

Operation Description

1.1. General Description

RM520N-GL is a 5G NR/LTE-FDD/LTE-TDD/WCDMA wireless communication module with receive diversity. It provides data connectivity on 5G NR SA and NSA, LTE-FDD, LTE-TDD, DC-HSDPA, HSPA+, HSDPA, HSUPA and WCDMA networks. RM520N-GL is standard M.2 Key-B WWAN module. For more details, see *PCI Express M.2 Specification Revision 4.0, Version 1.0*

RM520N-GL supports embedded operating systems such as Windows, Linux and Android, and also provides GNSS and voice* functionality to meet specific application demands.

RM520N-GL is an industrial-grade module for industrial and commercial applications only.

The following table shows the frequency bands, MIMO and GNSS systems supported by the module.

Table 1: Frequency Bands & MIMO & GNSS Systems

Mode	Frequency Bands
5G NR SA	n1/n2/n3/n5/n7/n8/n12/n13/n14/n18/n20/n25/n26/n28/n29/n30/n38/n40/n41/n48/n66/n70/n71/n75/n76/n77/n78/n79 DL 4 × 4 MIMO: n1/n2/n3/n7/n25/n30/n66/n38/n40/n41/n48/n70/n77/n78/n79 UL 2 × 2 MIMO: n38/n41/n48/n77/n78/n79
5G NR NSA	n1/n2/n3/n5/n7/n8/n12/n13/n14/n18/n20/n25/n26/n28/n29/n30/n38/n40/n41/n48/n66/n70/n71/n75/n76/n77/n78/n79 DL 4 × 4 MIMO: n1/n2/n3/n7/n25/n30/n66/n38/n40/n41/n48/n70/n77/n78/n79
LTE-FDD	FDD: B1/B2/B3/B4/B5/B7/B8/B12/B13/B14/B17/B18/B19/B20/B25/B26/B28/B29/B30/B32/B66/B71 TDD: B34/B38/B39/B40/B41/B42/B43/B46(LAA)/B48 DL 4 × 4 MIMO: B1/B2/B3/B4/B7/B25/B30/B38/B40/B41/B42/B43/B48/B66
WCDMA	B1/B2/B4/B5/B8/B19
GNSS	GPS/GLONASS/BDS/Galileo/QZSS

The module can be applied to the following fields:

- Rugged tablet PC and laptop computer
- Remote monitor system
- Smart metering system
- Wireless CPE
- Smart TV
- Outdoor live devices
- Wireless router and switch
- Other wireless terminal devices

1.2. Key Features

Feature	Details
Function Interface	PCI Express M.2 Interface
Power Supply	● Supply voltage: 3.135–4.4 V ● Typical supply voltage: 3.7 V
(U)SIM Interface	● Compliant with <i>ISO/IEC 7816-3</i>, ETSI and IMT-2000 ● Supported (U)SIM card: Class B (3.0 V) and Class C (1.8 V) ● (U)SIM1 and (U)SIM2 interfaces ● Dual SIM Single Standby
eSIM	eSIM function is optional
USB Interface	● Compliant with USB 3.1 Gen2 and USB 2.0 specifications ● Maximum transmission rates: – USB 3.1 Gen2: 10 Gbps – USB 2.0: 480 Mbps ● Used for AT command communication, data transmission, firmware upgrade (USB 2.0 only), software debugging, GNSS NMEA sentence output and voice over USB* ● Supported USB serial drivers: – Windows 7/8/8.1/10, – Linux 2.6–5.15 – Android 4.x–12.x
PCIe Interface	● Complaint with PCIe Gen 4 ● PCIe × 1 lane, supporting up to 16 Gbps ● Used for AT command communication, data transmission, firmware upgrade, software debugging, GNSS NMEA sentence output
Transmitting Power	● 5G NR bands: Class 3 (23 dBm ±2 dB) ● 5G NR n38/n40/n41/n77/n78/n79 bands HPUE: Class 2 (26 dBm +2/-3 dB)

