Datasheet of MGS-1513-52Q

Version 1.0
2024/12/19

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1. Introduction

MGS-1513-52Q is a complete standalone multi-frequency GNSS smart antenna module, including embedded patch antenna and GNSS receiver circuits which is based Airoha AG3352Q platform. The module can simultaneously acquire and track multiple satellite constellations that include GPS, GLONASS, GALILEO, BAIDOU, and QZSS simultaneously, which in combination with the support of SBAS, greatly increases the number of visible satellites and enhances positioning accuracy.

Its superior cold-start sensitivity allows it to acquire, track, and get position fix autonomously in difficult weak signal environment. Its superior tracking sensitivity allows continuous position coverage in nearly all outdoor application environments.

The module supports hybrid ephemeris prediction to achieve faster cold start. One is self-generated ephemeris prediction (called EASY) that is no need of both network assistance and host CPU's intervention. This is valid for up to 3 days and updates automatically from time to time when GNSS module is powered on and satellites are available. The other is server-generated ephemeris prediction (called EPO) that gets from an internet server. This is valid for up to 14 days. Both ephemeris predictions are stored in the on-board flash memory and perform a cold start time less than 15 seconds.

The faster GNSS fixes make it possible to use accurate positioning and navigation services anytime and anywhere with a smaller power budget than previously possible. Available in a cost-optimized version as well as a low-power version which supports for the Adaptive Low Power (ALP) feature in fitness and normal navigation modes.

2. Features

- Build on high performance, low-power AG3352Q chip set
- Ultra-High track sensitivity
- Support GPS, GLONASS, GALILEO, BAIDOU, and QZSS simultaneously
- Capable of SBAS (WAAS, EGNOS, MSAS, GAGAN)

- Build in LNA and Saw filter
- Low power consumption
- Free hybrid ephemeris prediction to achieve faster cold start
- Multipath detection and suppression
- Small form factor
- Connector or direct soldering connection alternatives
- RoHS compliant

