GNSS Module Hardware Specification

(High Precision Automotive DR GNSS Module)

Module : CEO1612AD

Version: V1.0

Date : 2022-10-19

Revision History

Revision	Release date	Issuer	Change description
CEO1612AD V1.0	2022-10-19		Creative

Contents

1 Description

This document specifies the electrical, mechanical and behavioral characteristics of High Precision Module — CEO1612AD

The CEO1612AD high precision module with 3D sensors and a multi-band GNSS receiver. The module provides lane accurate positioning under the most challenging conditions, centimeter level accuracy for automotive mass markets, It provides a low-risk multi-band RTK turnkey solution with built-in inertial sensors with up to 10 Hz real-time position update rate.

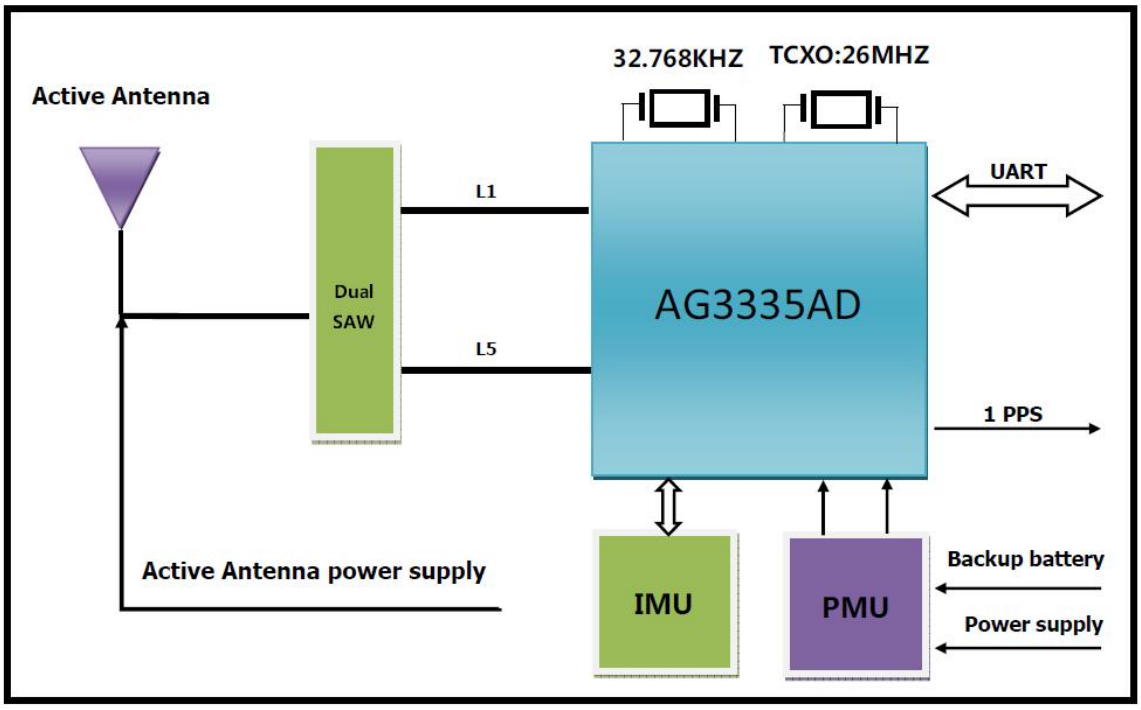
The CEO1612AD high precision module features the multi-Navigation systems BD /GPS/GLONASS/Galileo/ Nav.IC with dual-band L1/L5 receiver. with rapid convergence time within seconds. This mass-market component provides centimeter-level positioning with high availability, while making use of all four GNSS constellations simultaneously.

The CEO1612AD high precision module with an integrated Inertial Measurement Unit (IMU) Which providing the best solution with the highest sensitivity and tracking performance in the world and also with the highest position and speed accuracy in urban conditions. The sophisticated built-in algorithms fuse the IMS data, GNSS measurements, wheel ticks, and vehicle dynamics model to provide lane-accurate positioning where GNSS alone would fail. The module operates under open-sky motorways, in the wooded countryside, in difficult urban environments, and in tunnels and underground parking. CEO4545ADhigh precision Module is the ultimate solution.