	● LTE bands: Class 3 (23 dBm $\pm$2 dB) ● LTE B38/B41/B42/B43 bands HPUE ¹: Class 2 (26 dBm $\pm$2 dB) ● WCDMA bands: Class 3 (24 dBm +1/-3 dB)
5G NR Features	● Supports 3GPP Rel-16 ● Supported modulations: - Uplink: $\pi/2$-BPSK, QPSK, 16QAM, 64QAM and 256QAM - Downlink: QPSK, 16QAM, 64QAM and 256QAM ● Supports SCS 15 kHz ² and 30 kHz ² ● Supports SA ³ and NSA ³ operation modes on all the 5G band ● Supports Option 3x, 3a, 3 and Option 2 ● Max. transmission data rates ⁴: - NSA: 3.2 Gbps (DL)/525/550 ⁵ Mbps (UL) - SA: 2.4 Gbps (DL)/ 900 Mbps (UL)
LTE Features	● Supports 3GPP Rel-16 ● LTE Category: - DL Cat 19/ UL Cat 18 ● Supported modulations: - Uplink: QPSK, 16QAM and 64QAM and 256QAM - Downlink: QPSK, 16QAM and 64QAM and 256QAM ● Supports 1.4/3/5/10/15/20 MHz RF bandwidth ● Max. transmission data rates ⁴: - LTE: 1.6 Gbps (DL)/ 200 Mbps (UL)
UMTS Features	● Supports 3GPP Rel-9 DC-HSDPA, HSPA +, HSDPA, HSUPA and WCDMA ● Supports QPSK, 16QAM and 64QAM modulation ● Max. transmission data rates ⁴: - DC-HSDPA: 42 Mbps (DL) - HSUPA: 5.76 Mbps (UL) - WCDMA: 384 kbps (DL)/ 384 kbps (UL)
Rx-diversity	● Supports 5G NR/LTE/WCDMA Rx-diversity
GNSS Features	● Protocol: <i>NMEA 0183</i> ● Data Update Rate: 1 Hz
Antenna Interfaces	● ANT0, ANT1, ANT2, and ANT3
AT Commands	● Compliant with <i>3GPP TS 27.007</i> and <i>3GPP TS 27.005</i> ● Quectel enhanced AT commands
Internet Protocol Features	● Supports NITZ, PING and QMI protocols ● Supports PAP and CHAP for PPP connections

¹ HPUE is only for single carrier.

² 5G NR FDD bands only support 15 kHz SCS, and NR TDD bands only support 30 kHz SCS.

³ See **CA & ENDC list** for bandwidth supported by each frequency band in the NSA and SA modes.

⁴ The maximum rates are theoretical and the actual values refer to the network configuration.

⁵ 525 Mbps is the typical value; while 550 Mbps is the theoretical data rate when the UL 256QAM of both LTE and 5G NR are enabled (LTEUL 256QAM in EN-DC is disabled by default and has not been deployed by operators, and it is not fully tested).

Firmware Upgrade	● USB 2.0 interface ● PCIe interface ● (D)FOTA (support A/B system)
SMS	● Text and PDU modes ● Point-to-point MO and MT ● SMS cell broadcast ● SMS storage: ME by default
Physical Characteristics	● M.2 Key-B ● Size: 30.0 mm × 52.0 mm × 2.3 mm ● Weight: approx. 8.7 g
Temperature Range	● Operating temperature range: -30 °C to +75 °C ⁶ ● Extended temperature range: -40 °C to +85 °C ⁷ ● Storage temperature range: -40 °C to +90°C
RoHS	All hardware components are fully compliant with EU RoHS directive

CA & ENDC:

CA:

UL CA_1C; UL CA_3C; UL CA_5B; UL CA_7C; UL CA_38C; UL CA_40C
 UL CA_41C; UL CA_42C; UL CA_1A-3A; UL CA_1A-5A; UL CA_1A-7A; UL CA_1A-8A
 UL CA_1A-28A; UL CA_3A-5A; UL CA_3A-7A; UL CA_3A-8A;
 UL CA_3A-20A; UL CA_7A-20A; UL CA_7A-28A;
 DL CA_20A-32A; DL CA_1A-46A; DL CA_3A-46A; DL CA_7A-46A

ENDC:

DC_3A_n1A; DC_5A_n1A; DC_1A_n3A; DC_5A_n3A; DC_1A_n5A; DC_3A_n7A;
 DC_5A_n7A; DC_1A_n8A; DC_1A_n20A; DC_1A_n28A; DC_3A_n28A;
 DC_7A_n28A; DC_20A_n28A; DC_1A_n38A; DC_5A_n38A; DC_1A_n40A;
 DC_3A_n40A; DC_5A_n40A; DC_8A_n40A; DC_1A_n41A; DC_5A_n41A;
 DC_1A_n77A; DC_3A_n77A; DC_5A_n77A; DC_7A_n77A; DC_8A_n77A;
 DC_20A_n77A; DC_28A_n77A; DC_40A_n77A; DC_1A_n78A; DC_3A_n78A;
 DC_5A_n78A; DC_7A_n78A; DC_8A_n78A; DC_20A_n78A; DC_28A_n78A;
 DC_38A_n78A;

⁶ To meet this operating temperature range, you need to ensure effective thermal dissipation, for example, by adding passive or active heatsinks, heat pipes, vapor chambers, etc. Within this range, the module can meet 3GPP specifications.

