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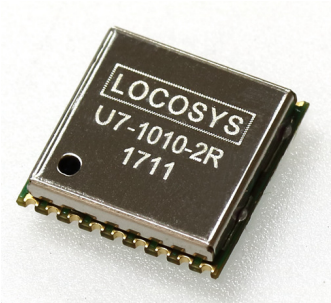
Product name	Description	Version
U7-1010-2R	Datasheet of U7-1010-2R standalone GNSS module	1.0



1 Introduction

LOCOSYS U7-1010-2R is a complete standalone GNSS module. The module can simultaneously acquire and track multiple satellite constellations that include GPS, GLONASS, QZSS and SBAS. It features low power and small form factor. Besides, it can provide you with superior sensitivity and performance even in urban canyon and dense foliage environment.

2 Features

- u-blox 7 high sensitivity solution
- Support GPS, GLONASS, QZSS
- Capable of SBAS (WAAS, EGNOS, MSAS)
- Support 56-channel GNSS
- Fast TTFF at low signal level
- Support 1PPS synchronize with NMEA output
- Small form factor 10.1x9.7x2 mm
- SMD type with stamp holes; RoHS compliant
- ISO/IATF 16949 quality control

3 Application

- Personal positioning and navigation
- Automotive navigation, model aircraft navigation
- Marine navigation

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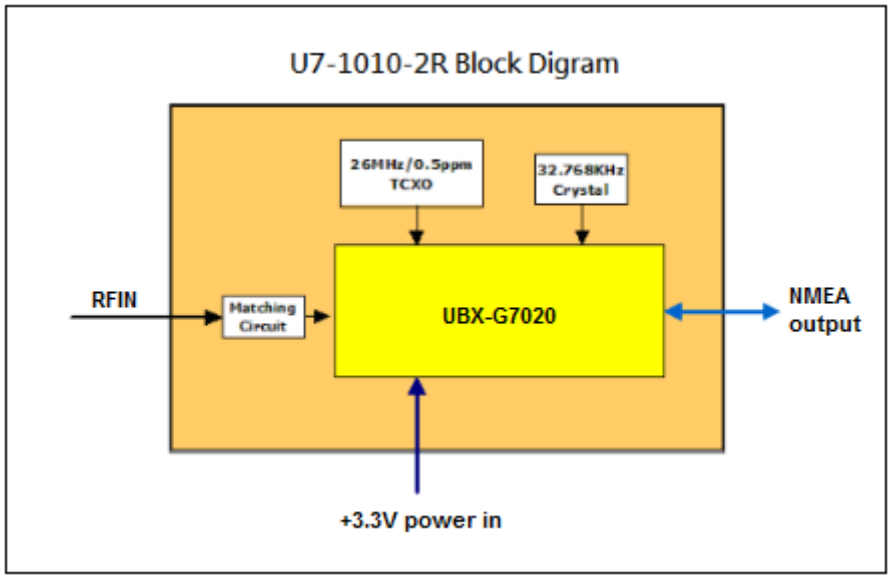
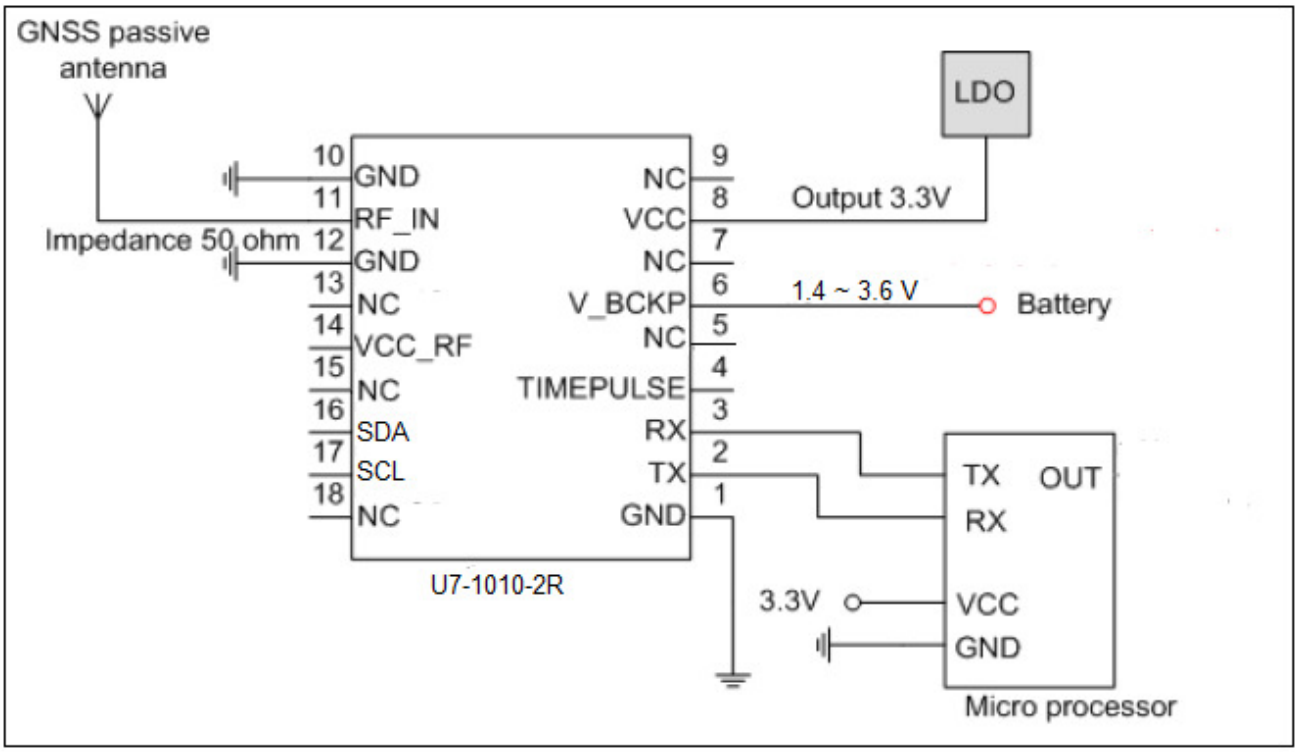
4 Overview

