SKG121T Datasheet

GNSS Module

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Revision	Description	Approved	Date
V1.01	Initial Release to V1.01	George	2020.5.22
V1.02	Update Antenna Detection	George	2021.3.23
V1.03	Update NMEA Protocol	George	2021.4.7
V2.01	Update format	Wendy	2021.04.20

Contents

1.General Description

The SKG121T is a high-performance GNSS all-in-one solution module that features super sensitivity, ultra low power and small form factor. The RF signal is applied to the antenna input of module, and a complete serial data message with position, velocity and time information is presented at the serial interface with NMEA protocol or custom protocol.

It is based on the high performance features of the STA8089 single-chip architecture, Its -162dBm tracking sensitivity extends positioning coverage into place like urban canyons and dense foliage environment where the GNSS was not possible before. The small form factor and low power consumption make the module easy to integrate into portable device like PNDs, mobile phones, cameras and vehicle navigation systems.

Figure 1: SKG121T Top View

2.Applications

- LBS (Location Based Service)
- PND (Portable Navigation Device)
- Vehicle navigation system
- Mobile phone

3.Features

- GPS/BDS/QZSS reseiver
- Ultra high sensitivity: -162dBm
- Extremely fast TTFF at low signal level

- Ultra low power consumption
- ±3.9ns high accuracy time pulse (1PPS)
- SBAS (WAAS,EGNOS,MSAS,GAGAN)
- Indoor and outdoor multi-path detection and compensation
- Small form factor: 16.2 x 12.2 x 2.4mm
- FCC compliance
- RoHS compliance (Lead-free)
- CE certificated

4 Pin Assignment

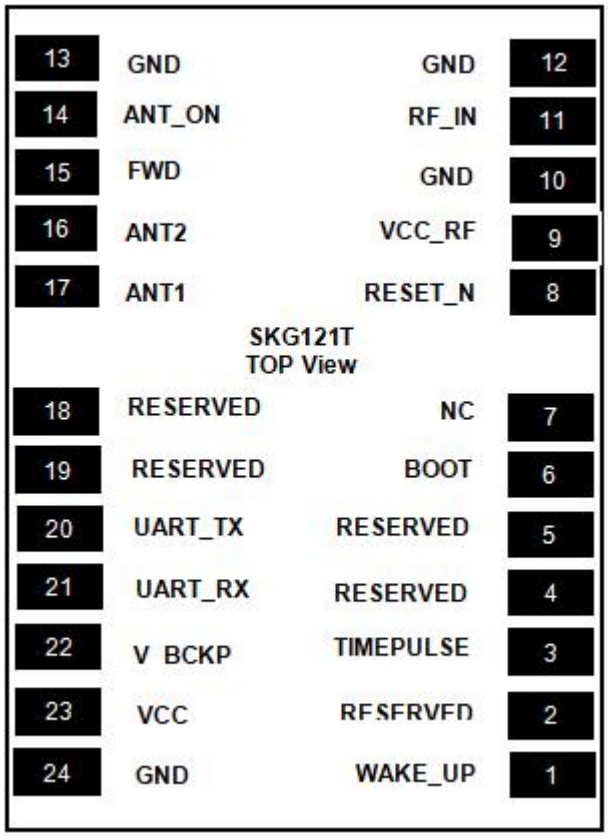


Figure 2: Pin Assignment

5 Pin Description

Pin No.	Pin name	I/O	Description	Remark
1	WAKE_UP	DI	Wake up the module from backup mode	Keep this pin at low voltage level in full on mode. Drive the pin to a high voltage level to make the module exit from backup mode. If unused, keep this pin open.
2	RESERVED	I/O	Not connected	
3	TIMEPULSE	DO	One pulse per second	Synchronized at rising edge, and the pulse width is 500ms. This pin must be low at startup for normal operation. It has been pulled down internally with
4	RESERVED	I	Not connected	
5	RESERVED		Not connected	
6	BOOT	DI	BOOT select	Please refer to Chapter 3.7
7	NC			
8	RESET_N	DI	Reset the module	Active low. If unused, keep this pin open.
9	VCC_RF	PO	Power supply for external RF components	Usually supply power for the external active antenna or the LNA. VCC_RF≈VCC
10	GND	G	Ground	
11	RF_IN	AI	RF signal input	50Ω characteristic impedance.
12	GND	G	Ground	
13	GND	G	Ground	
14	ANT_ON	DO	power control for active antenna detection	If unused, keep this pin open.
15	FWD			
16	ANT2	AI	Antenna detection 2	If unused, keep this pin open.
17	ANT1	AI	Antenna detection 1	If unused, keep this pin open.
18	RESERVED	O	Not connected	

19	RESERVED	I	Not connected	
20	UART_TX	DO	Transmit data	UART port is used for NMEA output and firmware upgrade.
21	UART_RX	DI	Receive data	UART port is used for NMEA output and firmware upgrade.
22	V_BCKP	PI	Backup power supply	Supply power for RTC domain when VCC is powered off.
23	VCC	PI	Module Power Supply	Assure load current not less than 150mA.
24	GND	G	Ground	

6.Interfaces Configuration

Power Supply

VCC pin supplies power for BB, RF and RTC domains. The load current of VCC pin varies according to the VCC level, processor load and satellite acquisition. It is important to supply sufficient current and make the power clean and stable. It is recommended to choose an LDO with a minimum output current of 150mA as the power supply, and add a decoupling capacitor combination (10uF and 100nF) as well as a TVS near the VCC pin.

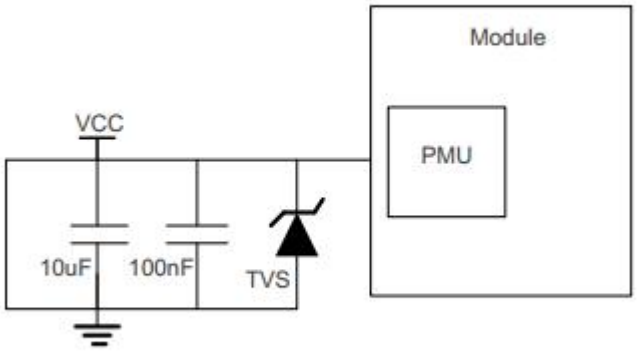


Figure 3: VCC Input Reference Circuit

The V_BCKP pin supplies power for RTC domain. A cell battery and a capacitor combination (4.7uF and 100nF) are recommended to be placed nearby V_BCKP pin. The voltage of RTC domain ranges from 2.0V to 3.6V. In order to achieve better Time to First Fix (TTFF), RTC domain should be valid all the time so as to supply power for SRAM memory which contains all the necessary GNSS information for quick start-up and a small amount of user configuration variables.

The module's internal power construction is shown as below.

