

# GPS Module DataSheet

Name: Ultra High Sensitivity and Low Power GPS Receiver Module

Model No.: SKM61

Revision: 001

Revision History:

Revision	Description	Approved	Date
001	Initial Release to 001	Wood	20131015

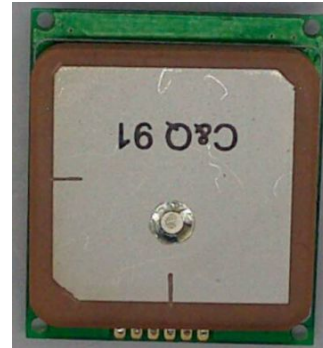
## General Description

The SKM61 is a complete GPS engine module that features super sensitivity, ultra low power and small form factor. The GPS 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 MediaTek single-chip architecture, Its  $-165\text{dBm}$  tracking sensitivity extends positioning coverage into place like urban canyons and dense foliage environment where the GPS 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.

## Applications

- LBS (Location Based Service)
- PND (Portable Navigation Device)
- Vehicle navigation system
- Timing application

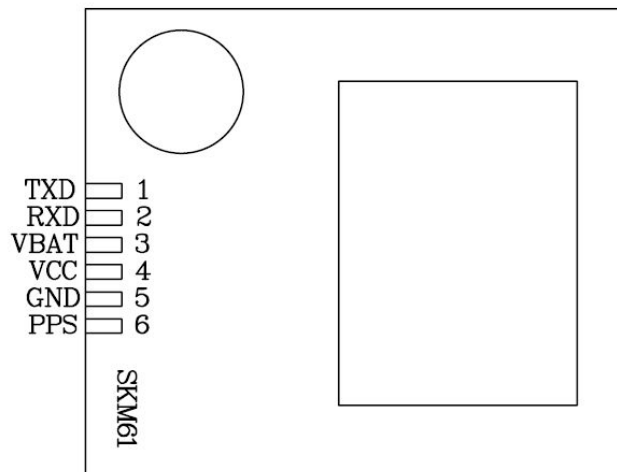


**Figure 1: SKM61 Top View**

## Features

- Ultra high sensitivity:  $-165\text{dBm}$
- Extremely fast TTFF at low signal level
- Built in high gain LNA
- Low power consumption: Typical  $23\text{mA}@3.3\text{V}$
- NMEA-0183 compliant protocol or custom protocol
- Operating voltage:  $3.3\text{V}$  to  $5.5\text{V}$
- Operating temperature range:  $-40$  to  $85^\circ\text{C}$
- Small form factor:  $30 \times 26 \times 7.6\text{mm}$
- RoHS compliant (Lead-free)

## Pin Assignment



**Figure 2: TOP View**

## Pin Description

Pin No.	Pin name	I/O	Description	Remark
1	TXD	O	UART Serial Data Output	
2	RXD	I	UART Serial Data Input	
3	VBAT	P	Battery Power Supply 2.0—4.2V	
4	VCC	P	Module Power Supply 3.3—5.5V	
5	GND	G	Ground	
6	PPS	O	Time pulse Signal (100ms)	

## Interfaces Configuration

### Power Supply

Regulated power for the SKM61 is required. The input voltage Vcc should be 3.3V to 5.5V range, current is no less than 50mA. Suitable decoupling must be provided by external decoupling circuitry (10uF and 1uF). It can reduce the Noise from power supply and increase power stability.

Main power supply Vcc current varies according to the processor load and satellite acquisition. Maximum Vcc peak current is about 30 mA during acquisition.

### UART Ports

The module supports one full duplex serial channels UART. The serial connections are at 2.85V LVTTTL logic levels, if need different voltage levels, use appropriate level shifters. the data format is however fixed: X, N, 8, 1, i.e. X baud rate, no parity, eight data bits and one stop bit, no other data formats are supported, LSB is sent first. The modules default baud rate is set up 9600bps. The RXD & TXD recommended to pull up (10KΩ). It can increase the stability of serial data.