3. Applications

- Personal positioning and navigation
- Automotive navigation
- Handheld device

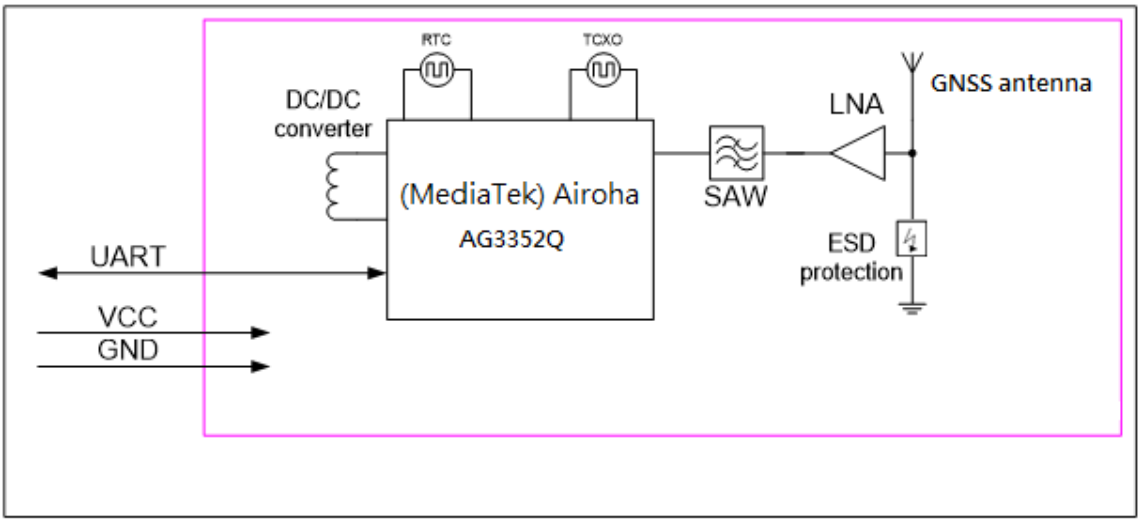

Figure 1: System block diagram

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4. Functional Description

4.1 Key Features

Table 1: Key Features

Parameter	Specification
GNSS engine	• GNSS engine has 47SVs channels and DSP accelerators
GNSS reception	• GPS/QZSS：L1 C/A, L1C • GLONASS：L1 • GALILEO：E1 • BEIDOU：B1I, B1C • SBAS：WAAS, EGNOS, MSAS, GAGAN
Update rate	• GNSS：1Hz default ,up to 10Hz (option) (1)
Position accuracy (2)	• GNSS：< 1.5m CEP • SBAS：< 1.5m CEP
Velocity & Time accuracy	• GNSS：< 0.1m/s CEP • 1PPS： ±10 ns
Time to First Fix (TTFF)(3)	• Hot start：< 2 sec • Cold start：<28 secs
Sensitivity	• Cold start：-149dBm • Hot start ：-155dBm • Reacquisition：-158dBm • Tracking & navigation：-165dBm
GNSS Operating limit	• Velocity：< 500 m/s • Altitude：< 10,000 m (4)
Datum	• Default WGS-84, User definable
UART Port	• UART Port: TXD and RXD
Protocol	• NMEA 0183 Protocol Ver.4.10, GNSS Receiver Protocol • Supports baud rate from 9600 bps to 961200 bps • 115200bps by default, 8 data bits, no parity, 1 stop bits • 1Hz: GGA, GLL, GSA, GSV, RMC, VTG, GST
Physical Characteristics	• Size：15.2±0.3x13±0.3x6.55±0.5mm • Weight：Approx. 3.8 g

Note (1): If you want to use 2/4/5/10Hz, please contact us.

Note (2): CEP, 50%, 24 hours static, open sky, > 6 SVs for each GNSS system.

Note (3): Commanded starts. All satellites signals at -130 dBm. Measured at room temperature.

Note (4): The maximum altitude of the balloon mode is 80,000 m. If you need, please contact us.

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5. Pin Assignment and Definition

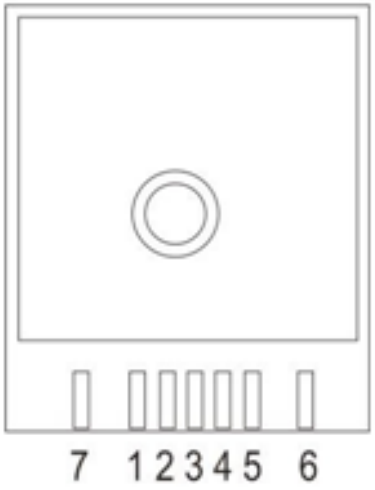

Figure 2: Pin Assignment

Table 2: Pin Definition

Pin No.	Name	I/O	Description	Remark
1	VBAT	I	RTC Battery Input	Voltage range: 1.5V~4.3V
2	TXD	O	UART Serial Data output	
3	RXD	I	UART Serial Data Input	
4	VCC	I	Module Power Supply	Voltage range: 2.8V~4.3V
5	GND	G	Ground	
6	PPS	O	One pulse per second	
7	GPIO1	I/O	General purpose I/O	

