antenova

DATASHEET

M20072

M20072·GNSSNOVA

Features

- Multi-constellation GNSS receiver (GPS/GLONASS/GALILEO/BEIDOU/QZSS)
- Full function GNSS module
- MediaTek AG3335MN flash chip
- Ultra-small SMD package; 13.8 x 9.5 x 1.8mm
- Low current consumption
- AIC, Active Interference Cancellation
- EASY - Internally generated orbit prediction for fast time to fix
- EPO (Extended Prediction Orbit) fast fix

1. Description

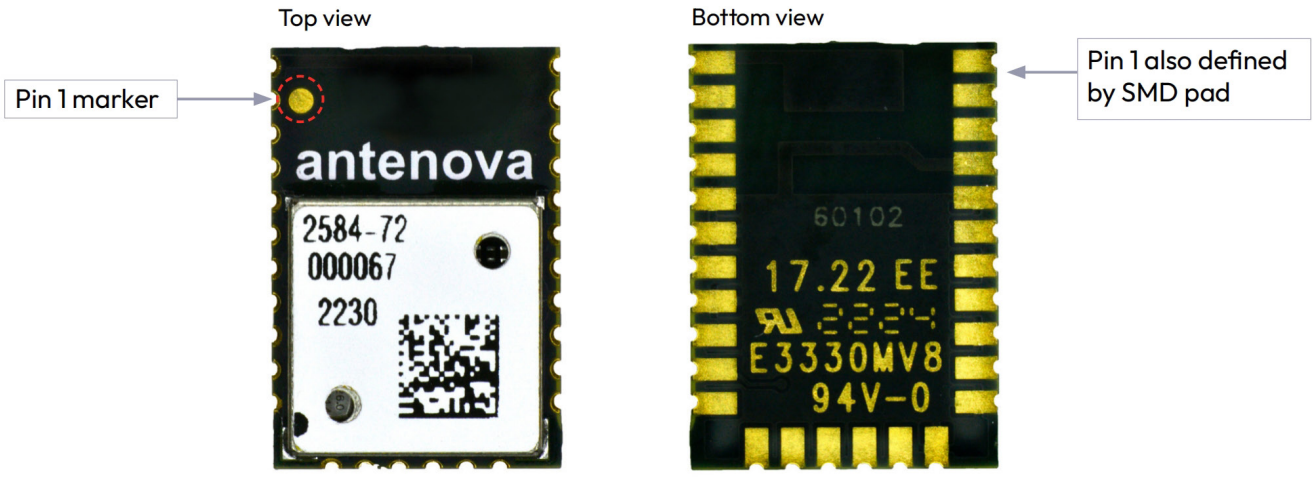
An integrated GNSS receiver module incorporating the MediaTek AG3335MN flash chip. The receiver tracks 4 GNSS constellations concurrently (GPS+Galileo+GLONASS+Beidou). 12nm process with 1.8V system power supply provides outstanding low power consumption. Multi-path algorithms improve position accuracy in inner-city environments. The on-board LNA provides good performance in weak-signal environments such as wearable devices.

2. Applications

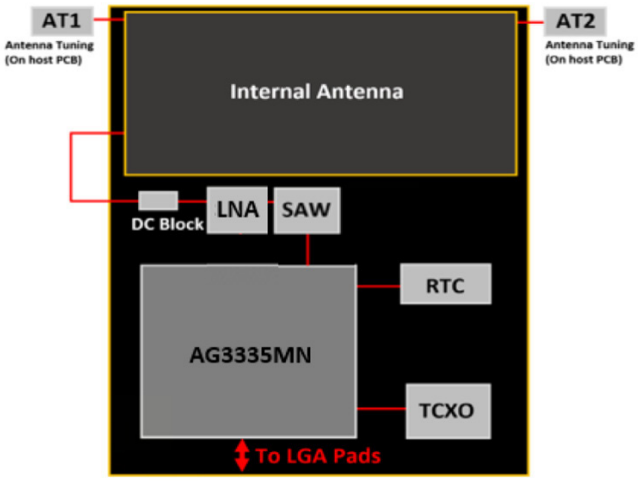
- Wearable devices such as Fitness watches
- Portable devices
- Asset tracking / Personal safety
- Vehicle trip recording cameras
- Sports electronics such as Golf computers
- Navigation systems

3. Part number

M20072



4. Functional block diagram



5. Module specifications

5.1. Absolute maximum ratings

SYMBOL	PARAMETER	MIN	MAX	UNIT
VIN_SYS	Main supply voltage for System	0	1.98	V
VIN_RTC	Supply voltage for RTC mode	0	1.98	V
VIO_1V8	Supply voltage for 1.8V I/O	0	1.98	V
VIO_2V8*	Supply voltage for 2.8V I/O	0	1.98	V
RF_{IN}	Maximum RF input power	N/A	3.08	V
T_{STG}	Storage temperature	-40	+85	°C
T_{OP}	Operating temperature	-40	+85	°C

Exposure to absolute ratings may adversely affect reliability and may cause permanent damage.
*If 2.8V I/O will be applied, please connect VIO_1V8 with 2.8V LDO's enable pin for power sequence constraint.