4.1 Block Diagram



4.2 Typical application circuit that uses a passive antenna.



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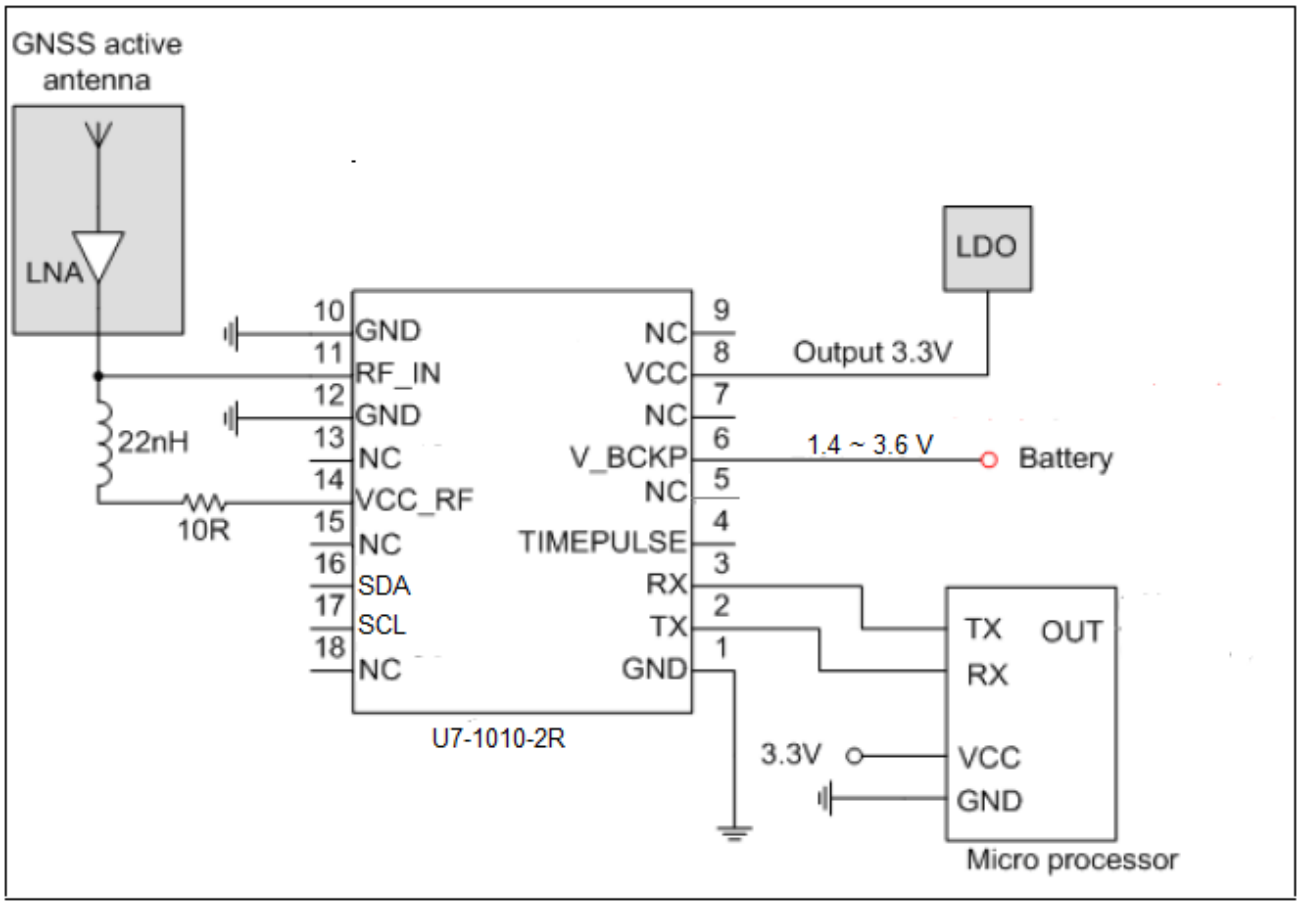
4.3 Typical application circuit that uses an active antenna