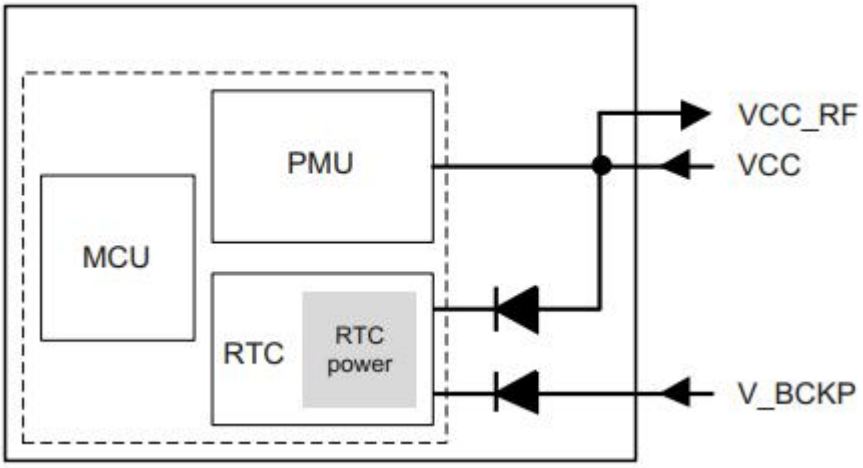


Figure 4: The module's internal power construction

VCC not only supplies power for PMU but also for VCC_RF and RTC domain, while V_BCKP supplies power for RTC domain only. When the power supply voltage of VCC is within the normal range, use VCC; otherwise, use V_BCKP.

Backup Battery Power

In case of a power failure on pin Vcc, real-time clock and backup RAM are supplied through pin V_BCKP. This enables the SKG121T Receiver to recover from power failure with either a hot start or a warm start (depending on the duration of Vcc outage). If no Backup Battery is connected, the receiver performs a cold start upon powered up.

Backup Battery Power V_BCKP draws typically 35 uA current in backup state.

Antenna

The SKG121T receiver is designed for supporting the active antenna or passive antenna connected with pin RF_IN. The gain of active antenna should be no more than 25dB (18~20dB Typical). The maximum noise figure should be no more than 1.5dB and output impedance is at 50 Ohm.

NOTE

With passive antenna keep the cable loss at minimum(<1dB)

VCC_RF

Antenna power output pin. When user wants to use external active antenna. The pin supply power for active antenna.

Reset

SKG121T module can be reset by driving RESET_N to a low-level voltage for at least 100ms and then releasing it. Please note that the resetting will possibly force the loss of volatile RAM data, while non-volatile backup RAM content is not cleared so that fast TTFF is still possible. An OC driver circuit shown as below is recommended to control the RESET.

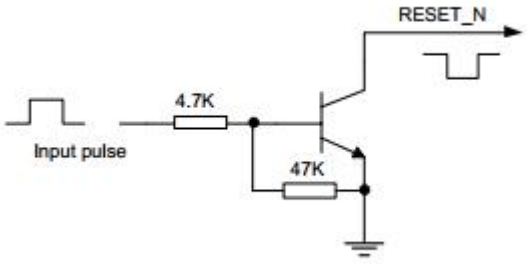


Figure 7: Reference OC Circuit for Module Reset

The following figure shows the reset timing of SKG121T module.

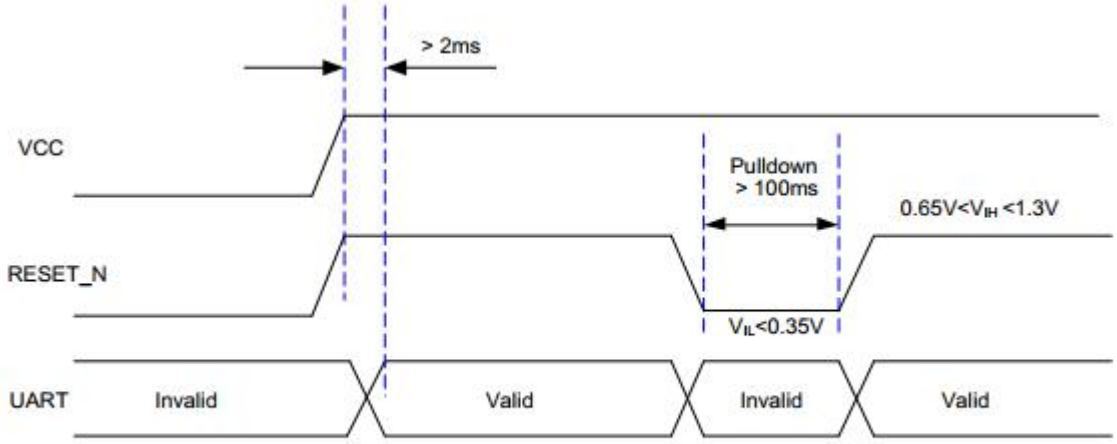


Figure 8: Reset Timing

UART Interface

SKG121T provides one universal asynchronous receiver & transmitter serial port, The module is designed as DCE (Data Communication Equipment), following the traditional DCE-DTE (Data Terminal Equipment) connection. The module and the client (DTE) are connected through the signals shown in the following figure. It supports data baud-rate from 4800bps to 115200bps, 115200bps by default UART port.

- UART_TX: Send data to the RXD signal line of DTE
- UART_RX: Receive data from the TXD signal line of DTE

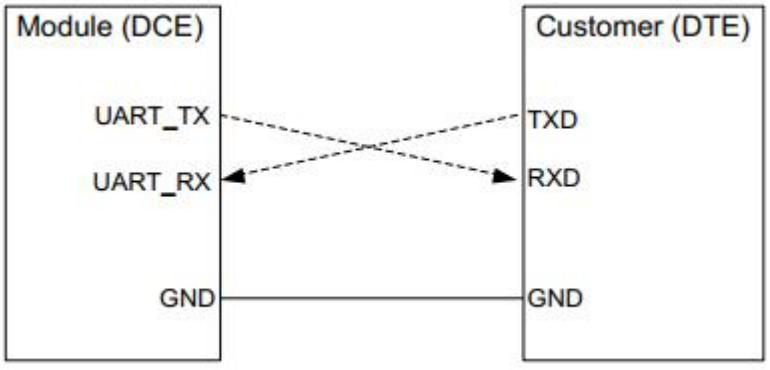


Figure 9: Reference Design for UART Port

This UART port has the following features:

- UART port can be used for NMEA output and firmware upgrade.
- The default output NMEA type setting is RMC,GGA,GSA,GSV,GLL,VTG,PSTMPPSDATA,PSTMPOSHOLD,PSTMTRAIMSTATUS,PSTMTRAIMUSED,PSTMTRAIMRES,PSTMTRAIMREMOVED.
- UART port supports the following data rates: 4800bps, 9600bps, 14400bps, 19200bps, 38400bps, 57600bps, 115200bps . The default setting is 115200bps, 8 bits, no parity bit, 1 stop bit.
- Hardware flow control and synchronous operation are not supported.