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6. Mechanical Dimensions

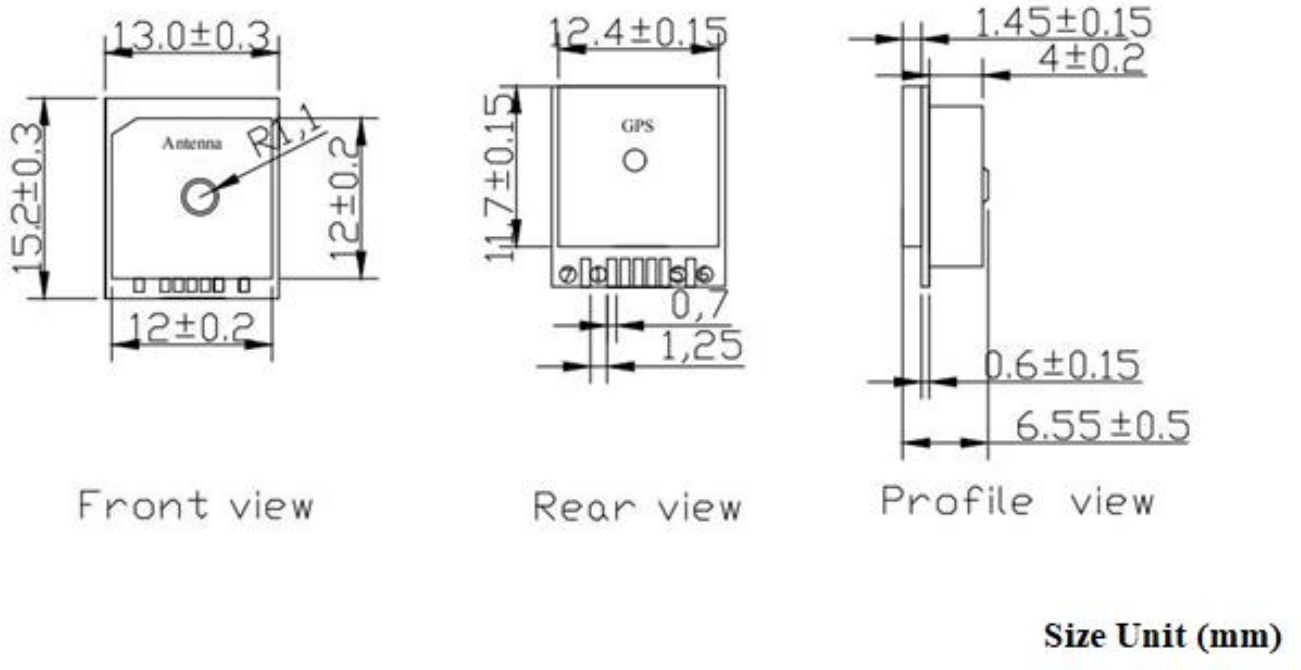

Figure 3: Specification size chart

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7. DC & Temperature characteristics

7.1 Absolute maximum ratings

Parameter	Symbol	Ratings	Units
Input Voltage	VCC	4.3V	V
Operating Temperature Range	Topr	-40 ~ 85	℃
Storage Temperature Range	Tstg	-55 ~ 100	℃

7.2 DC Electrical characteristics

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Input Voltage	VCC		2.8	3.3	4.3	V
Supply Current	I_{SS}	VCC = 3.3V, Acquisition Tracking Standby		 12 11 1.5		mA

7.3 Temperature characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units
Operating Temperature	Topr	-40	-	85	℃
Storage Temperature	Tstg	-55	-	100	℃

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8. Software Interface

8.1 NMEA output message

Table 3: NMEA output message

NMEA record	Description
GGA	Global positioning system fixed data
GLL	Geographic position - latitude/longitude
GSA	GNSS DOP and active satellites
GSV	GNSS satellites in view
RMC	Recommended minimum specific GNSS data
VTG	Course over ground and ground speed
GST	Estimated error in position solution

- GGA--- Global Positioning System Fixed Data

Contains the values for the following example

$GNGGA,061300.000,2503.71255,N,12138.74493,E,2,38,0.44,121.12,M,15.32,M,,*7E

Table 4: GGA Data Format

Name	Example	Units	Description
Message ID	$GNGGA		GGA protocol header
UTC Time	061300.000		hhmmss.sss
Latitude	2503.71255		ddmm.mmmmm
N/S indicator	N		N=north or S=south
Longitude	12138.74493		dddmm.mmmmm
E/W Indicator	E		E=east or W=west
Position Fix Indicator	2		See Table 5
Satellites Used	38		Number of satellites in view
HDOP	0.44		Horizontal Dilution of Precision (meters)
MSL Altitude	121.12	meters	Antenna Altitude above/below mean-sea-level (geoid) (in meters)
Units	M	meters	Units of antenna altitude, meters
Geoidal Separation	15.32	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	*7E		Checksum
<CR> <LF>			End of message termination

Table 5: Position Fix Indicators

Value	Description
0	No position fix
1	Autonomous GNSS fix
2	Differential GNSS fix
6	Estimated/Dead reckoning fix

- GLL--- Geographic Position – Latitude/Longitude

Contains the values for the following example:

$GNGLL,2503.71255,N,12138.74493,E,061300.000,A,D*42

Table 6: GLL Data Format

Name	Example	Units	Description
Message ID	$GNGLL		GLL protocol header
Latitude	2503.71255		ddmm.mmmmm
N/S indicator	N		N=north or S=south
Longitude	12138.7493		dddmm.mmmmm
E/W indicator	E		E=east or W=west
UTC Time	061300.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Mode	D		N = No position fix A = Autonomous GNSS fix D = Differential GNSS fix E = Estimated/Dead reckoning fix
Checksum	*42		
<CR> <LF>			End of message termination

- GSA---GNSS DOP and Active Satellites

Contains the values for the following example:

$GNGSA,A,3,19,195,17,06,20,11,09,02,194,12,05,04,0.81,0.44,0.68,1*04

$GNGSA,A,3,14,,,,,,,,,,,,0.81,0.44,0.68,1*03

$GNGSA,A,3,66,81,88,65,79,82,,,,,,0.81,0.44,0.68,2*0B

$GNGSA,A,3,03,15,34,27,30,,,,,,,0.81,0.44,0.68,3*02

$GNGSA,A,3,33,40,07,10,38,28,08,41,13,14,43,42,0.81,0.44,0.68,4*0B

$GNGSA,A,3,11,39,,,,,,,,,,0.81,0.44,0.68,4*09

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Table 7: GSA Data Format

Name	Example	Units	Description
Message ID	$GNGSA		GSA protocol header
Mode 1	A		See Table 8
Mode 2	3		See Table 9
ID of satellite used	19		SV on Channel 1
ID of satellite used	195		SV on Channel 2
ID of satellite used			SV on Channel 12
PDOP	0.81		Position Dilution of Precision
HDOP	0.44		Horizontal Dilution of Precision
VDOP	0.68		Vertical Dilution of Precision
GNSS system ID	1		See Table 10
Checksum	*04		
<CR> <LF>			End of message termination

Table 8: Mode 1

Value	Description
M	Manually set to operate in 2D or 3D mode
A	Automatically switching between 2D or 3D mode

Table 9: Mode 2

Value	Description
1	No position fix
2	2D fix
3	3D fix

Table 10: GNSS system ID

Value	Description
1	GPS
2	GLONASS
3	GALILEO
4	BEIDOU
6	IRNSS

- GSV---GNSS Satellites in View

Contains the values for the following example:

$GPGSV,4,1,15,196,73,108,46,19,72,077,47,195,71,061,47,199,59,164,22,1*5B
$GPGSV,4,2,15,17,54,115,47,06,49,003,48,20,44,248,47,11,36,306,46,1*6E
$GPGSV,4,3,15,09,35,079,45,02,31,307,45,194,28,175,43,12,25,302,43,1*52
$GPGSV,4,4,15,05,14,230,38,04,14,051,38,14,11,173,43,1*53
$GLGSV,2,1,07,66,71,107,44,81,39,356,48,88,36,067,47,67,33,187,,1*7B
$GLGSV,2,2,07,65,25,033,46,79,17,262,47,82,08,315,43,1*46
$GAGSV,2,1,05,03,49,122,45,15,47,342,45,34,37,056,43,27,33,273,43,7*7B
$GAGSV,2,2,05,30,30,208,41,7*49
$GBGSV,4,1,14,33,72,072,50,40,63,187,48,07,63,217,45,10,63,251,45,1*74
$GBGSV,4,2,14,38,58,328,48,28,56,353,49,08,52,306,44,41,47,200,48,1*75
$GBGSV,4,3,14,13,47,291,45,14,45,047,45,43,44,092,47,42,20,040,42,1*71
$GBGSV,4,4,14,11,20,105,41,39,11,172,42,1*78