4.4 GNSS Performance

Chip	UBX-G7020	
Frequency	GPS, QZSS: L1 1575.42MHz, C/A code GLONASS: L1 1598.0625MHz ~ 1605.375MHz, C/A code	
Channels	Support 56 channels	
Update rate	1Hz default, up to 10Hz	
Sensitivity	Tracking	GPS : -162dBm (with external LNA) GLONASS : -158dBm (with external LNA)
	Cold start	GPS : -148dBm (with external LNA) GLONASS : -140dBm (with external LNA)
Acquisition Time	Hot start (Open Sky)	GPS : < 1s (typical) GLONASS : < 1s (typical)
	Cold Start (Open Sky)	GPS : 29s (typical) GLONASS : 30s (typical)
Position Accuracy	Autonomous	GPS : 2.5m CEP GLONASS : 4.0m CEP

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Velocity Accuracy(1)	0.1 m/s	
Heading Accuracy(1)	0.5 degrees	
Max. Altitude	< 50,000 m	
Max. Velocity	< 500 m/s	
Protocol Support	NMEA 0183 ver 3.0	9600bps (2), 8 data bits, no parity, 1 stop bits (default) 1Hz: GGA, GLL, GSA, GSV, RMC, VTG and TXT
	UBX Protocol	9600 bps (configurable), 8 data bits, no parity, 1 stop bits

Note 1: 50% @30 m/s.

4.5 Pin assignment and descriptions (Top View)

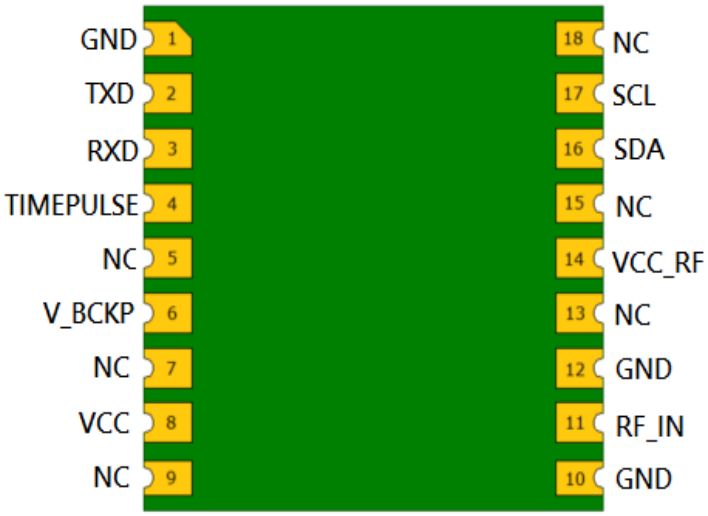

Table 4.3-1 Pin descriptions

Pin #	Name	Type	Description	Note
1	GND	P	Ground	
2	TXD	O	UART, asynchronous output.	
3	RXD	I	UART, asynchronous input.	
4	TIMEPULSE	O	Time pulse (1PPS, default 100 ms pulse/sec when 3D fix is available)	
5	NC	-	Reserved, keep open.	
6	V_BCKP	P	Backup battery supply voltage	
7	NC		Reserved, keep open.	1
8	VCC	P	Supply voltage	
9	NC	-	Reserved, keep open.	

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10	GND	P	Ground	
11	RF_IN	I	GNSS matched RF input, DC block inside.	
12	GND	P	Ground	
13	NC	O	Reserved, keep open.	
14	VCC_RF	P	Output voltage for active antenna	
15	NC	-	Reserved, keep open.	
16	SDA	I/O	DDC Data	
17	SCL	I/O	DDC Clock	
18	NC	-	Reserved, keep open.	

Note 1: For u-blox MAX-7 series, the pin is "VCC_IO".