The UART port does not support the RS-232 level but only CMOS level. If the module's UART port is connected to the UART port of a computer, it is necessary to add a level shift circuit in between. Please refer to the following figure.

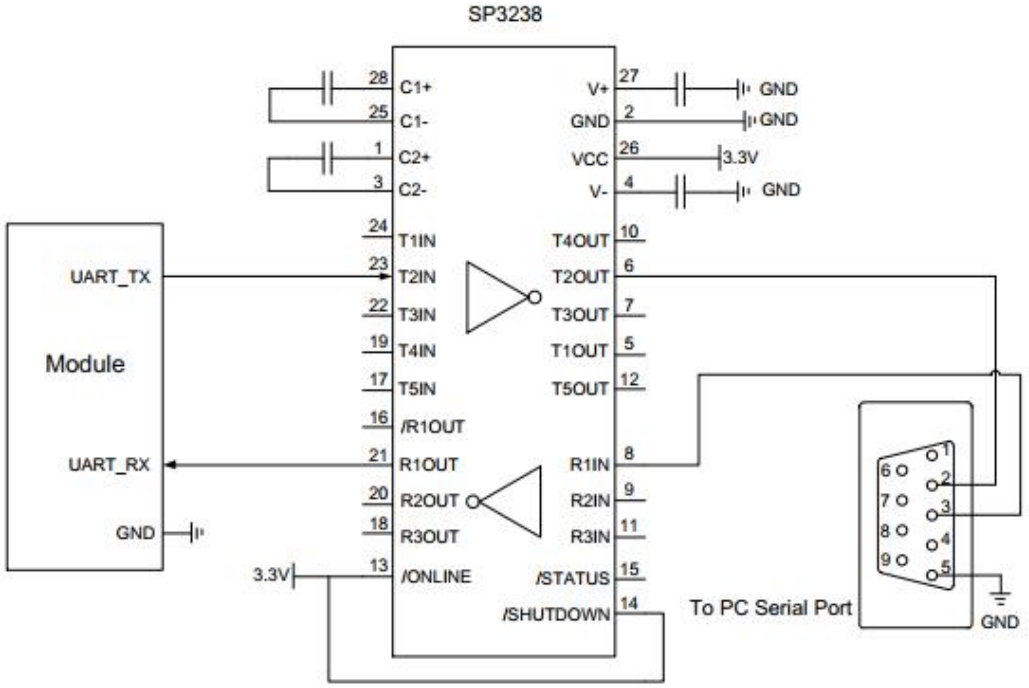


Figure 10: RS-232 Level Shift Circuit

NOTES

GNSS modules output more data than single GPS system. The default baud rate (115200bps) of SKG121T is enough to transmit GNSS NMEA message.

RF_IN

The transmission line must to be control impedance from RF_IN pin to the antenna or antenna connector of your choice. (Impedance 50Ω)

PPS

A pulse per second (1 PPS) is an electrical signal that very precisely indicates the start of a second. Depending on the source, properly operating PPS signals have an accuracy ranging 3.9ns. The PPS signals are used for precise timekeeping and time measurement.

BOOT Interface

The module has two download modes Boot download mode and Upgrade download mode. If SKG121T needs to update bootloader, it needs a 10KΩ resistor to pull BOOT pin up to VCC when the module is turned on. For more details about circuit design, please refer to ***document [3]***. Otherwise don't need to pull up BOOT pin.

Download mode	Comment
Boot download	A 10KΩ resistor to pull BOOT pin up to VCC when the module is turned on.
Upgrade download	Upgrade download

7 Operation Modes

7.1. Full on Mode

Full on mode comprises tracking mode and acquisition mode. Acquisition mode is defined as the mode in which the module starts to search satellites, and to determine the visible satellites, coarse carrier frequency as well as code phase of satellite signals. When the acquisition is completed, it will automatically switch to

tracking mode. Tracking mode is defined as the module tracking satellites and demodulating the navigation data from specific satellites.

When both VCC and V_BCKP pins are valid or only VCC is valid, the module will enter into full on mode automatically and follow the default configuration as below. Please refer to **Figure 3** about internal power construction for better comprehension.

Table 7.1.1: Default Configuration

Item	Configuration	Comment
Baud Rate	115200bps	
Protocol	NMEA	RMC,GGA,GSA,GSV, GLL,VTG,PSTMPPSDATA,PSTMPOSHOLD,PSTMTRAIMSTATUS,PSTMTRAIMUSED,PSTMTRAIMRES,PSTMTRAIMREMOVED
Update Rate	1Hz	
SBAS	Enable	
GNSS	GPS+BDS+Galileo +GLONASS	

7.2. Backup Mode

Backup mode is a low power consumption mode. In this mode, the module stops acquiring and tracking satellites. UART is not accessible. But the backup memory in RTC domain which contains all the necessary GNSS information for quick start-up and a small amount of user configuration variables is alive.

There is one way to enter into backup mode and two ways back to full on mode.

- Send “$PSTMFORCESTANDBY, <duration>” Command to enter into backup mode.

- There are two way to wake up the module: Driving the WAKE_UP pin to high voltage level to trigger interrupt wakeup or waiting for the command duration to end.

Table 7.2.1: Command Duration

Parameter	Format	Description
<duration>	Decimal, 5 digits	Duration of the backup time in seconds

For a better understanding, please refer to ***Chapter 3.3*** for details about the internal power construction. The V_BCKP pin can be directly powered by an external capacitor or battery (rechargeable or non-chargeable). The following figure illustrates the reference design for RTC backup supply.

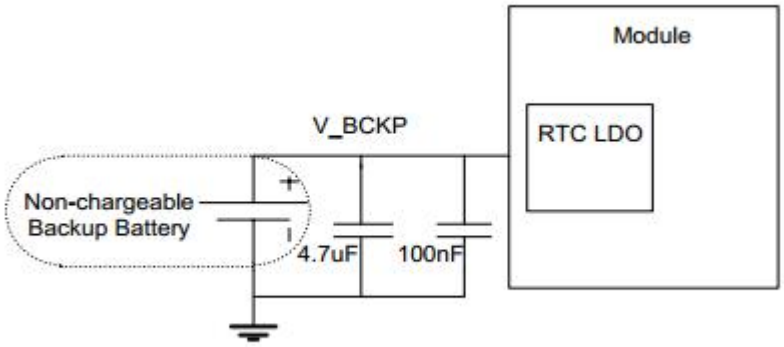


Figure 5: RTC Supply from Non-chargeable Battery

With a charging circuit, V_BCKP will support battery charging function. Please refer to the reference charging circuit in the figure below.