Table 11: GSV Data Format

Name	Example	Units	Description
Message ID	$GPGSV		GSV protocol header GP=GPS/QZSS, GL=GLONSS, GA=GALILEO, GB=BEIDOU, GI=IRNSS.
Total number of messages	4		Range 1 to 9
Message number	1		Range 1 to 9
Satellites in view	15		
Satellite ID	196		Channel 1
Elevation	73	degrees	Channel 1 (Range 00 to 90)
Azimuth	108	degrees	Channel 1 (Range 000 to 359)
SNR (C/No)	46	dB-Hz	Channel 1 (Range 00 to 99, null when not tracking)
Satellite ID	199		Channel 4
Elevation	59	degrees	Channel 4 (Range 00 to 90)
Azimuth	164	degrees	Channel 4 (Range 000 to 359)
SNR (C/No)	22	dB-Hz	Channel 4 (Range 00 to 99, null when not tracking)
Signal ID	1		GPS/QZSS: L1 C/A=1 GLONASS: L1 C/A=1 GALILEO: E1=7 BEIDOU: B1=1, B1C=3
Checksum	*5B		
<CR> <LF>			End of message termination

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- RMC---Recommended Minimum Specific GNSS Data

Contains the values for the following example:

$GNRMC,061300.000,A,2503.71255,N,12138.74493,E,0.01,30.70,150622,,,D,V*38

Table 12: RMC Data Format

Name	Example	Units	Description
Message ID	$GNRMC		RMC protocol header
UTC Time	061300.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Latitude	2503.71255		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12138.74493		dddmm.mmmmm
E/W Indicator	E		E=east or W=west
Speed over ground	0.001	knots	True
Course over ground	30.70	degrees	
Date	150622		ddmmyy
Magnetic variation		degrees	
Variation sense			E=east or W=west
Mode	D		N = No position fix A = Autonomous GNSS fix D = Differential GNSS fix E = Estimated/Dead reckoning fix
Navigational status indicator	V		S = Safe C = Caution U = Unsafe V = Void
Checksum	*38		
<CR> <LF>			End of message termination

- VTG---Course Over Ground and Ground Speed

Contains the values for the following example:

$GNVTG,30.70,T,,M,0.01,N,0.01,K,D*12

Table 13: VTG Data Format

Name	Example	Units	Description
Message ID	$GPVTG		VTG protocol header
Course over ground	30.70	degrees	Measured heading
Reference	T		True

Course over ground		degrees	Measured heading
Reference	M		Magnetic
Speed over ground	0.001	knots	Measured speed
Units	N		Knots
Speed over ground	0.001	km/hr	Measured speed
Units	K		Kilometer per hour
Mode	D		N = No position fix A = Autonomous GNSS fix D = Differential GNSS fix E = Estimated/Dead reckoning fix
Checksum	*12		
<CR> <LF>			End of message termination

- GST---Estimated error in position solution

Contains the values for the following example:

$GNGST,061300.000,2.6,1.9,1.6,169.8,1.9,1.6,6.8*71

Table 14: GST Data Format

Name	Example	Units	Description
Message ID	$GNGST		GST protocol header
UTC Time	061300.000		hhmmss.sss
RangeRMS	2.6	meters	RMS value of the standard deviation of the ranges
stdMajor	1.9	meters	Standard deviation of semi-major axis of error ellipse
stdMinor	1.6	Meters	Standard deviation of semi-minor axis of error ellipse
Orient	169.8	degrees	Orientation of semi-major axis of error ellipse
stdLat	1.9	meters	Standard deviation of latitude error
stdLong	1.6	meters	Standard deviation of longitude error
stdAlt	6.8	meters	Standard deviation of altitude error
Checksum	*71		
<CR> <LF>			End of message termination