The CEO1612AD high precision Module can support various location and navigation application, including autonomous BD/GPS/GLONASS/GALILEO/QZSS/SBAS signals .With the flexible software API and library ,customer can realize both autonomous navigation solution and assisted GPS navigation solution to obtain fast TTFF and accurate navigation performance even in harsh urban canyon or weak indoor signal environment.

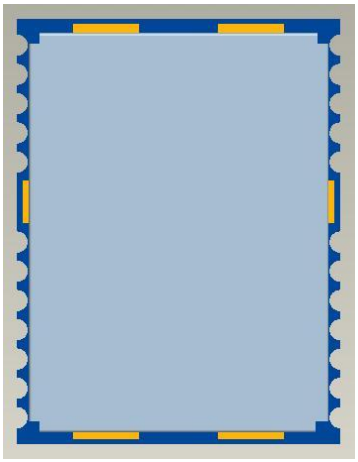
The CEO1612AD high precision module is the best choice for you to design for multi -GNSS related products.

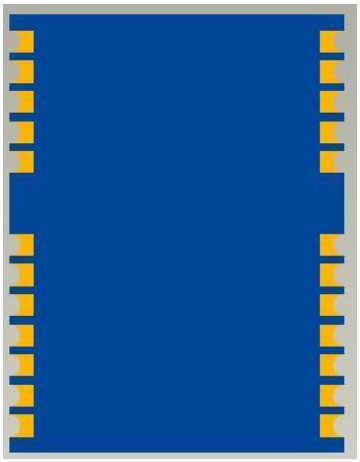
As following diagram is the CEO1612AD high precision Module architecture.



2 Mechanical specifications

The CEO1612AD GNSS Module has 24 pins on PCB board. A shield case is made of metallic material for suppressive RF radiation. Figure 2 is the Physical diagram.





The follow table is the mechanical dimensions character.

Item	Description
Width	16mm
Length	12mm
Height	2.8mm
Weight	——

3 Electrical Specifications

3.1 Absolute maximum ratings

Item	Symbol	Min	Max	Unit
Power supply voltage	Vcc_in	-0.5	7	V
High level input voltage GPIO and data bus	VIH	0.7 Vcc_in	-	V
low level input voltage GPIO and data bus	VIL	-	0.2Vcc_in	V
Operating temperature	Topr	-40	85	℃
Storage temperature	Tstg	-40	125	℃

3.2 Recommended Input Voltage

Item	Symbol	Min	Type	Max	Unit
Power On	Vcc_in	2.8	3.3	5.5	V

3.3 Power consumption

State	Min	Type	Max	Unit
Max. performance Mode	_	30.89	_	mA

4 Typical characteristics

4.1 General information

Receiving Frequency	● GPS L1C&L1CA:1575.42 MHZ GPS L5:1176.45MHZ ● BeiDou: B1C: 1575.42 MHZ , B1I:1561.098MHz, B2a: 1176.45MHZ ● GLONASS L1OF:1602MHz ● Galileo E1: 1575.42MHZ E5a: 1176.45MHZ	
Differential GNSS	RTCM3.3	
Datum	WGS-84	
Data output baud rate	115200bps(TXD,RXD)(option)	
Input /Output Format	NMEA0183	Default Date up rate:1HZ(option)
Accuracy of timepulse signal	10ns (RMS)	

4.2 Sensitivity

Tracking & navigation	-165dBm

Acquisition(Cold start)	-148dBm
Re-acquisition	-163dBm

4.3 Position&velocity &acceleration accuracy

Position accuracy	1m
	2.5cm(RTK Fixed mode)
Velocity accuracy	Without Aid: 0.1m/s
	DGPS: 0.05m/s
Acceleration accuracy	Without Aid: 0.1m/s2
	DGPS: 0.05m/s2