5 DC & Temperature characteristics

5.1 Absolute maximum ratings

Parameter	**Symbol**	**Ratings**	**Units**
DC Supply Voltage	VCC	3.6	V
Input Backup Battery Voltage	V_BCKP	3.6	V
Operating Temperature Range	Topr	-40 ~ 85	℃
Storage Temperature Range	Tstg	-40 ~ 85	℃

5.2 DC Electrical characteristics

Parameter	**Symbol**	**Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
Input Voltage	VCC		2.7	3.0	3.6	V
Input Backup Battery Voltage	V_BCKP		1.4		3.6	V
VCC_RF Output Voltage	VOUT			VCC-0.1		V
Supply Current	Iss	VCC = 3.3V, w/o active antenna, Peak Acquisition Tracking		 25 18	67	 mA mA mA
Backup Battery Current	Ibat	Remove the power of VCC		15		uA
VCC_RF Output Current	I_{out}	VIN = 3.3V			50	mA
High Level Input Voltage	V_{IH}		0.7*VCC		VCC+0.5	V
Low Level Input Voltage	V_{IL}		0		0.2*VCC	V
High Level Output Voltage	V_{OH}		VCC-0.4			V
Low Level Output Voltage	V_{OL}				0.4	V
High Level Output Current	I_{OH}			4		mA

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High Level Output Current	I_{OL}			4		mA

5.3 Temperature characteristics

Parameter	**Symbol**	**Min.**	**Typ.**	**Max.**	**Units**
Operating Temperature	Topr	-40	-	85	℃
Storage Temperature	Tstg	-40	25	85	℃

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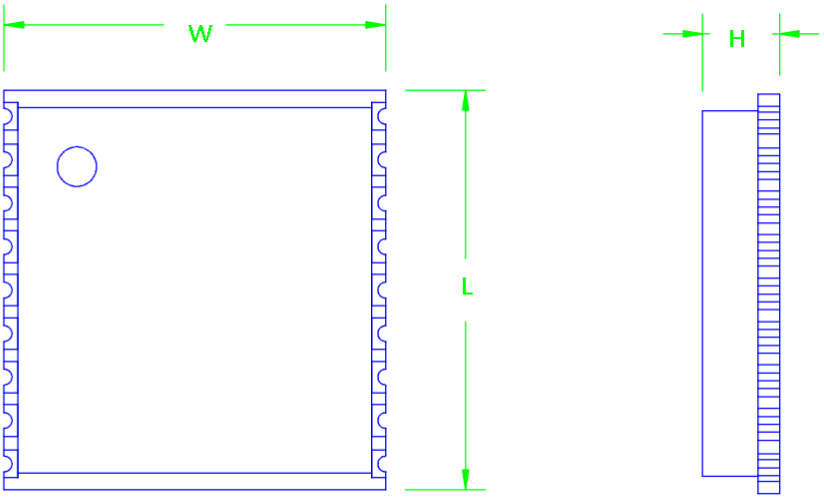
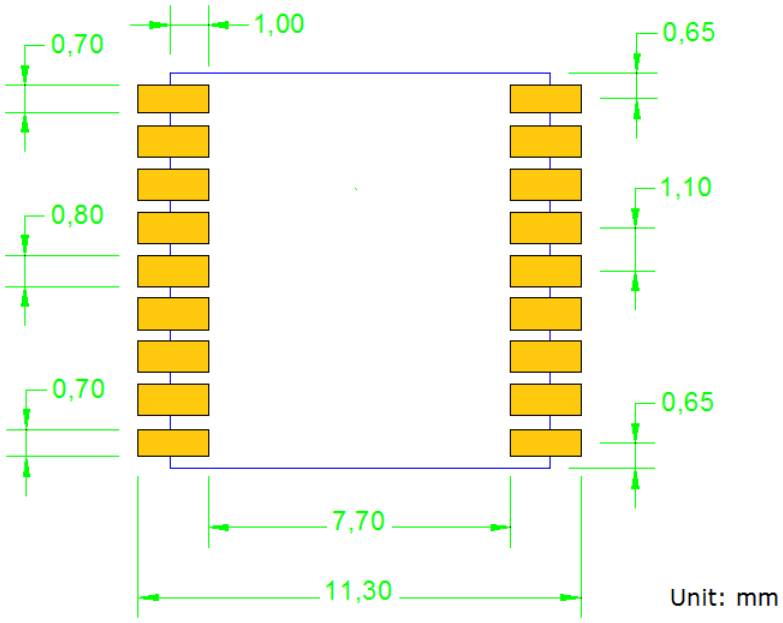
6 Mechanical specification

6.1 Outline dimensions



Symbol	Min. (mm)	Typ. (mm)	Max. (mm)
W	9.6	9.7	9.8
L	10.0	10.1	10.3
H	1.9	2.0	2.2

6.2 Recommended land pattern dimensions



Note: The recommended land pattern dimensions are shown for reference only, as actual pad layouts may vary depending on application.