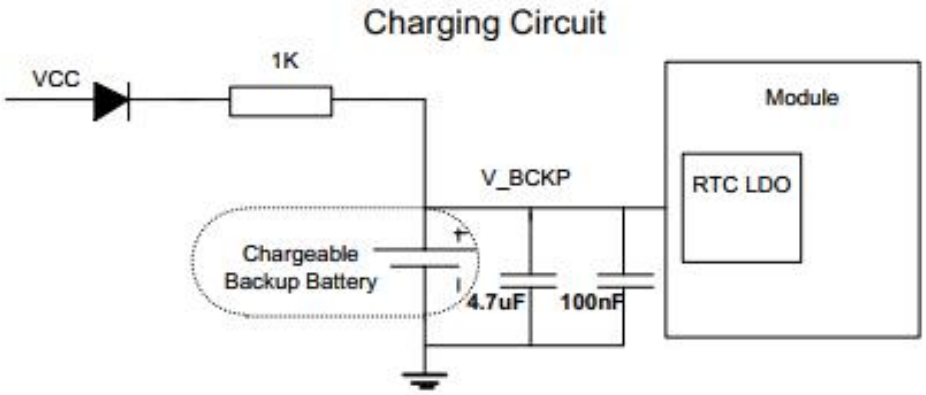


Figure 6: Reference Charging Circuit for Rechargeable Batteries

The coin-type rechargeable capacitor from Seiko (http://www.sii.co.jp/en) can be used as an alternative to the chargeable backup battery. And the Schottky diode from ON Semiconductor (http://www.onsemi.com) is recommended to be the choice of diode for its low voltage drop.

8 Performance Specification

Parameter	Specification	
Receiver Type	GPS L1 C/A (1575.42MHz) BeiDou B1 C/A (1561.098MHz) GLONASS L1 C/A (1602.5625MHz) Galileo E1 C/A (1575.42MHz)	
Sensitivity	Tracking Reacquisition Acquisition	-162dBm Typical -156dBm Typical -147dBm Typical
Accuracy	Position Velocity Timing (PPS)	<1.8m CEP* @-130dBm 0.1m/s without SA 3.9ns RMS
Acquisition Time	Cold Start Warm Start Hot Start	<32s(Typical Open Sky) <25s <1.5s

	Re-Acquisition	<1s
Assisted GPS support	Support	
Power Consumption	Tracking Acquisition	TBD TBD
Navigation Data Update Rate	Max 10Hz	Default 1Hz
Operational Limits	Altitude Velocity Acceleration	Max 18,000m Max 515m/s 4.5G

9 Electrical Characteristics

Absolute Maximum Rating

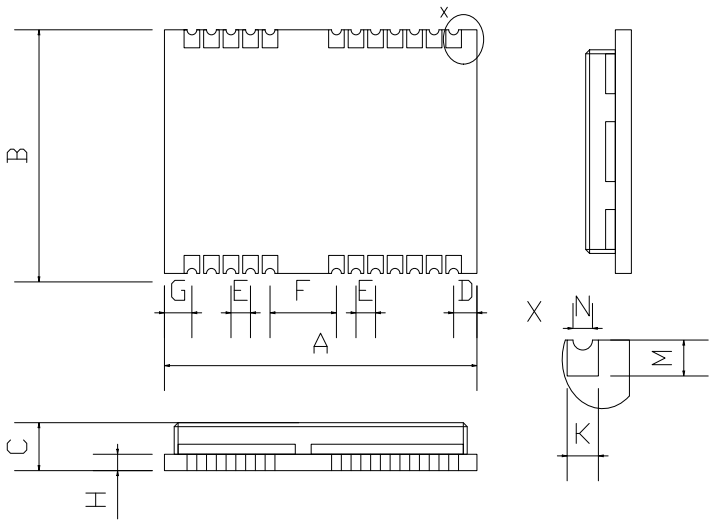
Parameter	Symbol	Min	Max	Units
Power Supply				
Power Supply Volt.	VCC	-0.3	4.8	V
Input Pins				
Input voltage on any input connection	VIO	-0.2	VCC+0.3V	V
Backup Battery	V_BCKP	-0.3	4.8	V
RF input power	RF_IN		15	dBm
Human Body Model ESD capability	RF_IN		2000	V
Machine Model ESD capability	RF_IN		100	V
Environment				
Storage Temperature	Tstg	-40	125	°C
Peak Reflow Soldering Temperature <10s	Tpeak		260	°C
Humidity			95	%

Note: Absolute maximum ratings are stress ratings only, and functional operation at the maxims 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, refer to the operating conditions tables as follow.

Operating Conditions

Parameter	Symbol	Condition	Min	Typ	Max	Units
Power supply voltage	Vcc		3	3.3	3.6	V
Backup Battery	V_BCKP		2	3.3	3.6	V
Power supply voltage ripple	Vcc_PP	Vcc=3.3V			30	mV
Peak supply current	Icc	Vcc=3.3V		150		mA
Supply current, Tracking	Icc	Vcc=3.3V		TBD		mA
Supply current, backup state	Ibckp	Vcc=3.3V		15		uA
VCC_RF Antenna bias supply	VCC_RF			VCC		V
Input high voltage	V_{IH}		2		3.6	V
Input low voltage	V_{IL}		-0.3		0.8	V
Output high voltage	V_{OH}		2.4		3.1	V
Output low voltage	V_{OL}		-0.3		0.4	V
Operating temperature	Topr		-40		85	°C

10 Mechanical Specification



Symbol	Min. (mm)	Typ. (mm)	Max. (mm)
A	16.0	16.3	16.6
B	12.0	12.2	12.4
C	2.2	2.4	2.6
D	0.9	1.0	1.3
E	1.0	1.1	1.2
F	2.9	3.0	3.1
G	0.9	1.0	1.3
H		0.8	
M	0.8	0.9	1.0
N	0.4	0.5	0.6
K	0.7	0.8	0.9
Weight	1.6g		

Parameter	specification	Units
Coplanarity	≤0.1	mm

Figure 7: SKG121T Dimensions

Recommend Layout

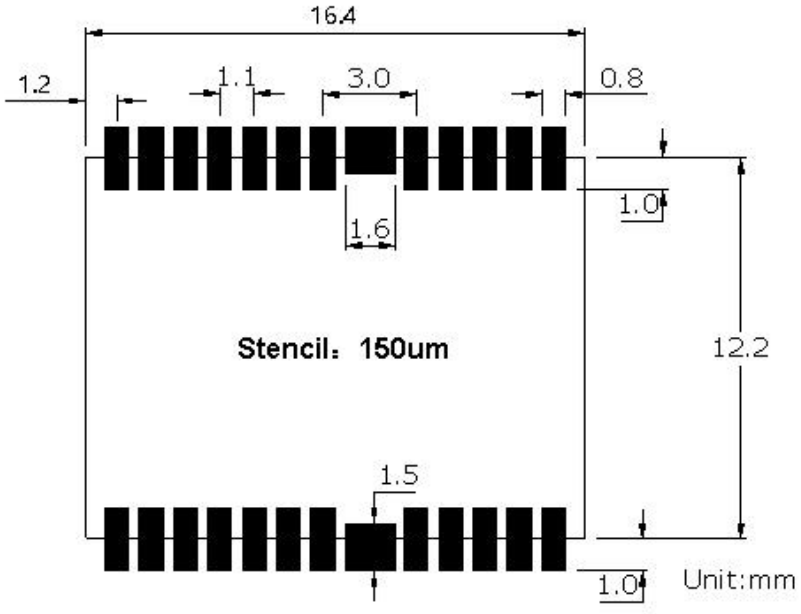


Figure 8: SKG121T Footprint

11 Reference design schematic

The following figure is a typical reference design for active antenna with Antenna Detection.