5.2. Recommended operating conditions

SYMBOL	PARAMETER	MIN	TYP	MAX	UNIT
VIN_SYS	Main supply voltage for System	1.62	1.8	1.98	V
VIN_RTC	Supply voltage for RTC	1.62	1.8	1.98	V
T_{OP}	Operating temperature	-40	-	+85	°C

5.3. DC electrical characteristics

Conditions: VIN_SYS = 1.8V, VIN_RTC = 1.8V, TOP = 25 °C

SYMBOL	PARAMETER	TYP	UNIT
$I_{CC(ACQ)}$	Acquisition mode current	18	mA
$I_{CC(TRK)}$	Tracking mode current	12	mA
$I_{CC(STBY)}$	RTC mode current	<100	μA

5.4. RF specifications

Conditions: VIN_SYS = 1.8V, VIN_RTC = 1.8V, TOP = 25 °C, Freq = 1575.420MHz

SYMBOL	PARAMETER	TYP	UNIT
NF_{LNA}	LNA Noise Figure (AG3335 Integral LNA)	3.0	dB
NF_{LNA1st}	1st Stage LNA	1.07	dB
ANT_{EFF}	Antenna total efficiency	>57 %	%

5.5. Band rejection

FREQUENCY	STANDARD	TYP*	UNIT
698-798	LTE700	38	dB
824-849	Cellular CDMA	38	dB
869-894	GSM850	38	dB
880-915	GSM900	37	dB
1710-1785	GSM1800/DCS	44	dB
1850-1910	GSM1900/PCS	44	dB
1920-1980	WCDMA	44	dB
2400-2492	WLAN, BT and WiMAX	50	dB
2500-2690	LTE2600	55	dB

Note: Does not include antenna rejection.

5.6. Mechanical specifications

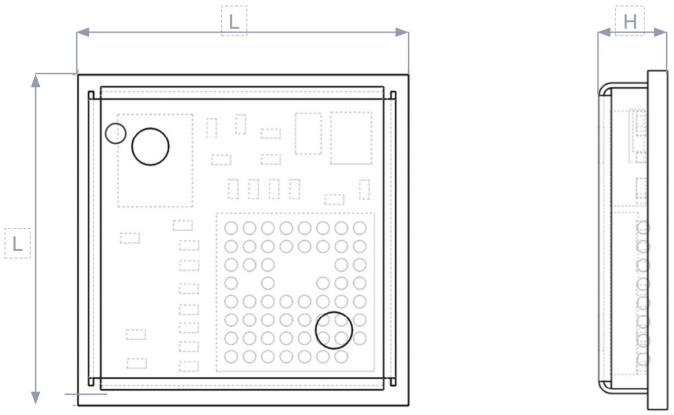
PARAMETER	TYP	UNIT
Module exterior dimensions (L x W x H)	18.3 (±0.1) x 9.5 (±0.1) x 1.8 (+0.2 / - 0.0)	mm
Module support and connection	Surface mounted (SMD)	-
Module mass	≤1	g

5.7. System specifications

COMMUNICATION	SPECIFICATION
Data Output Protocol	NMEA 0183
Host Interfaces	UART
Default data rate on UART	115200bps default rate, modify by input command
GPS ENGINE	
Chip	MTK AG3335MN Flash Chip
Channels	GPS+Galileo+GLONASS+Beidou
TCXO	0.5ppm
ACCURACY	
Horizontal position accuracy	<2.5m CEP
Maximum position update rate	10 Hz (Default 1Hz)
SENSITIVITY	
Acquisition (Cold)	-148dBm
Tracking	-165dBm
TTFF	
Hot start	<1s
Warm start	<25s (typical)
Cold start	<35s (typical)
GENERAL	
Maximum altitude	<10 km
Maximum speed	<514 m/s
Active interference cancellers	12 multi tone active cancellers; ISSCC2011 award
Additional features	1PPS Sync, SBAS, WAAS, EGNOS, QRZZ, GAGAN support
EPO / EASY	Orbit prediction

50% CEP, Open-Sky, 24hr Static, -130dBm, good view of the sky

6. Module dimension



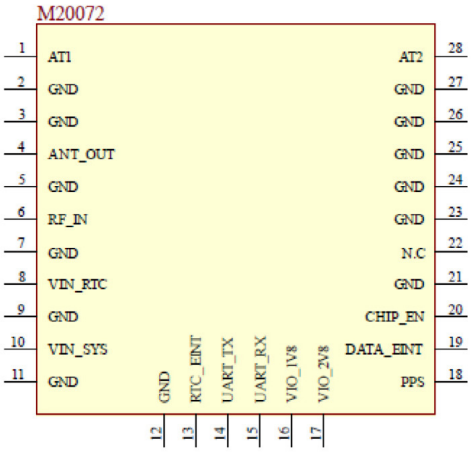
L	W	H
Length	Width	Height
13.8 ±0.1	9.5 ±0.1	1.8 ±0.2 / -0.0

All dimensions in (mm)