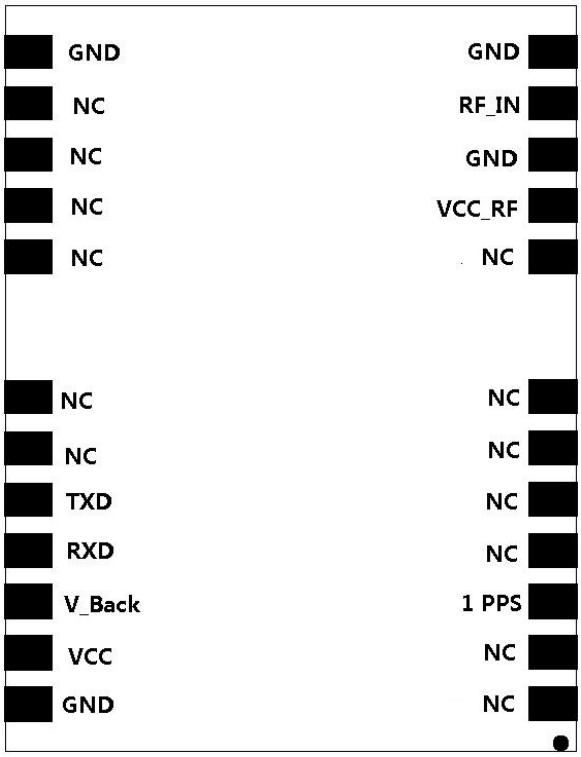
4.4 Dynamic performance

Maximum altitude	18000 m
Maximum velocity	515 m/s
Maximum acceleration	4 G

4.5 Time To First Fix

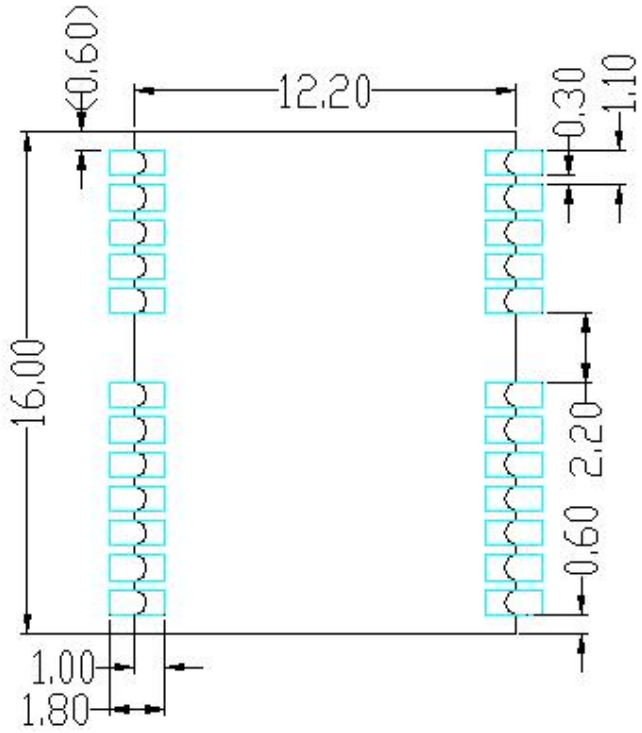
Hot start	≤1 s
Warm start	≤24 s
Cold start	≤24 s
Re-acquisition time	≤1 s

5 Pin Definition



Pin No.	Pin name	Type	Description
1	NC		Keep NC for future use
2	NC	O	Keep NC for future use
3	1PPS	O	1PPS Output, Synchronized with GPS time .
4	NC		Keep NC for future use
5	NC		Keep NC for future use
6	NC		Keep NC for future use
7	NC		Keep NC for future use
8	NC		Keep NC for future use
9	NC	O	Keep NC for future use
10	GND	G	GND
11	RF_IN	I	Passive antenna signal input.50ohm

12	GND	G	GND
13	GND	G	GND
14	NC		Keep NC for future use
15	NC		Keep NC for future use
16	NC		Keep NC for future use
17	NC		Keep NC for future use
18	NC		Keep NC for future use
19	NC		Keep NC for future use
20	TXD	O	Serial port output
21	RXD	I	Serial port input
22	V_BACK	I	Backup power input.
23	VCC	I	The main power input ,the type voltage is 3.3V
24	GND	G	GND



Reference PCB layout

6 NMEA output Sentence

Follow tables list the each of the NMEA output sentence specifically developed and defined for users within GNSS module.