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7 Software interface

7.1 NMEA output message

Table 7.1-1 NMEA output message

NMEA	Description
GGA	Global positioning system fixed data
GLL	Geographic position - latitude/longitude
GSA	GNSS Overall satellite data
GSV	GNSS Detailed satellite data
RMC	Recommended minimal data for GNSS
VTG	Course over ground and ground speed
TXT	Text Transmission

● GGA Global positioning system fixed data

Table 7.1-2 contains the values for the following example:

$GPGGA,092725.00,4717.11399,N,00833.91590,E,1,08,1.01,499.6,M,48.0,M,,*5B

Table 7.1-2 GGA Data Format

Name	Example	Units	Description
Message ID	$GPGGA		GGA Message ID (GP = current Talker ID)
UTC Time	092725.00		hhmmss.ss
Latitude	4717.11399		ddmm.mmmmm
N/S indicator	N		N=north or S=south
Longitude	00833.91590		dddmm.mmmmm
E/W Indicator	E		E=east or W=west
Position Fix Indicator	1		See Table 7.1-3
Satellites Used	08		Number of satellites in view, 00-24
HDOP	1.01		Horizontal Dilution of Precision (meters)
MSL Altitude	499.6	meters	Antenna Altitude above/below mean-sea-level (geoid) (in meters)
Units	M	meters	Units of antenna altitude, meters
Geoidal Separation	48.0	meters	
Units	M	meters	Units of geoidal separation, meters
Age of diff. GNSS data		second	Null fields when DGPS is not used
Diff. Ref. Station ID			Differential reference station ID, 0000-1023
Checksum	*5B		Checksum
<CR> <LF>			End of message termination

Table 7.1-3 Position Fix Indicators

Value	Description

0	Fix not available
1	GNSS fix
2	Differential GNSS fix

● GLL--- Geographic Position – Latitude/Longitude

Table 7.1-4 contains the values for the following example:

$GPGLL,2503.71286,N,12138.74702,E,034518.00,A,A*63

Table 7.1-4 GLL Data Format

Name	**Example**	**Units**	**Description**
Message ID	$GPGLL		GLL protocol header
Latitude	2503.71286		ddmm.mmmmm
N/S indicator	N		N=north or S=south
Longitude	12138.74702		dddmm.mmmmm
E/W indicator	E		E=east or W=west
UTC Time	034518.00		hhmmss.ss
Status	A		A=data valid or V=data not valid
Mode	A		V = Invalid, A= Autonomous and D =Differential
Checksum	*63		
<CR> <LF>			End of message termination

● GSA--GNSS DOP and Active Satellites

Table 7.1-5 contains the values for the following example:

$GPGSA,A,3,08,23,09,16,27,,,,,,,,6.61,3.36,5.69*0D

Table 7.1-5 GSA Data Format

Name	**Example**	**Units**	**Description**
Message ID	$GPGSA		GSA protocol header
Mode 1	A		See Table 7.1-6
Mode 2	3		See Table 7.1-7
ID of satellite used	08		Sv on Channel 1
ID of satellite used	23		Sv on Channel 2
….			….
ID of satellite used			Sv on Channel 12
PDOP	6.61		Position Dilution of Precision
HDOP	3.36		Horizontal Dilution of Precision
VDOP	5.69		Vertical Dilution of Precision
Checksum	*0D		
<CR> <LF>			End of message termination

Table 7.1-6 Mode 1

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

Table 7.1-7 Mode 2

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

Note 1: 2D fix hint that the receiver position error meets the 2D level. Maybe under this condition the used satellite number is little more than 4

● GSV---GNSS Satellites in View

Table 7.1-8 contains the values for the following example:

$GPGSV,4,1,16,04,47,095,36,07,,,35,08,53,223,39,09,25,305,34*4C

$GPGSV,4,2,16,10,,,22,11,,,32,12,,,16,16,47,016,36*4A

$GPGSV,4,3,16,19,,,22,20,,,21,21,,,29,23,46,273,36*48

$GPGSV,4,4,16,26,32,049,33,27,87,000,39,28,,,22,31,,,36*7B

Table 7.1-8 GSV Data Format

Name	Example	Units	Description
Message ID	$GPGSV		GSV protocol header
Total number of messages[1]	4		Range 1 to 6
Message number[1]	1		Range 1 to 6
Satellites in view	16		
Satellite ID[2]	04		Channel 1
Elevation	47	degrees	Channel 1 (Range 00 to 90)
Azimuth	095	degrees	Channel 1 (Range 000 to 359)
SNR (C/No)	36	dB-Hz	Channel 1 (Range 00 to 99, null when not tracking)
….			….
Satellite ID	09		Channel 4 (Range 01 to 196)
Elevation	25	degrees	Channel 4 (Range 00 to 90)
Azimuth	305	degrees	Channel 4 (Range 000 to 359)
SNR (C/No)	34	dB-Hz	Channel 4 (Range 00 to 99, null when not tracking)
Checksum	*4C		
<CR> <LF>			End of message termination

Note 1: Depending on the number of satellites tracked multiple messages of GSV data may be required.