## Performance Specification

Parameter	Specification
Receiver Type	L1 frequency band, C/A code, 22 Tracking / 66 Acquisition-Channel
Sensitivity	Tracking -165dBm Typical Acquisition -148dBm Typical
Accuracy	Position 3.0m CEP50 without SA(Typical Open Sky) Velocity 0.1m/s without SA Timing (PPS) 10ns RMS
Acquisition Time	Cold Start 23s(Typical Open Sky) Warm Start 2-3s Hot Start 1s Re-Acquisition <1s
Assisted GPS support	EPO

Power Consumption	Tracking	23mA @3.3V Typical
	Acquisition	27mA @3.3V
Navigation Data Update Rate	Max 10Hz	Default 1Hz
Operational Limits	Altitude	Max 18,000m
	Velocity	Max 515m/s
	Acceleration	Less than 4g

## Electrical Characteristics

### Absolute Maximum Rating

Parameter	Symbol	Min	Max	Units
<b>Power Supply</b>				
Power Supply Volt.	VCC	-0.3	7.0	V
<b>Input Pins</b>				
Input voltage on any input connection	VIO	-0.3	3.6	V
Human Body Model ESD capability	ANTENNA_IN		2000	V
Machine Model ESD capability	ANTENNA_IN		100	V
<b>Environment</b>				
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.

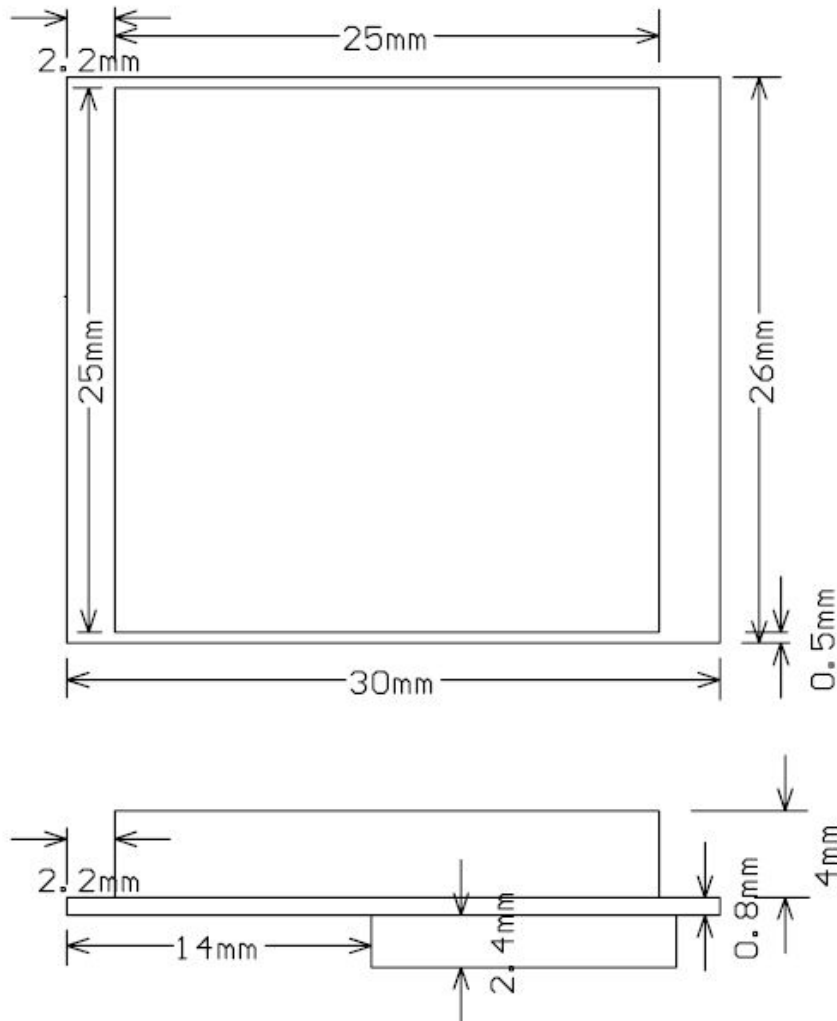
The SKM61 module is Electrostatic Sensitive Device (ESD) and may be damaged with ESD or spike voltage. Although it has built-in ESD protection circuitry at digital I/O, please handle with care to avoid permanent malfunction or performance degradation. Note that RFIN has no ESD protection circuits.