Option	Description
GA	Galileo navigation satellite system
GP	GPS-global position system
GL	GLONASS navigation satellite system
GB	BeiDou navigation satellite system

Option	**Description**
GGA	Global Position System Fix Data. Time. Position and fix related data for a GPS receiver
GSA	GNSS DOP and Active Satellites
GSV	GNSS Satellites in view
RMC	Recommended Minimum Navigation Information
VTG	Course and speed information relative to the ground
ZDA	Time and Date
GST	GNSS Pseudo Range Error Statistics
PAIRMSG	IMS Message

6.1 NEMA output Sentence

$GNRMC,103124.000,A,2233.6054,N,11356.4124,E,0.04,0.00,131022,,,D,V*09

$GNVTG,0.00,T,,M,0.04,N,0.08,K,D*2A

$GNZDA,103124.000,13,10,2022,,*4C

$GNGST,103124.000,4.8,3.6,2.8,98.4,2.8,3.6,15.5*74

$PAIRMSG,90,103124.000,1*5C

$PAIRMSG,91,103124.000,1,0*41

$GNGGA,103124.000,2233.6054,N,11356.4124,E,2,53,0.5,39.00,M,,M,,*57

$GNGLL,2233.6054,N,11356.4124,E,103125.000,A,D*42

$GNGSA,A,3,26,22,194,199,16,31,196,32,195,29,27,,1.03,0.53,0.88,1*05

$GNGSA,A,3,72,75,71,74,,,,,,,,1.03,0.53,0.88,2*04

$GNGSA,A,3,19,21,04,,,,,,,,,1.03,0.53,0.88,3*08

$GNGSA,A,3,40,07,19,03,39,06,16,46,59,10,09,20,1.03,0.53,0.88,4*07

$GNGSA,A,3,02,01,60,36,27,37,,,,,,,1.03,0.53,0.88,4*01

$GPGSV,3,1,12,26,75,295,48,22,70,083,47,194,63,051,47,199,60,149,40,1*6F

$GPGSV,3,2,12,45,54,224,42,16,52,232,46,31,46,022,48,196,45,166,39,1*5D

$GPGSV,3,3,12,32,44,124,48,195,23,137,32,29,21,060,44,27,14,185,22,1*57

$GPGSV,2,1,07,26,75,295,43,194,63,051,43,199,60,149,32,196,45,166,41,8*5D
$GPGSV,2,2,07,32,44,124,41,195,23,137,33,27,14,185,26,8*68
$GLGSV,1,1,04,72,79,294,47,75,43,292,28,71,43,162,44,74,37,009,34,1*70
$GAGSV,1,1,04,19,82,067,41,21,51,024,45,04,31,323,39,20,,,38,7*46
$GAGSV,1,1,03,19,82,067,37,21,51,024,41,04,31,323,32,1*40
$GBGSV,7,1,27,40,67,167,42,07,62,194,43,19,62,279,46,03,62,189,38,1*70
$GBGSV,7,2,27,39,61,040,41,06,59,008,41,16,59,024,40,46,52,001,43,1*77
$GBGSV,7,3,27,59,51,128,36,10,50,204,41,09,50,341,39,20,48,177,41,1*7C
$GBGSV,7,4,27,02,47,237,33,01,46,124,35,60,42,238,41,36,39,284,38,1*73
$GBGSV,7,5,27,04,32,111,29,05,24,256,30,27,19,106,32,22,17,319,28,1*73
$GBGSV,7,6,27,30,16,157,32,13,15,212,,37,14,053,37,08,10,198,18,1*70
$GBGSV,7,7,27,38,08,186,22,55,,,32,47,,,31,1*4F
$GBGSV,2,1,07,40,67,167,28,39,61,040,41,46,52,001,42,20,48,177,40,4*7D
$GBGSV,2,2,07,36,39,284,37,27,19,106,30,37,14,053,39,4*45 6.1.1 GGA

6.1.1 GGA

The GGA contains following information example below:

$GNGGA,103124.000,2233.6054,N,11356.4124,E,2,53,0.5,39.00,M,,M,,*57

Name	Example	Unit	Description
Message ID	$GNGGA		GGA Message ID
UTC Time	103124.000		UTC time :hhmmss.sss
Latitude	2233.6054		Latitude : ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	11356.4124		Longitude :dddmm.mmmm
E/W Indicator	E		E=east or W=west
Position Fix Indicator	2		0:Fix not available 1:GPS fix 2: Differential GPS fix
Satellites Used	53		Number of satellites used
HDOP	0.5		Horizontal Dilution of Precision
MSL Altitude	39.00	meters	Altitude above/ below mean sea-level
Units	M	meters	Altitude units
Geoidal Separation		meters	Geoid separation: difference between ellipsoid and mean sea level
Units	M	meters	Geoid separation units
Age of Diff. Corr.			Null fields when DGPS is not used
Checksum	*57	second	