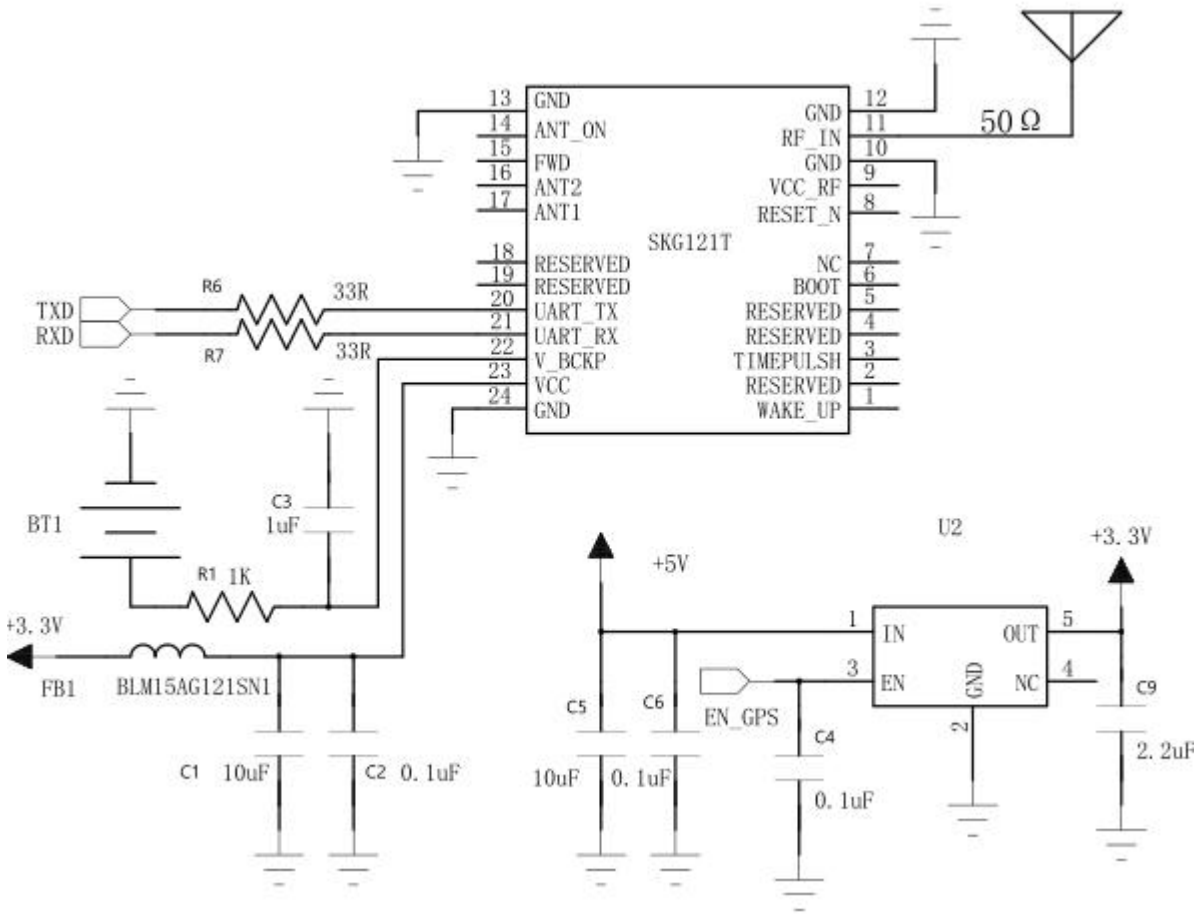


Figure 9: SKG121T Typical Reference design schematic

12 Packaging Specification

SKG121T modules are shipped in reel and with 1200 units per reel. Each tray is ‘dry’ package.