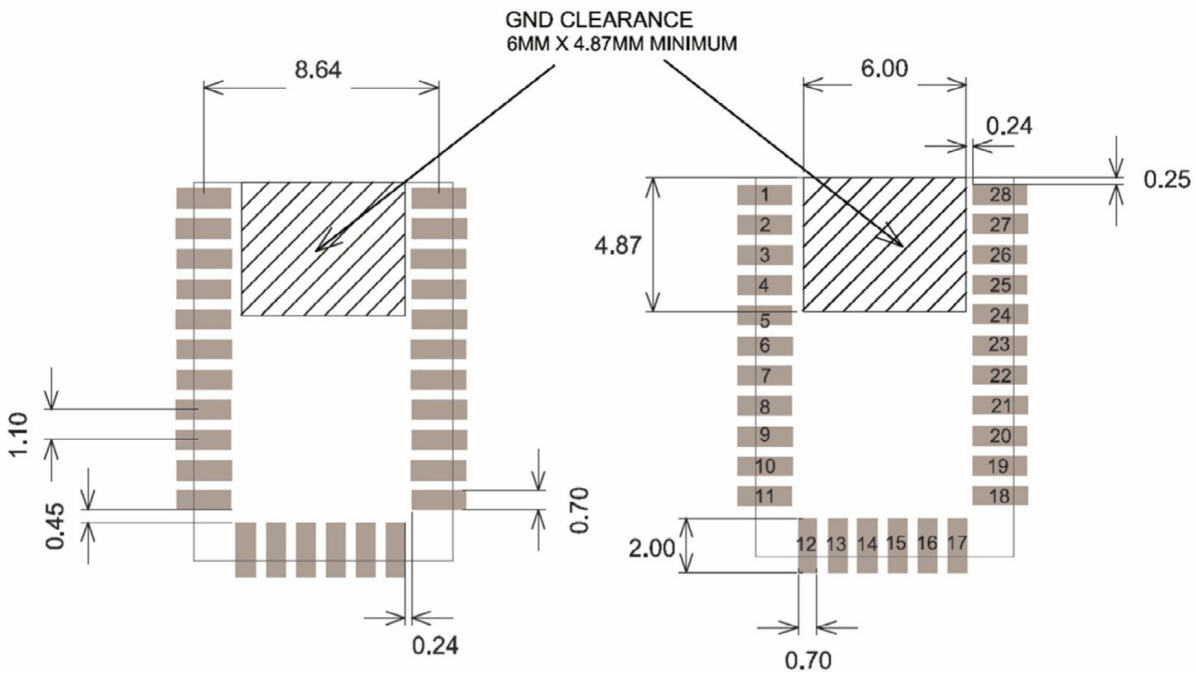
7. Schematic symbol and pin definition

PIN	DESIGNATOR	DESCRIPTION
1	AT1	Antenna tuning left side
2	GND	Ground connection
3	GND	Ground connection
4	ANT_OUT	RF from internal antenna to external pin(connect to pin 6)
5	GND	Ground connection
6	ANT_IN	RF input from antenna
7	GND	Ground connection
8	VIN_RTC	RTC supply voltage, 1.8V in TYP
9	GND	Ground connection
10	VIN_SYS	Main supply voltage, 1.8V in TYP
11	GND	Ground connection
12	GND	Ground connection
13	RTC_EINT	To wake up module from RTC mode
14	UART_TX	UART interface transmit data line
15	UART_TX	UART interface receive data line
16	VIO_1V8	1.8V output for 1.8V I/O suppor
17	VIO_2V8	2.8V input for 2.8V I/O support
18	PPS	1PPS (pulse per second output)
19	DATA_EINT	Handshaking with host
20	CHIP_EN	System reset, active low

PIN	DESIGNATOR	DESCRIPTION
21	GND	Ground connection
22	N.C	No connect
23	GND	Ground connection
24	GND	Ground connection
25	GND	Ground connection
26	GND	Ground connection
27	GND	Ground connection
28	AT2	Antenna tuning right side



8. Host PCB footprint



All dimensions in (mm)

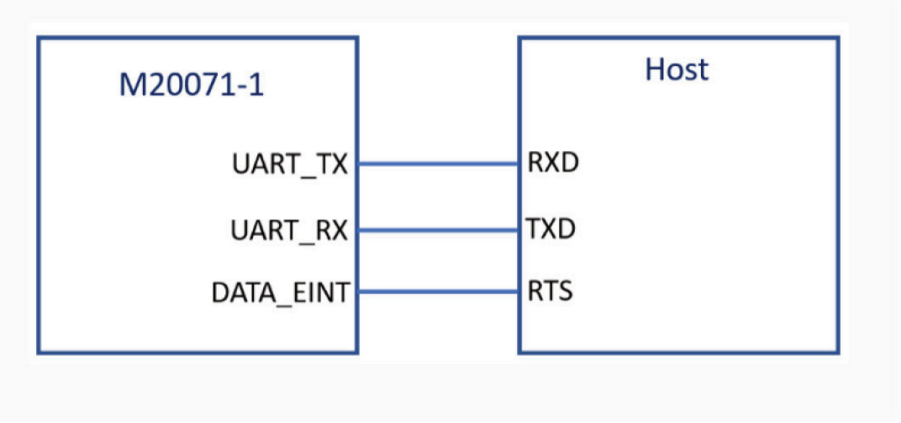
9. Module subsystem feature

9.1. Host interface

The UART interface is used for M20072 to provide full-serial data communication channels between M20072 and host. The UART communication function includes UART data transmit/receive, GNSS NMEA sentence input/output, and MTK command input.

The UART supports standard baud rate and can be changed after bootup by using the relevant command. Please contact Antenova for more information about the baud rate configuration.

DATA_EINT on M20072 pin19 is for handshaking with host to avoid missing command and needs to connect to host UART RTS.



9.2. Power supply

The M20072 uses 1.8V DC power inputs. VIN_SYS is main power supply for the core system, and VIN_RTC is power supply for RTC clock and RTC RAM. M20072 supports power saving mode (RTC mode), and it needs standalone VIN_RTC in the design for support RTC mode.

9.3. Power constraint for 2.8V IO

The voltage level of the IO interface is 1.8V only. If 2.8V IO needs to be applied, there's a power sequence constraint for 2.8V IO application.
Connect VIO_1V8 (pin16) to 2.8V LDO's enable pin, so that the 2.8V for VIO_2V8 (pin17) will be powered up after VIO_1V8.

9.4. Pulse Per Second (PPS)

PPS (pulse per second) is a pulse signal output from the M20072, repeating an accurate synchronized pulse signal once per second. The pulse width is 100ms by default, and can be configured from 50ms to 999ms by using MTK command. The PPS function is enabled by default, and module will output PPS signal once the 3D-fixed is completed. Please contact Antenova for more information about the PPS pulse width configuration.

9.5. HRST (Hardware reset pin)

The CHIP_EN pin is for hardware reset function and is internal pull-high. To initiate a hardware reset, the pin needs to be pulled low for 10ms.

9.6. Power saving mode

The M20072 has three power saving modes.

- OFF mode
- RTC mode
- Periodic mode

9.6.1. OFF mode

OFF mode is controlled by the CHIP_EN pin. When CHIP_EN is low, only the power management logic is active, and all other logic is powered down.