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● RMC---Recommended Minimum Specific GNSS Data

Table 7.1-9 contains the values for the following example:

$GPRMC,034519.00,A,2503.71293,N,12138.74692,E,0.123,,260517,,,A*70

Table 7.1-9 RMC Data Format

Name	Example	Units	Description
Message ID	$GPRMC		RMC protocol header
UTC Time	034519.00		hhmmss.ss
Status	A		A=data valid or V=data not valid
Latitude	2503.71293		ddmm.mmmmm
N/S Indicator	N		N=north or S=south
Longitude	12138.74692		dddmm.mmmmm
E/W Indicator	E		E=east or W=west
Speed over ground	0.123	knots	True
Course over ground		degrees	
Date	260517		ddmmyy
Magnetic variation		degrees	
Variation sense			E=east or W=west
Mode	A		V=Invalid A=autonomous, D=Differential.
Checksum	*70		
<CR> <LF>			End of message termination

● VTG---Course Over Ground and Ground Speed

Table 7.1-10 contains the values for the following example:

$GPVTG,,T,,M,0.023,N,0.043,K,A*25

Table 7.1-10 VTG Data Format

Name	Example	Units	Description
Message ID	$GPVTG		VTG protocol header
Course over ground		degrees	Measured heading
Reference	T		True
Course over ground		degrees	Measured heading
Reference	M		Magnetic
Speed over ground	0.023	knots	Measured speed
Units	N		Knots
Speed over ground	0.043	km/hr	Measured speed
Units	K		Kilometer per hour
Mode	A		V=Invalid A=autonomous, D=Differential.
Checksum	*25		

<CR> <LF>			End of message termination

● TXT--- Text Transmission

Table 7.1-11 contains the values for the following example:

$GPTXT,01,01,02,ANTSTATUS=INIT*25

$GPTXT,01,01,02,ANTSTATUS=OK*3B

Table 7.1-11 TXT Data Format

Name	**Example**	**Units**	**Description**
Message ID	$GPTXT		TXT protocol header
numMsg	01		Total number of messages in this transmission, 01.. 99
msgNum	01		Message number in this transmission, range 01..xx
msgType	02		Text identifier, u-blox GPS receivers specify the type of the message with this number. 00: Error 01: Warning 02: Notice 07: User
text	ANTSTATUS=INT		Any ASCII text
Checksum	*25		
<CR> <LF>			End of message termination

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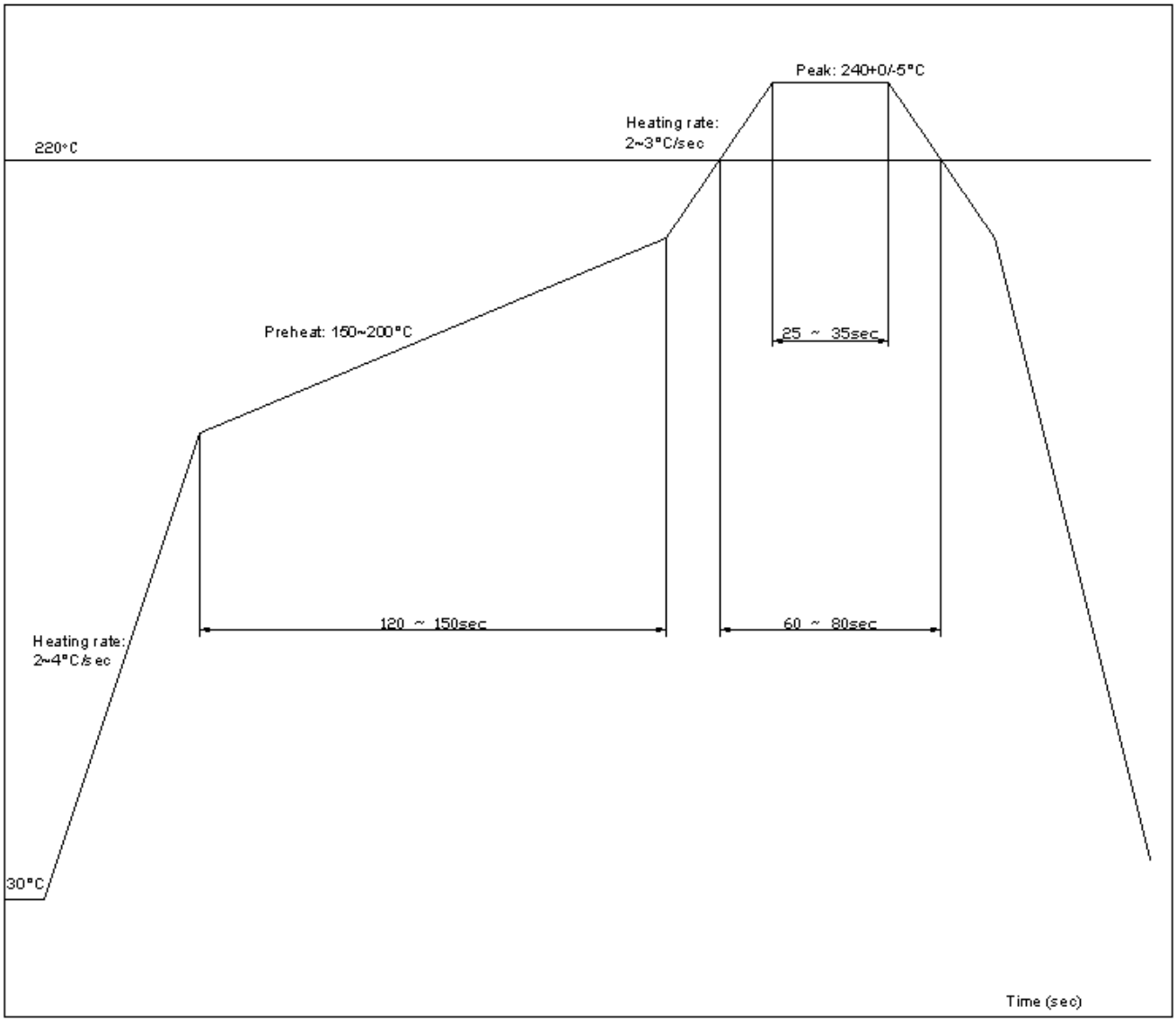
8 Recommended soldering reflow profile