<CR> <LF>			End of message termination

6.1.2 GLL

The GLL contains following information example below:

$GNGLL,2233.6054,N,11356.4124,E,103125.000,A,D*42

Name	Example	Unit	Description
$GNGLL	$GNGLL	-	GLL Message ID,
Latitude	2233.6054	-	Latitude : ddmm.mmmm
N	N	-	North/South indicator N=north or S=south
Longitude	11356.4124	-	Longitude :dddmm.mmmm
E	E	-	E/W indicator, E=east or W=west
UTC Time	103125.000	-	UTC time :hhmmss.sss
Valid	A	-	Data validity status
Mode	D	-	Positioning Mode
cs	*42	-	Checksum
<CR><LF>		-	Carriage Return and Line Feed

6.1.3 GSA

The GSA contains following information example below:

$GNGSA,A,3,26,22,194,199,16,31,196,32,195,29,27,,1.03,0.53,0.88,1*05

$GNGSA,A,3,72,75,71,74,,,,,,,,1.03,0.53,0.88,2*04

$GNGSA,A,3,19,21,04,,,,,,,,,1.03,0.53,0.88,3*08

$GNGSA,A,3,40,07,19,03,39,06,16,46,59,10,09,20,1.03,0.53,0.88,4*07

$GNGSA,A,3,02,01,60,36,27,37,,,,,,,1.03,0.53,0.88,4*01

Name	Example	Unit	Description
Message ID	$GNGSA		GSA Message ID
Mode 1	A		Operation mode: M = Manually set to operate in 2D or 3D mode A = Automatically switching between 2D or 3D mode
Mode 2	3		Navigation mode,1: Fix not available. 2:2D 3:3D
Satellite Used	26/22/194/---		Satellite Used of GPS
Satellite Used	72/75/71/---		Satellite Used of Glonass
Satellite Used	19/21/04/---		Satellite Used of Galileo
Satellite Used	40/07/19/---		Satellite Used of BeiDou
Satellite Used	02/01/60/---		Satellite Used of BeiDou
PDOP	1.03		Position Dilution of Precision
HDOP	0.53		Horizontal Dilution of Precision

VDOP	0.88		Vertical Dilution of Precision
System Id	1/2/3/4/4		NMEA-defined GNSS system ID,
Checksum	*05/*04/---		
<CR> <LF>			End of message termination

6.1.4 GSV

The GSV contains following information example below:

$GPGSV,3,1,12,26,75,295,48,22,70,083,47,194,63,051,47,199,60,149,40,1*6F

$GPGSV,3,2,12,45,54,224,42,16,52,232,46,31,46,022,48,196,45,166,39,1*5D

$GPGSV,3,3,12,32,44,124,48,195,23,137,32,29,21,060,44,27,14,185,22,1*57

$GPGSV,2,1,07,26,75,295,43,194,63,051,43,199,60,149,32,196,45,166,41,8*5D

$GPGSV,2,2,07,32,44,124,41,195,23,137,33,27,14,185,26,8*68

$GLGSV,1,1,04,72,79,294,47,75,43,292,28,71,43,162,44,74,37,009,34,1*70

$GAGSV,1,1,04,19,82,067,41,21,51,024,45,04,31,323,39,20,,,38,7*46

$GAGSV,1,1,03,19,82,067,37,21,51,024,41,04,31,323,32,1*40

$GBGSV,7,1,27,40,67,167,42,07,62,194,43,19,62,279,46,03,62,189,38,1*70

$GBGSV,7,2,27,39,61,040,41,06,59,008,41,16,59,024,40,46,52,001,43,1*77

$GBGSV,7,3,27,59,51,128,36,10,50,204,41,09,50,341,39,20,48,177,41,1*7C

$GBGSV,7,4,27,02,47,237,33,01,46,124,35,60,42,238,41,36,39,284,38,1*73

$GBGSV,7,5,27,04,32,111,29,05,24,256,30,27,19,106,32,22,17,319,28,1*73

$GBGSV,7,6,27,30,16,157,32,13,15,212,,37,14,053,37,08,10,198,18,1*70

$GBGSV,7,7,27,38,08,186,22,55,,,32,47,,,31,1*4F

$GBGSV,2,1,07,40,67,167,28,39,61,040,41,46,52,001,42,20,48,177,40,4*7D

$GBGSV,2,2,07,36,39,284,37,27,19,106,30,37,14,053,39,4*45 6.1.1 GGA

Take $GPGSV for example. There are two $GPGSV sentences, the first one contains GPS L1 band satellite information, and the second contains GPS L5 band satellite information.

Name	Example	Unit	Description
Message ID	$GPGSV		GSV Message ID
Number of Messages	3/2		Number of messages(range: 1-9). 3-L1 /2-L5
Message Number	1 2 3/1 2		Number of this message
Satellites in View	12/07		Number of known satellites in view regarding both the talker ID and the signal Id
Satellite ID(GPS)	26/26		Satellite ID. PRN:26
Elevation(GPS)	75/75	degrees	Elevation (Maximum 90)
Azimuth(GPS)	295/295	degrees	Azimuth (Range 0 to 359)

SNR (C/No)(GPS)	48/43	dBHz	Signal strength (C/N0, range: 0-99)
--------	--------	-------	--------
SignalId	1/8		NMEA-defined GNSS signal ID
Checksum	*6F/*5D/---		
<CR> <LF>			End of message termination

6.1.5 RMC

The RMC contains following information example below:

$GNRMC,103124.000,A,2233.6054,N,11356.4124,E,0.04,0.00,131022,,,D,V*09

Name	Example	Unit	Description
Message ID	$GNRMC		RMC Message ID
UTC Time	103124.000		UTC time :hhmmss.sss
Status	A		A=data valid or V=data not valid
Latitude	2233.6054		Latitude : ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	11356.4124		Longitude :dddmm.mmmm
E/W Indicator	E		E=east or W=west
Speed Over Ground	0.04	knots	
Course Over Ground	0.00	degrees	TRUE
Date	131022		ddmmyy
,,		,,	,,
Mode Indicator	D		A=Autonomous mode/ D= Differential mode E= Estimated mode
Navigational status indicator	V		Equipment is not providing navigational status information, fixed field, only available in NMEA 4.10 and later
Checksum	*74		
<CR> <LF>			End of message termination

6.1.6VTG

The VTG contains following information example below:

$GNVTG,0.00,T,,M,0.04,N,0.08,K,D*2A

Name	Example	Unit	Description
Message ID	$GNVTG		VTG Message ID

Course over ground	0.00	degrees	
Reference	T		Course over ground units: T (degrees true, fixed field)
Course over ground (magnetic)		degrees	
Course over ground units:	M		M (degrees magnetic, fixed field)
Speed over ground	0.04	knots	
Units	N		Knots
Speed over ground	0.08	km/h	Measured horizontal speed
Units	K		K -kilometers per hour, fixed field
Mode indicator	D		A=Autonomous mode/ D= Differential mode E= Estimated mode
Checksum	*2A		
<CR> <LF>			End of message termination

6.1.7 ZDA

$GNZDA,103124.000,13,10,2022,,,*4C

Name	Example	Unit	Description
Message ID	$GNZDA		ZDA Message ID
UTC Time	103124.000		UTC time :hhmmss.sss
UTC day	13		day
UTC month	10		month
UTC year	2022		Year
Local time zone hours			
Local time zone minutes			
Checksum	*4C		
<CR> <LF>			End of message termination

6.1.8 GST

$GNGST,103124.000,4.8,3.6,2.8,98.4,2.8,3.6,15.5*74

Name	Example	Unit	Description
Message ID	$GNGST		GST Message ID
UTC Time	103124.000		UTC time :hhmmss.sss
RMS value of the standard	4.8		

deviation of the ranges			
Standard deviation of semi-major axis	3.6		
Standard deviation of semi-minor axis	2.8		
Orientation of semi-major axis	98.4		
Standard deviation of latitude error	2.8		
Standard deviation of longitude error	3.6		
Standard deviation of altitude error	15.5		
Checksum	*74		
<CR> <LF>			End of message termination