9.6.2. RTC mode

RTC mode is a low-power mode that shuts down the system core. When system goes in to the RTC mode, all the commands cannot be sent and the module no longer provides position-related information. The navigation data is saved to RTC-RAM, and when the system is woken up, this data is used to regain a position fix.

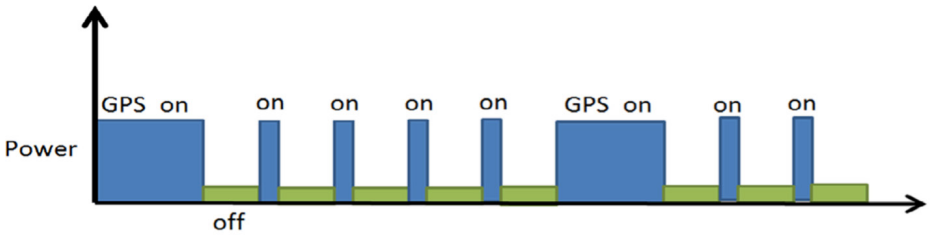
The chip is woken up by pulling the RTC_EINT pin high for 1ms. Once the module exits the RTC mode, all system resources will be re-initialized. The navigation data will be loaded from RTCRAM. If all the data are valid, it will facilitate the TTFF performance
M20072 support software RTC mode by sending the MTK command listed in below:

RTC MODE COMMAND	EXIT RTC MODE
$PAIR650,0	Pull-High RTC_EINT for 1ms

9.6.3. Periodic mode

Periodic mode is a module controlled mode that reduces current consumption by module running and sleeping periodically to maintain fixed data.

The periodic state can be configured by users base on their needs. Contact Antenova for more information and a user command manual.



COMMAND (EXAMPLE)	M20071 TIME FOR OFF/AWAKE
$PAIR690,1,21,39,48,72	Module sleep 39s then run 21s in signal condition; Module sleep 72s then run 48s in no signal condition.

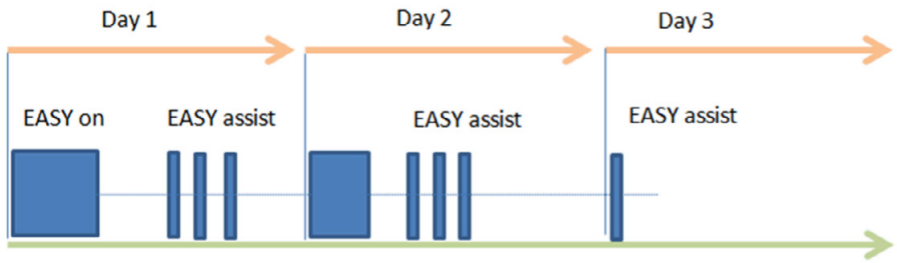
9.7. EPO (Extended Prediction Orbit) data service

The EPO allows the use of up to 30-day orbit predictions that can be used to aid the module for an instant fix solution.

- A proxy server on the customer's side to update EPO files from the MTK server daily.
- Application software to access the proxy server through the internet (optional if host device can access internet).
- Software on host device to send EPO data to M20072 module to allow instant fix by using EE data. Please contact Antenova for more information. Requires permission from MTK to use service.

9.8. EASY (Self-Generated Orbit Prediction)

The M20072 module supports EASY (Embedded Assisted System). EASY is an Orbit Prediction feature that speeds up TTFF (time to first fix) performance. EASY provides up to 3 days of GPS orbit predictions, and it does not require an internet connection or software running on a host processor. EASY within the GNSS receiver and accelerates TTFF by calculating a predicted satellite orbits (called the ephemeris). The calculations performed by EASY are scheduled during normal operation of the GNSS receiver. EASY is switched on by default and can be disabled by a PMTK command.



Time

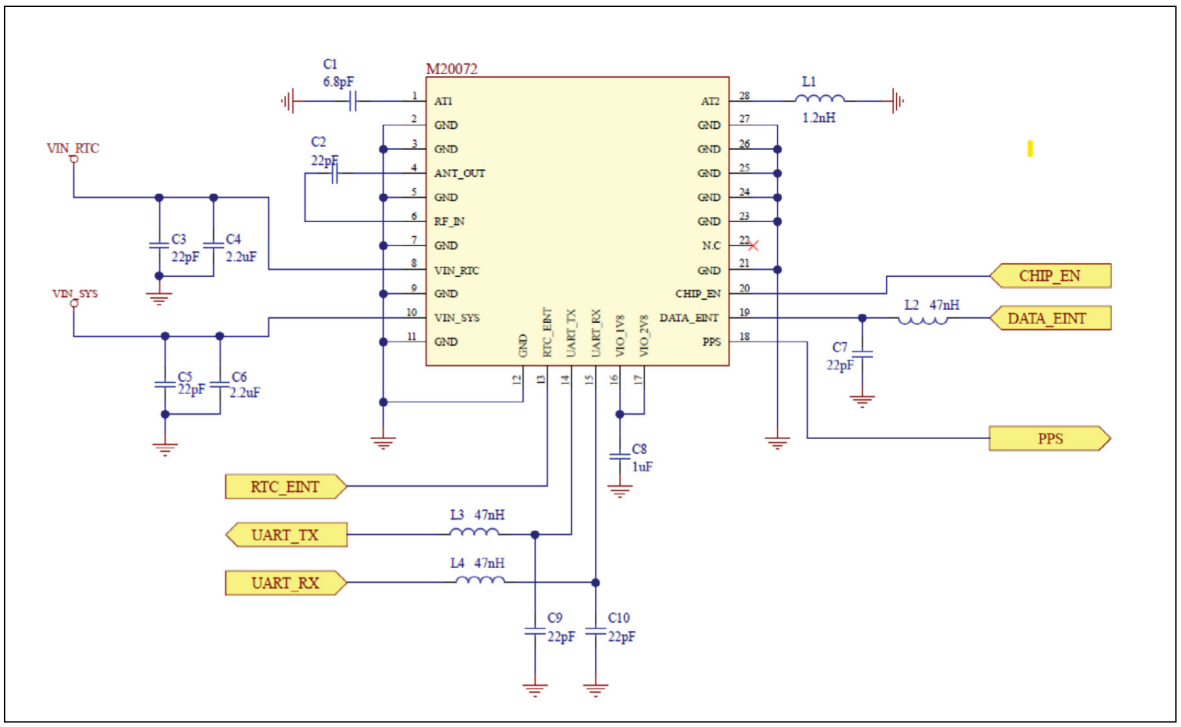
9.9. AIC (Active Interference Cancellation)