### Operating Conditions

Parameter	Symbol	Condition	Min	Typ	Max	Units
Power supply voltage	Vcc		3.3	5.0	5.5	V

Power supply voltage ripple	V <sub>cc_PP</sub>	V <sub>cc</sub> =3.3V			30	mV
Supply current, navigation	I <sub>cc</sub>	V <sub>cc</sub> =3.3V		23	28	mA
Supply current, backup state	I <sub>bkp</sub>	V <sub>cc</sub> =3.3V		7		uA
Input high voltage	V <sub>IH</sub>		2		3.6	V
Input low voltage	V <sub>IL</sub>		-0.3		0.8	V
Output high voltage	V <sub>OH</sub>		2.4		3.1	V
Output low voltage	V <sub>OL</sub>		-0.3		0.4	V
Operating temperature	T <sub>opr</sub>		-40		85	°C

**Mechanical Specification**



**Figure 3: SKM61 Dimensions**

**Software Protocol**

**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 \$GPxxx 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 SKM61 supports the following NMEA-0183 messages: GGA, GLL, GSA, GSV, RMC VTG, ZDA. The module default NMEA-0183 output is set up GGA、GSA、RMC、GSV, and default baud rate is set up 9600bps.

Table 1: NMEA-0183 Output Messages

NMEA Record	Description	Default
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GGA	Global positioning system fixed data	Y
GLL	Geographic position—latitude/longitude	N
GSA	GNSS DOP and active satellites	Y
GSV	GNSS satellites in view	Y
RMC	Recommended minimum specific GNSS data	Y
VTG	Course over ground and ground speed	N
ZDA	Date and Time	N

**GGA-Global Positioning System Fixed 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,021514.000,2232.1799,N,11401.1823,E,1,6,1.25,84.0,M,-2.2,M,\*74

Table 2: GGA Data Format

Name	Example	Units	Description
Message ID	\$GPGGA		GGA protocol header
UTC Position	021514.000		hhmmss.sss
Latitude	2232.1799		ddmm.mmmm
N/S indicator	N		N=north or S=south
Longitude	11401.1823		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Position Fix Indicator	1		See Table 2-1
Satellites Used	6		Range 0 to 12
HDOP	1.25		Horizontal Dilution of Precision
MSL Altitude	84.0	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	*74		
EOL	<CR> <LF>		End of message termination

Table 2-1: 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

### GLL-Geographic Position – Latitude/Longitude

This sentence contains the fix latitude and longitude.

\$GPGLL,2232.1799,N,11401.1824,E,021513.000,A,A\*50

Table 3: GLL Data Format

Name	Example	Units	Description
Message ID	\$GPGLL		GLL protocol header
Latitude	2232.1799		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	11401.1824		dddmm.mmmm
E/W Indicator	E		E=east or W=west
UTC Position	021513.000		hhmmss.sss
Fix Status	A		A=data valid or V=data not valid
Fix Mode	A		A=autonomous, N = No fix, D=DGPS, E=DR
Checksum	*50		
EOL	<CR> <LF>		End of message termination

### 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.

\$GPGSA,A,3,26,05,18,15,27,29,,,,,,,,,1.52,1.25,0.87\*0F

Table 4: GSA Data Format

Name	Example	Units	Description
Message	\$GPGSA		GSA protocol header
Mode 1	A		See Table 4-2
Mode 2	3		See Table 4-1
ID of satellite used	26		Sv on Channel 1
ID of satellite used	05		Sv on Channel 2
...	...		...
ID of satellite used	<Null>		Sv on Channel 12 (Null fields when it is not Used)
PDOP	1.52		Position Dilution of Precision
HDOP	1.25		Horizontal Dilution of Precision
VDOP	0.87		Vertical Dilution of Precision
Checksum	*0F		
EOL	<CR> <LF>		End of message termination