6.1.9 PAIRMSG

$PAIRMSG,90,103124.000,1*5C

Name	Example	Unit	Description
Message ID	$PAIRMSG		PAIRMSG Message ID
Message Number	90		
UTC Time	103124.000		UTC time :hhmmss.sss
DR stage	1		DR _Solution _unknown=0 DR _Solution _init=1 DR _Solution _coarse=2 DR _Solution _stable=3
Checksum	*5C		
<CR> <LF>			End of message termination

6.1.10 PAIRMSG

$PAIRMSG,91,103124.000,1,0*41

Name	Example	Unit	Description
Message ID	$PAIRMSG		PAIRMSG Message ID
Message Number	91		

UTC Time	103124.000		UTC time :hhmmss.sss
Dynamic status	1		Unknown=0 Static=0X01 Dynamic=0X02
Alarm status	0		Unknown =0 Harsh_ acceleration= 0x01 Harsh_ deceleration = 0x02 Harsh_ turn = 0x04 Harsh_ lane _change = 0x08 Horizontal _collision= 0x10 Rollover = 0x20 Stability _warning = 0x40 Euler _anomaly= 0x80
Checksum	*41		
<CR> <LF>			End of message termination

7 Supplier's Responsibility

7.1 Life Expectancy

The CEO1612AD module has MTBF>100000 hrs with at least 90% confidence. A prediction of life expectancy will be made .The result will be discussed with customers.

7.2 Reliability

Design FMEA of the CEO1612AD module at the part level will be made and documented. 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. 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.

8 Notice for handling

8.1 Maximum Rating

Do not use over maximum rating because if use over maximum rating it is doubt become the fault.

Maximum voltage

It is regulated maximum voltage which compensate input voltage between input terminal and GND.

Once over the maximum voltage is inputted, it is become the reason of faulty.

Input Voltage

It is regulated maximum voltage to input terminal. Once over the maximum voltage is inputted, it is become the reason of faulty.

Operating Temperature

It is the temperature rang which can have a guarantee for operating Range. Once over the temperature rang it is become the reason of faulty or it is doubt that can not have the satisfy of the function of GPS.

Storage Temperature

It is the temperature range which unit is strong in case storage temperature is over this temperature rang, it is become the reason of faulty or it can not have a satisfy of the function.

8.2 Caution for Installation

In case handle with this unit, be careful against a static electricity. It is not that unit will be damaged by a static electricity. Specially, handle with I/O connector, be careful against a static electricity. Do not touch the I/O connector dirty with hand.

Please mount within two weeks after opening the prevention-of-moisture packing. After the prevention-of-moisture packing is opened, it need be kept in dry atmosphere.

8.3 Notice for Storage

Do not storage the place where corrosion gas will be generated or exist many dusts. Do not storage the place where temperature rang will be change widely because the dewdrop will be formed therefore.

8.4 Transportation

Do not throw, do not drop, otherwise unit itself will be damaged.

Protect from water, when transport in the rain/snow, protect from them.

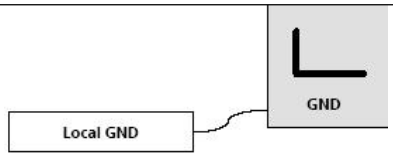
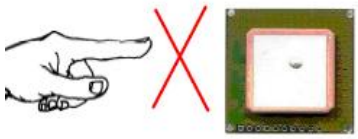
8.5 Overcurrent Protection

The CEO1612AD does not have a fuse for overcurrent protect.

Please put a fuse for overcurrent protect in your system because the prevention of danger.

9 ESD handling precautions

GPS receivers are Electrostatic Sensitive Devices and require special precautions when handling. The following item should be pay more attention

	When there is a galvanic coupling with module ,Do not ignore the module GND connect to the local GND
	The RF pin of the module is sensitive to ESD .when handling the module be careful of the ESD,
	To prevent electrostatic discharge through the RF input do not touch the mounted patch antenna.
	When soldering RF connectors and patch antennas to the receiver’ s RF pin, make sure to use an ESD safe soldering iron

Failure to observe these precautions can result in severe damage to the GPS receiver!