTL |
| 3 | RXD | I | NMEA_RX : UART Input | 3.3V LVTTL |
| 4 | GND | P | Digital Reference Ground | Digital Reference Ground |

**VCC DC Power Input**

This is the main power supply for the Engine board. The power range is **DC +5V ±10% (** 3.3V to 5.5V Acceptable )**.** Suitable decoupling must be provided by external decoupling circuitry.

**GND**

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

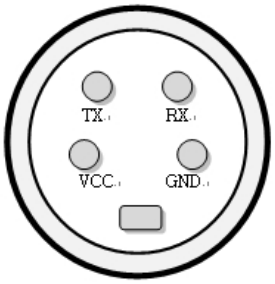
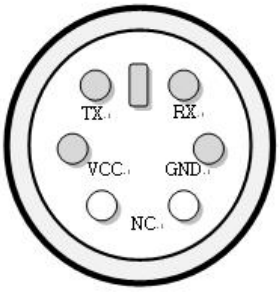
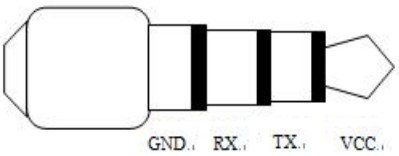
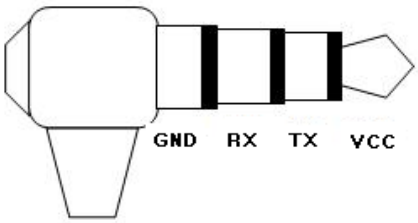
**TXD**

NMEA_TX, UART output, 3.3V LVTTL logic level. This is the main transmit channel and is used to output navigation and measurement data to user written software. 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.

**RXD**

NMEA_RX, UART input,3.3V LVTTL logic level. This is the main receiving channel and is used to receive software commands to the Engine board from user written software.

## I /O INTERFACE

| | | |
|---|---|---|
| Mini Din Jack 4pin Φ9.0 |  |  |
| Mini Din Jack 6pin Φ9.0 |  |  |
| Stereo Jack (Straight) Φ2.5 Φ3.5 |  |  |
| Stereo Jack (Angle) Φ2.5 Φ3.5 |  |  |

## Packing Information

TBD : To be determined

## GPS/GLONASS Receiver User's Tip

1. GPS/GLONASS signal will be affected by weather and environment conditions, thus suggest to use the GPS/GLONSS 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/GLONASS 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 near by radio wave sources, such as mobile phone base stations.
   f. Bad or heavy cloudy weather.
4. If the satellite signals can not be locked or encounter receiving problem (while in the urban area), the following steps are suggested:
   a. Move to another open space or reposition GPS/GLONASS receiver toward the direction with fewer blockages.
   b. Move the GPS/GLONASS receiver away from the interference resources.
   c. 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. |
| $GNGSA<br>$GPGSA<br>$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. |
| $GPGSV<br>$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<br>Leading zeros transmitted |
| 3 | N/S Indicator | N | Latitude hemisphere indicator, ‘N’ = North, ‘S’ = South |
| 4 | Longitude | 12100.5223 | Longitude in dddmm.mmmm format<br>Leading zeros transmitted |
| 5 | E/W Indicator | E | Longitude hemisphere indicator, 'E' = East, 'W' = West |
| 6 | GPS quality indicator | 1 | GPS quality indicator<br>0: position fix unavailable<br>1: valid position fix, SPS mode<br>2: valid position fix, differential GPS mode<br>3: GPS PPS Mode, fix valid<br>4: Real Time Kinematic. System used in RTK mode with fixed integers<br>5: Float RTK. Satellite system used in RTK mode. Floating integers<br>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<br>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<br>Leading zeros transmitted |
| 2 | N/S Indicator | N | Latitude hemisphere indicator<br>'N' = North<br>'S' = South |
| 3 | Longitude | 12100.5213 | Longitude in dddmm.mmmm format<br>Leading zeros transmitted |
| 4 | E/W Indicator | E | Longitude hemisphere indicator<br>'E' = East<br>'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<br>'N' = Data not valid<br>'A' = Autonomous mode<br>'D' = Differential mode<br>'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 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<br>'M' = Manual, forced to operate in 2D or 3D mode<br>'A' = Automatic, allowed to automatically switch 2D/3D |
| 2 | Mode | 3 | Fix type<br>1 = Fix not available<br>2 = 2D<br>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)<br>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<br>'V' = Navigation receiver warning<br>'A' = Data Valid |
| 3 | Latitude | 2447.0949 | Latitude in dddmm.mmmm format<br>Leading zeros transmitted |
| 4 | N/S indicator | N | Latitude hemisphere indicator<br>'N' = North<br>'S' = South |
| 5 | Longitude | 12100.5223 | Longitude in dddmm.mmmm format<br>Leading zeros transmitted |
| 6 | E/W Indicator | E | Longitude hemisphere indicator<br>'E' = East<br>'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<br>'N' = Data not valid<br>'A' = Autonomous mode<br>'D' = Differential mode<br>'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<br>'N' = not valid<br>'A' = Autonomous mode<br>'D' = Differential mode<br>'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**