The AIC feature provides effective narrow-band interference cancellation. The GPS signal can be recovered from signals that contain interference signals. High speed processors generate clock harmonics that cause interference to be present within the GPS band.

10. Module application

10.1. Reference schematic

The circuit below shows a basic design for 1.8V I/O interface.



Bill of Material

DESIGNATOR	VALUE	DESCRIPTION/COMMENTS	QUANTITY
C1	6.8pF capacitor	Capacitor for antenna tuning	1
L1	12nH Inductor	Inductor for antenna tuning	1
C2, C3, C5, C7, C9, C10	22pF capacitor	Decoupling cap. Place close to corresponding pin	6
C4, C6	2.2uF capacitor	Decoupling cap. Place close to corresponding pin	2
L2, L3, L4	47nH Inductor	Filter component	3
C8	1uF capacitor	Decoupling cap. Place close to pin16	1

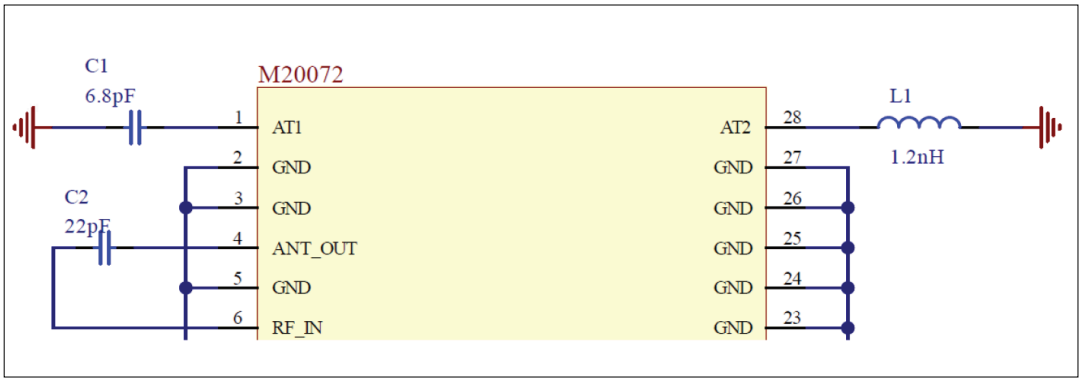
Information and all such information shall be entirely at the user's risk.

10.2. External matching

The M20072 module uses external matching circuit components on the host PCB to fine-tune the onboard antenna to each specific application. This “external matching” allows compensating for the detuning of the antenna caused by various components that can be close to the M20072 module in the actual application (plastic case, battery, speakers, etc.).

The external matching must be placed on the host PCB as close as possible to the module pads AT1(Pad1) and AT2 (Pad28), respectively. A single matching component for each pin is required. A perfect GND plane connecting for each matching component is needed. For multi-layer PCB, an individual GND via should be placed close to the matching component as possible.

Schematic: In the example above AT1 uses a 6.8pF capacitor and AT2 uses a 1.2nH inductor for antenna tuning. Both components should be designed in as they may be required for the intended device.



Type of Matching Components:

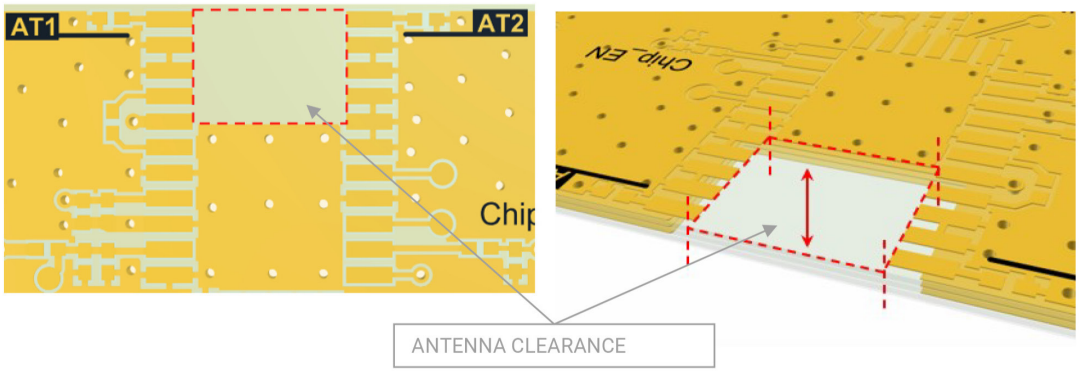
- Capacitors: Use 0402, COG components
- Inductors: Use 0402 Multi-layer type inductors (e,g Murata LQG15 series)

External Antenna Support: A low-cost external circuit can be used to provide external antenna support. Please contact Antenova for more information, and example circuit.