Table 4-1: Mode 1

Value	Description
1	Fix not available
2	2D Fix



3	3D Fix
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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-GNSS Satellites in View**

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

\$GPGSV,3,1,12,15,79,333,42,42,50,127,,29,45,263,44,02,36,124,30\*7E

\$GPGSV,3,2,12,26,36,226,34,05,35,046,22,27,33,161,29,21,16,319,\*7D

\$GPGSV,3,3,12,10,15,066,31,18,14,285,45,24,12,319,15,08,09,047,18\*7E

Table 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	12		Number of satellites in view
Satellite ID	15		Channel 1(Range 01 to 32)
Elevation	79	degrees	Channel 1(Range 00 to 90)
Azinmuth	333	degrees	Channel 1(Range 000 to 359)
SNR(C/NO)	42	dB-Hz	Channel 1(Range 00 to 99, null when not tracking)
...			...
Satellite ID	02		Channel 4(Range 01 to 32)
Elevation	36	degrees	Channel 4(Range 00 to 90)
Azimuth	124	degrees	Channel 4(Range 000 to 359)
SNR(C/NO)	30	dB-Hz	Channel 4(Range 00 to 99, null when not tracking)
Checksum	*7E		
EOL	<CR> <LF>		End of message termination

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

**RMC-Recommended Minimum Specific GNSS Data**

This sentence contains the recommended minimum fix information.

See GGA for Fix Quality, Sats Used, HDOP, Altitude, Geoidal Separation, and DGPS data.

See GSA for Fix Type, PDOP and VDOP.

\$GPRMC,023345.000,A,2232.1767,N,11401.1953,E,0.18,151.55,100410,,A\*6B

Table 6: RMC Data Format

Name	Example	Units	Description
Message ID	\$GPRMC		RMC protocol header
UTS Position	023345.000		hhmmss.sss

Status	A		A=data valid or V=data not valid
Latitude	2232.1767		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	11401.1953		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Speed Over Ground	0.18	Knots	
Course Over Ground	151.55	Degrees	True Course
Date(UTC)	100410		ddmmyy
Magnetic variation	<Null>	Degrees	Null fields when it is not Used
Magnetic Variation Direction	<Null>		E=east or W=west (Null fields when it is not Used)
Fix Mode	A		A=autonomous, N = No fix, D=DGPS, E=DR
Checksum	*6B		
EOL	<CR> <LF>		End of message termination

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

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

\$GPVTG,148.81,T,,M,0.13,N,0.24,K,A\*3D

Table 7: VTG Data Format

Name	Example	Units	Description
Message ID	\$GPVTG		VTG protocol header
Tcourse	148.81	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	0.13	Knots	Nautical Miles per Hour
Units	N		Knots
Speed over ground	0.24	Km/hr	in Kilometers per Hour
Units	K		Kilometer per hour
Mode	A		A=Autonomous, N=No fix, D=DGPS, E=DR
Checksum	*3D		
EOL	<CR> <LF>		End of message termination

**ZDA-Date and Time**

This sentence contains UTC date & time, and local time zone offset information.

\$GPZDA,023345.000,10,04,2010,,\*50

Table 8: ZDA Data Format

Name	Example	Units	Description
Message ID	\$GPZDA		ZDA protocol header
UTC Time	023345.000		hhmmss.sss

Day	10		UTC time: day (01 ... 31) dd
Month	04		UTC time: month (01 ... 12) mm
Year	2010		UTC time: year (4 digit year) yyyy
local zone hours	<null>		Local Time Zone Offset Hours (Null fields when it is not Used)
local zone minutes	<null>		Local Time Zone Offset Minutes (Null fields when it is not Used)
Checksum	*50		
EOL	<CR> <LF>		End of message termination

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