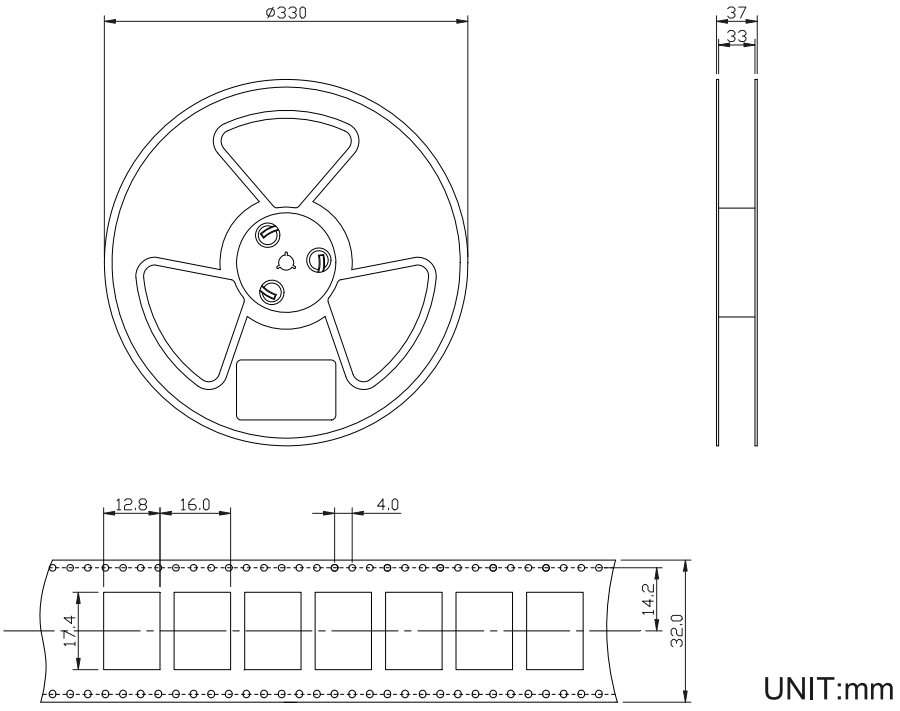


Figure 10: SKG121T Packaging

13 Manufacturing Process Recommendations

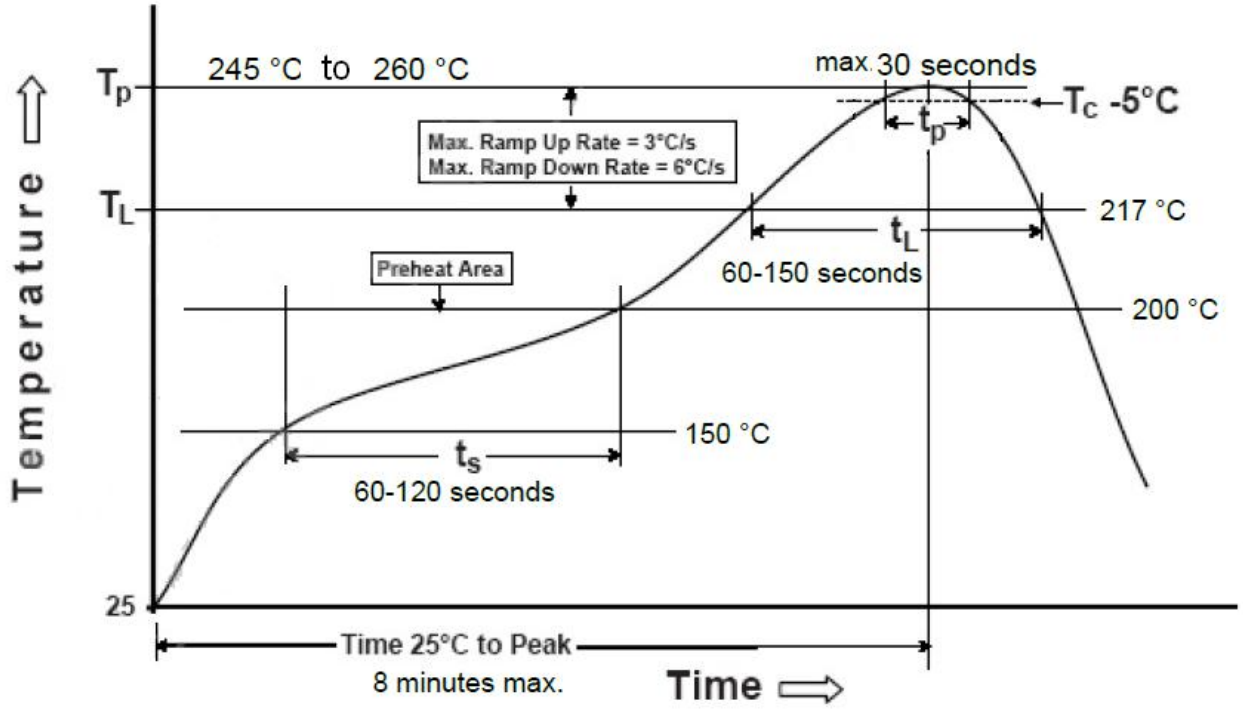


Figure 11: SKG121T Typical Leadfree Soldering Profile

Note： The final soldering temperature chosen at the factory depends on additional external factors like choice of soldering paste，size，thickness and properties of the baseboard，etc. Exceeding the maximum soldering temperature in the recommended soldering profile may permanently damage the module.

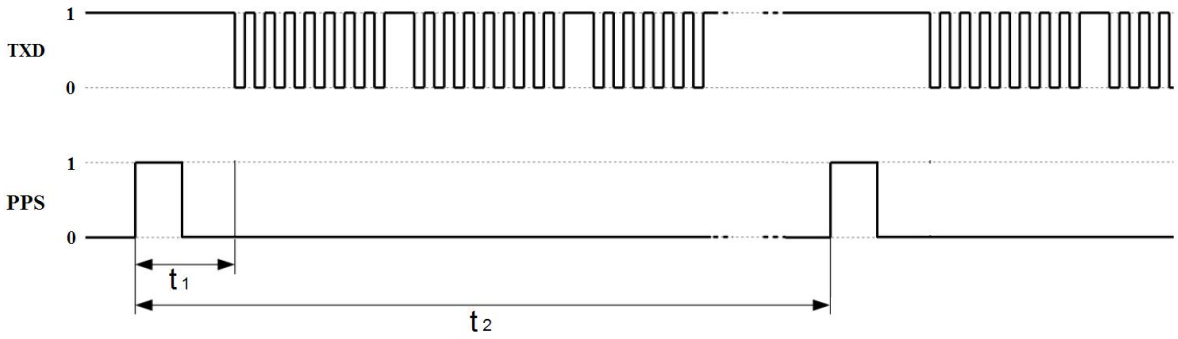
Soldering Paste: OM338 SAC405 / Nr.143714 (Cookson Electronics)
Alloy specification: Sn 95.5/ Ag 4/ Cu 0.5 (95.5% Tin/ 4% Silver/ 0.5% Copper)

Melting Temperature: 217 °C

Stencil Thickness: 150um

14 Software Protocol

Nmea output timing diagrams



Parameter.	Description	Recommendation
t1	Nmea out time	155~175 ms
t2	A pulse per second (1PPS) time pulse	1s

NMEA 0183 Protocol

The NMEA protocol is an ASCII-based protocol, Records start with a $ and with carriage return/line feed. GPS specific messages all start with $GNxxx where xxx is a three-letter identifier of the message data that follows. NMEA messages have a checksum, which allows detection of corrupted data transfers.

The Skylab SKG121T supports the following NMEA-0183 messages: RMC,GGA,VTG,GSA,GSV,GLL,PSTMPPSDATA,PSTMPOSHOLD,PSTMTRAIMSTATUS,PSTMTRAIMUSED,PSTMTRAIMRES,PSTMTRAIMREMOVED. The module default NMEA-0183 output is set up RMC,GGA,VTG,GSA,GSV,GLL,PSTMPPSDATA,PSTMPOSHOLD,PSTMTRAIMSTATUS,PSTMTRAIMUSED,PSTMTRAIMRES,PSTMTRAIMREMOVED and default baud rate is set up 115200bps.

Table 1: NMEA-0183 Output Messages

NMEA Record	Description	Default
RMC	Recommended minimum specific GNSS data	Y
GGA	Global positioning system Fix Data	Y
GSA	GNSS DOP and active satellites	Y
GSV	GNSS Satellites in View	Y
VTG	Track Made Good and Ground Speed	Y
GLL	Geographic Position	Y
PSTMPPSDATA	Pulse Per Second data	Y
PSTMPOSHOLD	Position Hold status and position	Y
PSTMTRAIMSTATUS	TRAIM algorithm status	Y
PSTMTRAIMUSED	satellite used for timing correction	Y
PSTMTRAIMRES	time error residuals for satellites used for timing correction	Y
PSTMTRAIMREMOVED	satellite used for timing correction	Y

Table 1-1: Identifier mnemonic code

Identifier	Description
BD	Beidou System mode
GP	GPS mode
GN	GNSS mode
GA	Galileo mode
GI	IRNSS mode
QZ	QZSS mode

RMC-Recommended Minimum Specific GNSS Data

This sentence contains the recommended minimum fix information.