10.3. Internal antenna clearance

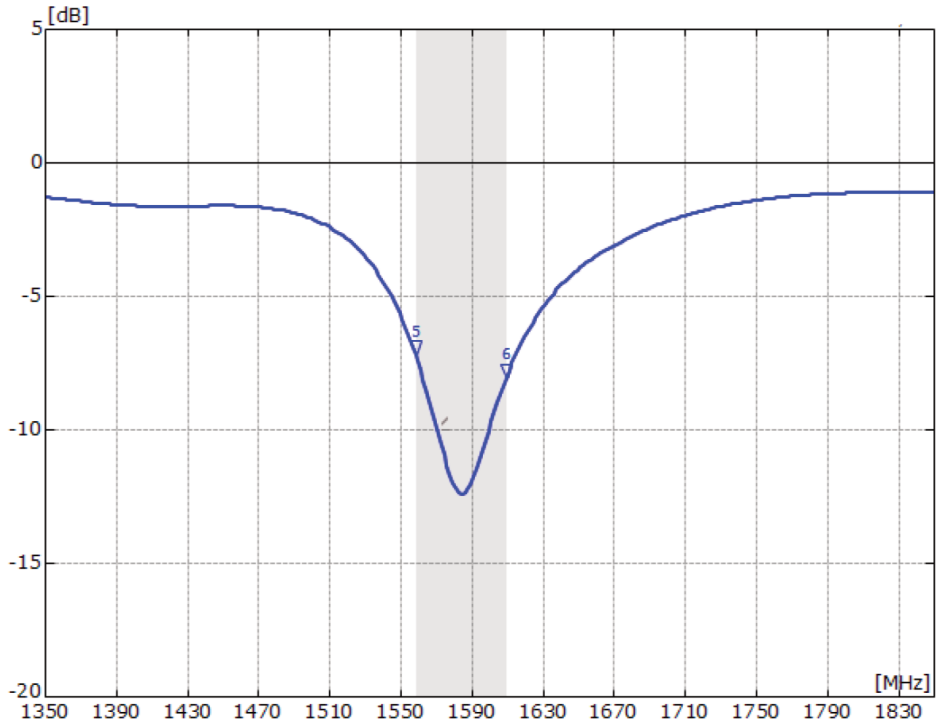
The M20072 module internal antenna requires a clearance on the host PCB to operate. The clearance means that no ground or tracks of any kind can be placed within this area. This clearance area also needs to be applied through the entire PCB stack up. The minimum area needed for clearance is 6mm x 4.87mm.

Top view of M20072 host PCB footprint



10.4. Typical antenna matching results

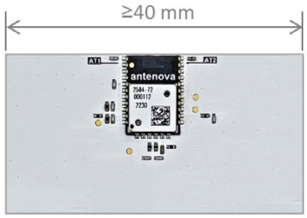
Typical antenna matching as seen by RF_IN (Pin6) is shown in the following plot. The matching bandwidth at -7dB is typically 65MHz. Measured on M20072 EVB test board.



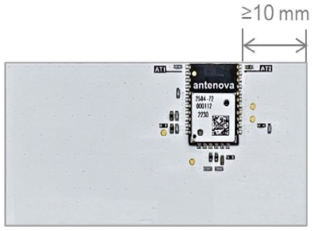
10.5. Module placement guideline

For the internal antenna performance, the placement of the module on the host PCB should be considered very carefully. Here are some guidelines that should be used when deciding the position of the module..

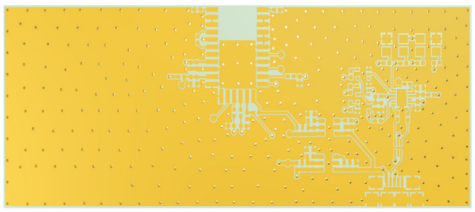
- The module top edge must be placed almost level with the edge of the host PCB.
- The edge of the host PCB that the module is to be placed at must be a minimum of 40mm in length.



- The central placement of the module is advised. However, an offset placement is also possible.
- For an offset closer to the PCB edge to the right side of the module, a minimum of 10mm distance is required to the edge of the host PCB.

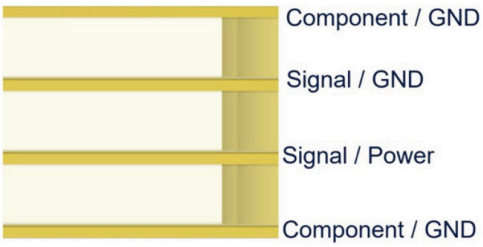


- The antenna uses the host PCB ground to effectively radiate. As such, a GND plane must be placed on the host PCB on at least one layer.
- In the example below, the only area void of GND is the antenna keep-out area. The solder mask is removed to make the copper visible.



- An ideal stack-up for a host PCB would be to use the top and bottom layers as GND planes, while using the internal layers for any signal and power planes. This not only helps the GPS antenna to perform effectively, but also helps to reduce any potential noise issues that can be associated with mixed signal PCB's.

- An example below shows a 4-layer host PCB. For GND layer, all available space should not be used for signal trace routing or component placement



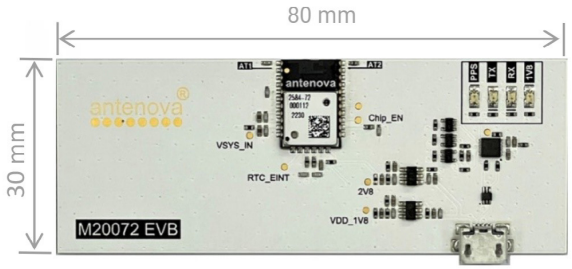
11. Evaluation kit

11.1. Antenna placement

The EVK is a single PCB that contains the M20072 module and required components to run on a PC via a USB cable and Antenova software.