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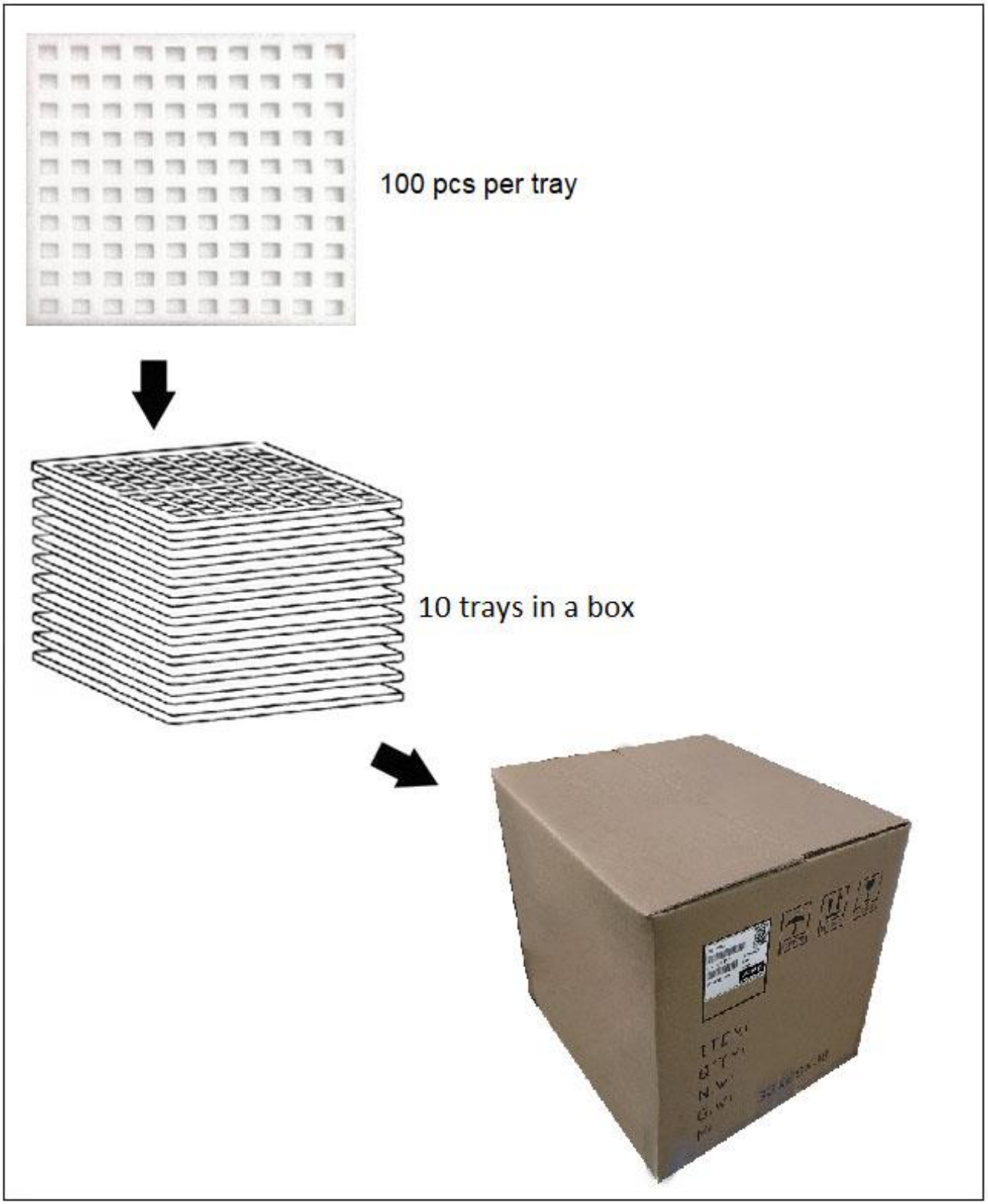
9. Packing and Handling

9.1 Packing



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9.2 ESD Handling

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

LOCOSYS GNSS smart antenna modules are sensitive to electrostatic discharges and thus are Electrostatic

Sensitive Devices (ESD). Careful handling of the GPS modules follow the standard ESD safety protections:

- Unless there is a galvanic coupling between the local (i.e. the worktable) 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 the antenna feed pin, please make sure the GND is connected.
- When working with the antenna feed 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 the antenna feed pin, please make sure to use an ESD safe soldering iron (tip).

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10. Document change list

Revision 0.1

- Draft release on Oct 7, 2024.

Revision 1.0 (December 19, 2024)

- Changed the velocity accuracy from 0.01 m/s CEP to 0.1 m/s CEP in section 4.1.
- Changed the hot start from 2s to < 2s in section 4.1.
- Changed the time accuracy from 10ns to ±10 ns in section 4.1.
- Added note in section 4.1.