$GPRMC,070302.000,A,2238.34313,N,11403.10153,E,0.0,0.0,200521,,,D*65

Table 2: RMC Data Format

Name	Example	Units	Description
Message ID	$GPRMC		RMC protocol header
UTS Position	070302.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Latitude	2238.34313		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	11403.10153		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Speed Over Ground	0.0	Knots	
Course Over Ground	0.0	Degrees	True Course
Date(UTC)	200521		ddmmyy
Magnetic variation	<Null>	Degrees	Null fields when it is not Used
Magnetic variation Direction	<Null>		E=east or W=west
Fix Mode	D		A=autonomous, N = No fix, D=DGPS, E=DR
Checksum	*65		
EOL	<CR> <LF>		End of message termination

GGA-Global Positioning System Fix Data

This sentence contains the position, time and quality of the navigation fix.

See RMC for Fix Status, Fix Mode, Fix Date, Speed, and True Course.

See GSA for Fix Type, PDOP and VDOP.

$GPGGA,070302.000,2238.34313,N,11403.10153,E,2,25,0.6,101.62,M,-2.2,M,,*7D

Table 3: GGA Data Format

Name	Example	Units	Description
Message ID	$GPGGA		GGA protocol header
UTC Position	070302.000		hhmmss.sss
Latitude	2238.34313		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	11403.10153		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Position Fix Indicator	2		See Table 3-1
Satellites Used	25		Range 0 to 12
HDOP	0.6		Horizontal Dilution of Precision
MSL Altitude	101.62	meters	Altitude (referenced to the Ellipsoid)
AltUnit	M	meters	Altitude Unit
GeoSep	-2.2	meters	Geoidal Separation
GeoSepUnit	M	meters	Geoidal Separation Unit
Age of Diff.Corr	<Null>	second	Null fields when it is not Used
Diff.Ref.Station ID	<Null>		Null fields when it is not Used
Checksum	*7D		
EOL	<CR> <LF>		End of message termination

Table 3-1: Position Fix indicators

Value	Description
0	Fix not available or invalid
1	GPS SPS Mode, fix valid
2	Differential GPS, SPS Mode, fix valid
3	GPS PPS Mode, fix valid

GSA-GNSS DOP and Active Satellites

This sentence contains the mode of operation, type of fix, PRNs of the satellites used in the solution as well as PDOP, HDOP and VDOP.

$GNGSA,A,3,02,06,03,30,17,04,14,28,19,,,,1.1,0.6,0.9*22

$GNGSA,A,3,312,311,324,331,,,,,,,,,1.1,0.6,0.9*24

$GNGSA,A,3,173,147,153,148,150,143,163,145,168,142,177,141,1.1,0.6,0.9*25

Table 4: GSA Data Format

Name	Example	Units	Description
Message ID	$GPGSA		GSA protocol header
Mode 1	A		See Table 4-2
Mode 2	3		See Table 4-1
ID of satellite used	02		Sv on Channel 1
ID of satellite used	06		Sv on Channel 2
...	...		...
ID of satellite used	<Null>		Sv on Channel 12
PDOP	1.1		Position Dilution of Precision
HDOP	0.6		Horizontal Dilution of Precision
VDOP	0.9		Vertical Dilution of Precision
Checksum	*25		
EOL	<CR> <LF>		End of message termination

Table 4-1: Mode 1

Value	Description
1	Fix not available
2	2D Fix
3	3D Fix

Table 4-2: Mode 2

Value	Description
M	Manual-forced to operate in 2D or 3d mode
A	Automatic-allowed to automatically switch 2D/3D

GSV-Satellites in View

This sentence contains the PRNs, azimuth, elevation, and signal strength of all satellites in view.

$GPGSV,3,1,10,28,85,232,42,14,66,165,44,17,51,019,18,06,50,287,43*75

$GPGSV,3,2,10,19,43,343,42,03,27,045,43,02,22,262,39,09,12,129,*7A

$GPGSV,3,3,10,30,11,191,37,04,07,097,25,,,,,,,,*7C

$GAGSV,2,1,07,324,66,269,42,312,48,006,38,331,44,172,41,311,39,288,36*6D

$GAGSV,2,2,07,325,21,319,33,304,17,153,,333,13,051,,,,,*60

$BDGSV,4,1,15,150,79,304,40,147,72,146,42,148,68,324,39,143,64,190,40*66

$BDGSV,4,2,15,153,60,270,40,142,47,236,36,141,47,122,42,173,45,140,33*6D

$BDGSV,4,3,15,163,40,227,39,168,39,321,39,177,28,290,37,151,26,060,26*6E

$BDGSV,4,4,15,145,23,255,34,165,15,177,,174,10,077,14,,,,*69

Tabel 5: GSV Data Format

Name	Example	Units	Description
Message ID	$GPGSV		GSV protocol header
Number of Message	3		Total number of GSV sentences (Range 1 to 3)
Message Number	1		Sentence number of the total (Range 1 to 3)
Satellites in View	10		Number of satellites in view
Satellite ID	27		Channel 1 (Range 01 to 32)
Elevation	79	degrees	Channel 1 (Range 00 to 90)
Azinmuth	144	degrees	Channel 1 (Range 000 to 359)
SNR(C/NO)	48	dB-Hz	Channel 1 (Range 00 to 99, null when not tracking)
...	...		...
Satellite ID	08		Channel 4 (Range 01 to 32)
Elevation	46	degrees	Channel 4 (Range 00 to 90)
Azinmuth	204	degrees	Channel 4 (Range 000 to 359)
SNR(C/NO)	44	dB-Hz	Channel 4 (Range 00 to 99, null when not tracking)
Checksum	*72		
EOL	<CR> <LF>		End of message termination

Depending on the number of satellites tracked multiple messages of GSV data may be required.

VTG-Course Over Ground and Ground Speed

This sentence contains the course and speed of the navigation solution.

$GPVTG,0.0,T,,M,0.0,N,0.1,K,D*09

Table 6: VTG Data Format

Name	Example	Units	Description
Message ID	$GPVTG		VTG protocol header
Tcourse	0.0	Degrees	True Course
Reference	T		T = True

Mcourse	<Null>	Degrees	Magnetic Course (Null fields when it is not Used)
Reference	M		M = Magnetic (Null fields when it is not Used)
Speed over ground	0.0	Knots	Nautical Miles per Hour
Units	N		Knots
Speed over ground	0.1	Km/hr	in Kilometers per Hour
Units	K		Kilometer per hour
Mode	D		A=Autonomous, N=No fix, D=DGPS, E=DR
Checksum	*09		
EOL	<CR> <LF>		End of message termination

GLL-Geographic Position – Latitude/Longitude

This sentence contains the fix latitude and longitude.

$GPGLL,2238.34313,N,11403.10153,E,070302.000,A,D*56

Table 7: GLL DATA Format

Name	Example	Units	Description
Message ID	$GNGLL		GLL protocol header
Latitude	2238.34313		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	11403.10153		dddmm.mmmm
E/W Indicator	E		E=east or W=west
UTC Position	070302.000		hhmmss.sss
Fix Status	A		A=data valid or V=data not valid
Fix Mode	D		A=autonomous, N = No fix, D=DGPS, E=DR
Checksum	*56		
EOL	<CR> <LF>		End of message temination

PSTMPPSDATA - Reports the Pulse Per Second data

This sentence contains the Pulse Per Second data.