The module belongs to RoHS device. The maximum of reflow temperature, real on top of PCB, is not over 240 Celsius.

Lead-free Processes



Lead –Free Solder Paste (Sn 96.5-Ag 3.0-Cu 0.5) Cycle Interval: 300 sec

Note:
The U7-1010-2R module should be soldered on the topside in the soldering process to prevent from falling down.

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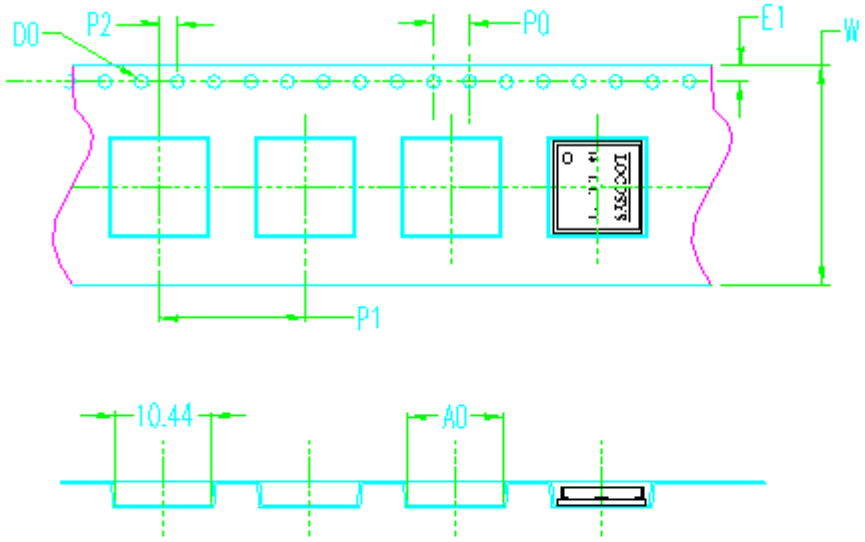
9 Reel packing information



1. 10 sprocket hole pitch cumulative tolerance ±0.2
2. Camber not to exceed 1mm in 250mm
3. A0 and B0 measured on a plane 0.30mm above the bottom of the pocket
4. K0 measured from a plane on the inside bottom of the pocket to the top surface of the carrier
5. pocket position relative to sprocket hole measured as true position of pocket,not pocket hole.
6. Component load per 13"reel: 1500 pcs
7. All dimensions meet EIA-481-C requirements.

A0	10.44 ±0.1
B0	10.60 ±0.1
D0	ø1.5 +0.10 −0.00
E1	1.75 ±0.1
K0	2.60 ±0.1
P0	4.0 ±0.1
P1	16.0 ±0.1
P2	2.0 ±0.15
T	0.30 ±0.05
W	24.0 ±0.3