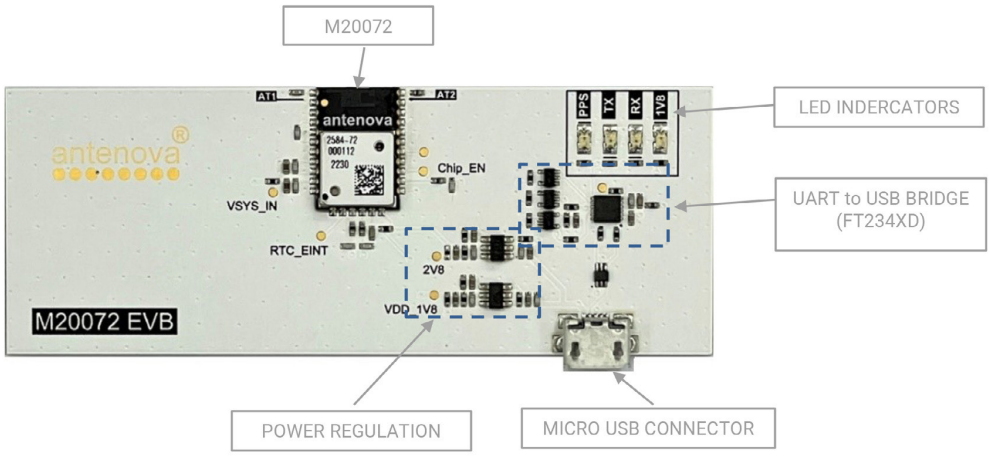
Evaluation kits are available on request. Please contact Antenova for more information. (Part number: M20072).

To order a reference board please see antenova.com



Front view

Bottom view



12. Reflow soldering

12.1. Placement

Typical placement systems used for any BGA/LGA package are acceptable.
Recommended nozzle diameter for placement: 5mm

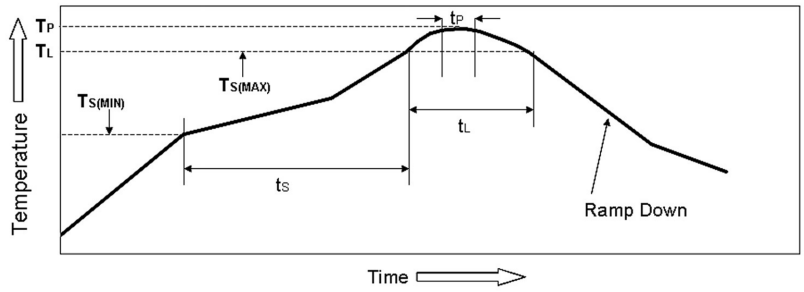
12.2. Soldering paste

Use of “No Clean” soldering paste is strongly recommended, as it does not require cleaning after the soldering process has taken place. An example of suitable soldering paste is Alpha OM350.

12.3. Soldering

The recommended soldering profile for M20072 is shown below. However, it is the responsibility of the Contract Manufacturer to determine the exact reflow profile used, taking into consideration the parameters of the host PCB, solder paste used, etc.

PROFILE FEATURE		PB-FREE SOLDER
Pre-Heat	Temperature (T_s) Min	130°C
	Temperature (T_s) Max	220°C
	Time (t_s)	<150s
Reflow	Liquidus Temperature - (T_l)	220°C
	Time (t_l)	45-90s
Peak Package Body Temperature (T_p)		245°C
Time within 5°C of peak temp (t_p)		30s
Average Ramp up rate - T_s(max) to (T_p)		3°C/s
Ramp Down Rate		6°C/s max



The Pb Free Process-Package Peak Reflow Temperature is 260°C.
Exceeding the maximum soldering temperature could permanently damage the module.

12.4. Multiple soldering

The M20072 module can be submitted up to 2 reflow soldering processes.
Upside-down soldering is acceptable but it is recommended that the Contract Manufacturer qualify the process before mass production. The second reflow must take place within the recommended floor life limit (MSL3). Please contact Antenova for further information.

12.5. Hand soldering

Hand-soldering and rework of the M20072 module is acceptable, however care must be taken to avoid short circuits due to the small size of the module pads.

13. Quality and environmental specifications

TEST	STANDARD	PARAMETERS
PCB inspection	IPC-6012B, Class 2. Qualification and Performance Specification for Rigid Printed Boards - Jan 2007	
Assembly inspection	IPC-A-610-D, Class 2 “Acceptability of electronic assemblies”	
Temperature range	ISO16750-3	-30 °C, +25 °C, +85 °C, operating
Moisture/Reflow sensitivity	IPC/JEDEC J-STD-020D.1	MSL3
Storage (Dry Pack)	IPC/JEDEC J-STD-033C	MSL3
Solderability	EN/IEC 60068-2-58 Test Td	More than 90% of the electrode should be covered by solder. Solder temperature 245 °C ± 5 °C

Moisture sensitivity:

Antenova ships all devices dry packed in tape on reel with desiccant and moisture level indicator sealed in an airtight package. If on receiving the goods the moisture indicator is pink in colour or a puncture of the airtight seal packaging is observed, then follow J-STD-033 “Handling and Use of Moisture/ Reflow Sensitive Surface Mount Devices”.

14. Hazardous material regulation conformance

The RF antenna module has been tested to conform to RoHS and REACH requirements. A certificate of conformance is available from Antenova's website.