$PSTMPPSDATA,1,1,1,0,1,0,0.500000,0,633,420,420,633,0,0,0,10,129,21,3,18,18,0,0,0,8.770e-09,65473942.30,25999993.63,4*2D

Table 8: PSTMPPSDATA DATA Format

Name	Example	Units	Description
Message ID	$PSTMPPSDATA		PSTMPPSDATA protocol header
ON/OFF	1		PPS signal ON/OFF status 0: OFF 1: ON
PPS_Valid	1		Global PPS validity flag 0: PPS not valid 1: PPS valid
Synch_Valid	1		PPS synchronization validity 0: Not Valid 1: Valid
out_mode	0		0 = PPS_OUT_MODE_ALWAYS 1 = PPS_OUT_MODE_ON_EVEN_SECONDS 2 = PPS_OUT_MODE_ON_ODD_SECONDS
ref_time	1		0 = UTC 1 = GPS_UTC (GPS Time) 2 = GLONASS_UTC (GLONASS Time) 3 = UTC_SU 4 = GPS_UTC_FROM_GLONASS
ref_constellation	0		0 = GPS 1 = GLONASS
pulse_duration	0.500000		Pulse duration [s]
pulse_delay	0		Pulse delay [ns]
gps_delay	633		GPS path RF delay [ns]
glo_delay	420		GLONASS path RF delay [ns]

bei_delay	420		BEIDOU path RF delay [ns]
gal_delay	633		GALILEO path RF delay [ns]
inverted_polarity	0		Pulse polarity inversion: 0 = not inverted 1 = inverted
fix_cond	0		Selected GNSS fix condition for PPS signal generation: 1 = NO_FIX 2 = 2D_FIX 3 = 3D_FIX
sat_th	0		Selected minimum number of satellites for PPS signal generation.
elev_mask	10		Selected minimum satellite elevation for time correction.
const_mask	129		Selected constellations for time correction.
ref_sec	21		Second at which the reported PPS data is applied. According to the reference time configuration it could be a UTC or a GPS or a GLONASS time second.
fix_status	3		GNSS position fix status when the time has been corrected.
used_sats	18		Used satellites for time correction.
gps_utc_delta_s	18		UTC leap seconds [s]
gps_utc_delta_ns	0		UTC – GPS delta time [ns]
glonass_utc_delta_ns	0		UTC – GLONASS delta time [ns]
galileo_utc_delat_ns	0		UTC – GALILEO delta time [ns]
quantization_error	8.770e-09		Quantization error [s]
pps_clock_freq	65473942.30		PPS clock frequency [Hz]

tcxo_clock_freq	25999993.63		TCXO clock frequency [Hz]
Checksum	*2D		
EOL	<CR> <LF>		End of message temination

PSTMPOSHOLD - Reports the Position Hold status and position

This sentence contains the Position Hold status and position.

$PSTMPOSHOLD,0,2238.34260,N,11403.10153,E,096.61*4D

Table 9:PSTMPOSHOLD DATA Format

Name	Example	Units	Description
Message ID	$PSTMPOSHOLD		PSTMPOSHOLD protocol header
ON/OFF	1		Position Hold enabling/disabling status 0: disabled 1: enabled
Lat	2238.34260		Lat in degree: DD: Degree MM: Minutes MMMMM: partsMinutes
N/S	N		Lat Direction: North or South
Long	11403.10153		Lat in degree: DD: Degree MM: Minutes MMMMM: partsMinutes
E/W	E		Long Direction: East or West
Alt	096.61		Height above WGS84 Elipsoid, max: 100000
Checksum	*4C		
EOL	<CR> <LF>		End of message temination

PSTMTRAIMSTATUS - Reports the TRAIM algorithm status

This sentence contains the TRAIM algorithm status.

$PSTMTRAIMSTATUS,1,0,15,1,17,4,4*53

Table 10:PSTMTRAIMSTATUS DATA Format

Name	Example	Units	Description
Message ID	$PSTMTRAIMSTATUS		PSTMTRAIMSTATUS protocol header
ON/OFF	1		TRAIM ON/OFF status 0: OFF 1: ON
traim_solution	0		TRAIM algorithm status: 0 = UNDERAlarm 1 = OVERAlarm 2 = UNKNOWN
alarm	15		Time error threshold [ns]
ave_error	1		Average time error [ns]
used_sats	17		Number of used satellites
removed_sats	4		Number of removed satellites
ref_second	4		Second at which the PPS signal is generated based on reported TRAIM status
Checksum	*53		
EOL	<CR> <LF>		End of message temination

PSTMTRAIMUSED - Reports the satellite used for timing correction

This sentence contains the satellite used for timing correction.

$PSTMTRAIMUSED,1,17,172,168,167,148,5,9,153,173,19,143,150,147,17,145,141,142,177*71

Table 11:PSTMTRAIMUSED DATA Format

Name	Example	Units	Description
Message ID	$PSTMTRAIMSTATUS		PSTMTRAIMSTATUS protocol header
ON/OFF	1		TRAIM ON/OFF status 0: OFF 1: ON
used_sats	17		Number of used satellites.
Sat1..satN	...		Used satellites list
Checksum	*71		
EOL	<CR> <LF>		End of message temination

PSTMTRAIMRES - the time error residuals for satellites used for timing correction

This sentence contains the time error residuals for satellites used for timing correction.

$PSTMTRAIMRES,1,17,2,-6,-15,-10,11,10,5,-9,6,-3,-6,5,15,12,-6,-5,-5*10

Table 12:PSTMTRAIMRES DATA Format

Name	Example	Units	Description
Message ID	$PSTMTRAIMRES		PSTMTRAIMRES protocol header
ON/OFF	1		TRAIM ON/OFF status 0: OFF 1: ON
used_sats	17		Number of used satellites.

res1..resN	...		Time error residuals for satellites reported in the TRAIMUSED message. Each residual refers to the satellite in the same message position.
Checksum	*10		
EOL	<CR> <LF>		End of message temination

PSTMTRAIMREMOVED - Reports the satellite removed by the timing correction algorithm

This sentence contains the satellite removed by the timing correction algorithm.

$PSTMTRAIMREMOVED,1,4,2,12,6,28*13

Table 13:PSTMTRAIMREMOVED DATA Format

Name	Example	Units	Description
Message ID	$PSTMTRAIMREMOVED		PSTMTRAIMREMOVED protocol header
ON/OFF	1		TRAIM ON/OFF status 0: OFF 1: ON
removed_sats	4		Number of removed satellites
Sat1..satN	...		Removed satellites list
Checksum	*13		
EOL	<CR> <LF>		End of message temination

15 Contact Information

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