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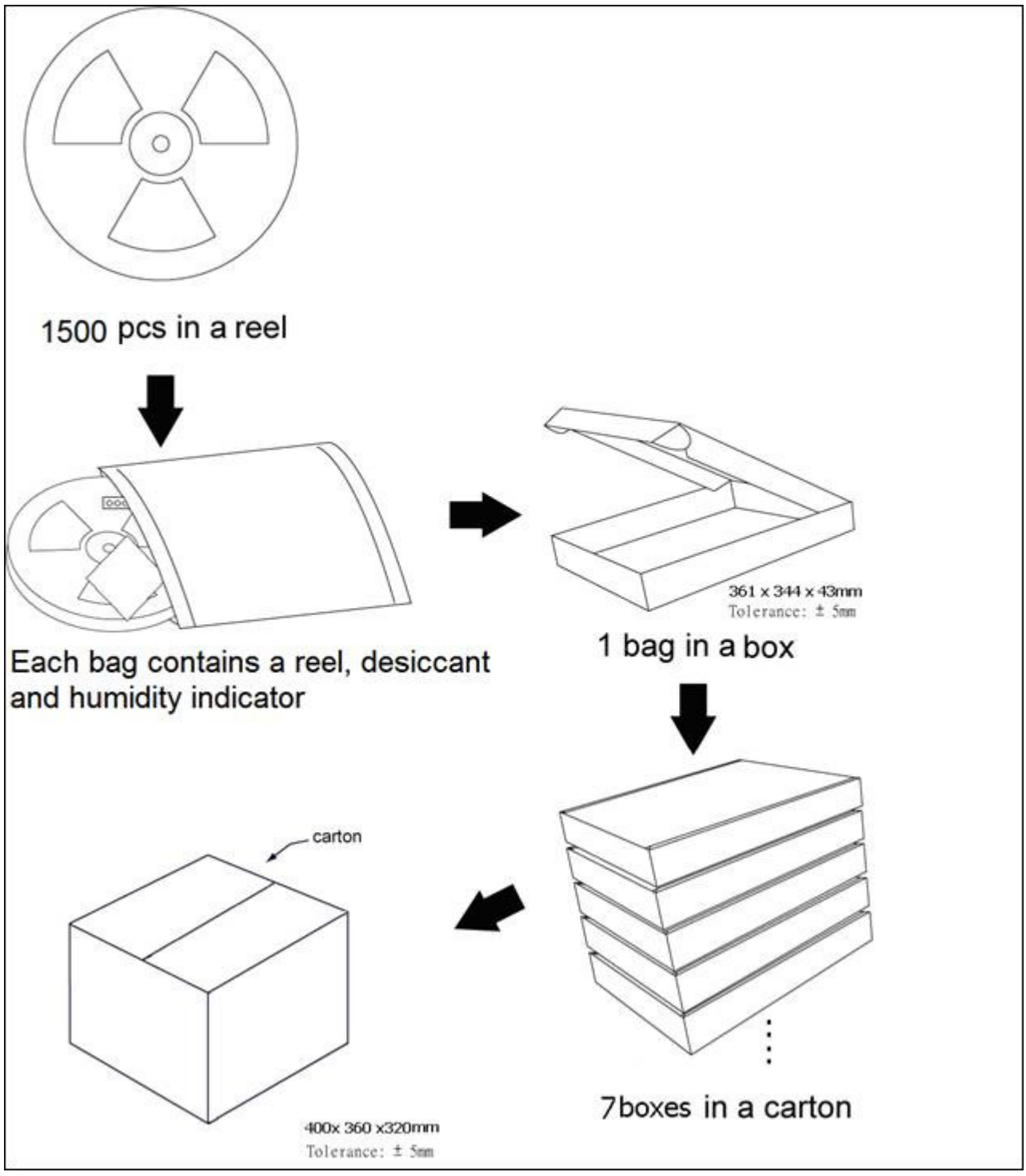
10 Packing and Handling

GNSS modules, like any other SMD devices, are sensitive to moisture, electrostatic discharge, and temperature. By following the description sketched in the document for LOCOSYS GNSS module storage and handling, it is possible to reduce the chances of them being damaged during production.

10.1 Packing



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10.2 Moisture Sensitivity

The module belongs to moisture sensitive device (IPC/JEDEC J-STD-020C Level III). If it is not used by then, we strong recommended storing the GNSS modules in dry places such as dry cabinet. The approximate shelf life for LOCOSYS GNSS modules packages is 6 months from the bag seal date, when store in a non-condensing storage environment (<30°C/60% RH)

10.3 ESD Handling

Please carefully follow the following precautions to prevent severe damage to GNSS modules.

LOCOSYS GNSS modules are sensitive to electrostatic discharges, and thus are Electrostatic Sensitive Devices (ESD). Careful handling of the GNSS modules and in particular RFIN pin must follow the standard ESD safety protections:

- Unless there is a galvanic coupling between the local GND and the PCB GND, then the first point of contact when handling the PCB shall always be between the local GND and PCB GND.
- Before working with RFIN pin, please make sure the GND is connected
- When working with RFIN pin, do not contact any charges capacitors or materials that can easily develop or store charges such as patch antenna, coax cable, soldering iron.
- When soldering RFIN pin, please make sure to use an ESD safe soldering iron (tip).

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Document change list

Revision 1.0

- First release on Dec 15, 2017.