15. Packaging

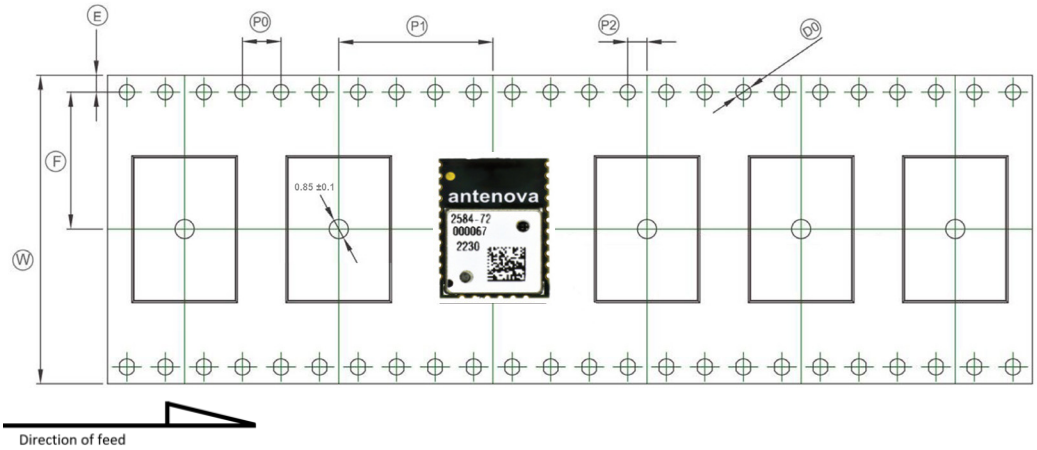
15.1. Optimal storage conditions

TEMPERATURE	-10°C to 40°C
HUMIDITY	Less than 75% RH
SHELF LIFE	24 Months
STORAGE PLACE	Away from corrosive gas and direct sunlight
PACKAGING	Reels should be stored in unopened sealed manufacturer's plastic packaging.
MSL LEVEL	3

Note: The M20072 modules meet MSL Level 3 of the JEDEC specification J-STD-020D - 168 hours Floor Life (out of bag) ≤30 °C/60% RH. If the stated floor life expires prior to reflow process then follow J-STD-033 "Handling and Use of Moisture/Reflow Sensitive Surface Mount Devices".

The shelf life of the antenna is 2 years provided the factory seal on the package has not been broken.

15.2. Tape characteristics



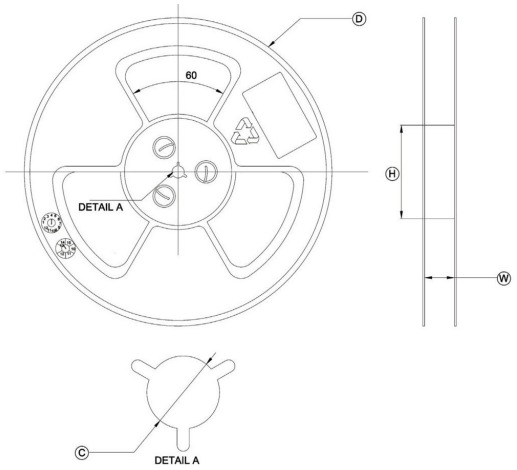
P0	P1	P2	D0
4.00 ± 0.1	16.00 ± 0.1	2.00 ± 0.1	1.55 ± 0.1

E	F	W
1.75 ± 0.1	14.20 ± 0.1	32.00 ± 0.3

All dimensions in (mm)

QUANTITY	LEADING SPACE	TRAILING SPACE
1000 pcs / reel	50 blank module holders	50 blank module holders

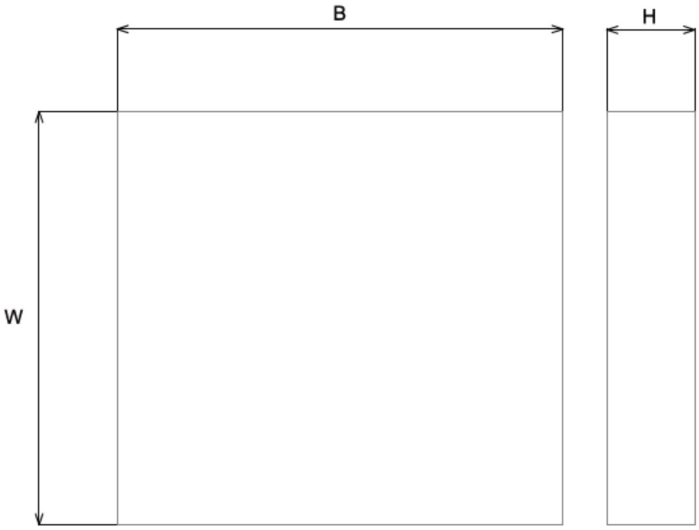
15.3. Reel dimensions



D	C	H	W
330.0 ± 2.0	13.3 ± 0.3	100.0 ± 3.0	32.4 ± 0.2

All dimensions in (mm)

15.4. Box dimensions

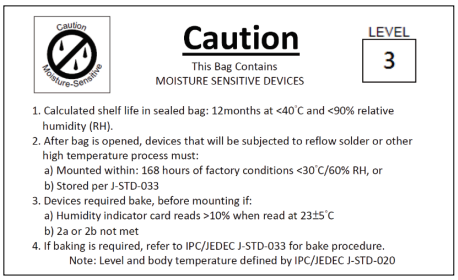


Width (W)	Breadth (B)	Height (H)
340mm	339mm	53mm

15.5. Bag properties

Reels are supplied in protective plastic packaging.

15.6. Reel label information



Quality statements

Antenova's products conform to REACH and RoHS legislation. For our statements regarding these and other quality standards, please see antenova.com.

Certification No. 11070
ISO 9001

Datasheet version

2.01 release 15th June 2026

antenova

Antenna design, integration and test resources

Product designers – the details contained in this datasheet will help you to complete your embedded antenna design. Please follow our technical advice carefully to obtain optimum antenna performance.

We aim to support our customers to create high performance wireless products. You will find a wealth of design resources, calculators and case studies to aid your design on our website.

Antenova's design laboratories are equipped with the latest antenna design tools and test chambers. We provide antenna design, test and technical integration services to help you complete your design and obtain the required certifications.

If you cannot find the antenna you require in our product range, please contact us to discuss creating a custom antenna to meet your exact requirements.

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