⁷ To meet this extended temperature range, you need to ensure effective thermal dissipation, for example, by adding passive or active heatsinks, heat pipes, vapor chambers, etc. Within this range, the module remains the ability to establish and maintain functions such as voice*, SMS, emergency call*, etc., without any unrecoverable malfunction. Radio spectrum and radio network are not influenced, while one or more specifications, such as P_{out}, may undergo a reduction in value, exceeding the specified tolerances of 3GPP. When the temperature returns to the normal operating temperature level, the module will meet 3GPP specifications again.

OEM Installation Guidance

For Senao 5G Sub-6 GHz M.2 Module

FCC ID: U2M-2022RM520NGL, IC: 3616C-022RM520NGL

- OEM integrators must ensure that its product is electrically identical to Senao's reference designs. Any modifications to Senao's reference designs may invalidate regulatory approvals in relation to the product, or may necessitate notifications to the relevant regulatory authorities.
 - OEM integrators are responsible for regression testing to accommodate changes to designs, new antennas, and host and submit for C2PC filings.
- Colocation with other transmitter modules will be addressed through filings for those co-located transmitters when necessary or that colocation of other transmitters will be according to applicable KDB guidelines including those for RF exposure
- The final system integrator must ensure there is no instruction provided in the user manual or customer documentation indicating how to install or remove the transmitter
 - Appropriate labels must be affixed to the product that complies with applicable regulations in all respects. The regulatory label on the final system must include the statement: "Contains FCC ID: U2M-2022RM520NGL and/or IC: 3616C-022RM520NGL".
 - A user's manual or instruction manual must be included with the product that contains the text as required by applicable law shall be provided to OEM integrators. They may include:

1. USA—Federal Communications Commission (FCC)

FCC COMPLIANCE STATEMENT:

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

INFORMATION TO USER:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with the instructions, it may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by tuning the equipment off and on, the user is encouraged to try and correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the distance between the equipment and the receiver.
- Connect the equipment to outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

The final host manual shall include the following regulatory statement:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with the instructions, it may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by tuning the equipment off and on, the user is encouraged to try and correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the distance between the equipment and the receiver.
- Connect the equipment to outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

2. Canada - Industry Canada (IC)

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

French:

Cet appareil est conforme avec Industrie Canada exempts de licence standard RSS (s). L'utilisation de ce dispositif est autorisée seulement aux conditions suivantes: (1) il ne doit pas produire de brouillage et (2) l'utilisateur du dispositif doit être prêt à accepter tout brouillage radioélectrique reçu, même si ce brouillage est susceptible de compromettre le fonctionnement du dispositif.

Radiation Exposure Statement:

The product comply with the FCC/IC portable RF exposure limit set forth for an uncontrolled environment and are safe for intended operation as described in this manual. The further RF exposure reduction can be achieved if the product can be kept as far as possible from the user body or set the device to lower output power if such function is available.

Déclaration d'exposition aux radiations:

Le produit est conforme aux limites d'exposition pour les appareils portables RF pour les Etats-Unis et le Canada établies pour un environnement non contrôlé.

Le produit est sûr pour un fonctionnement tel que décrit dans ce manuel. La réduction aux expositions RF peut être augmentée si l'appareil peut être conservé aussi loin que possible du corps de l'utilisateur ou que le dispositif est réglé sur la puissance de sortie la plus faible si une telle fonction est disponible

Information on test modes and additional testing requirements

This transmitter is tested in a standalone mobile RF exposure condition and any co-located or simultaneous transmission with other transmitter(s) or portable use will require a separate class II permissive change re-evaluation or new certification.

Additional testing, Part 15 Subpart B disclaimer

This transmitter module is tested as a subsystem and its certification does not cover the FCC Part 15 Subpart B (unintentional radiator) rule requirement applicable to the final host. The final host will still need to be reassessed for compliance to this portion of rule requirements if applicable.

As long as all conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

IMPORTANT NOTE:

In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.

OEM/Host manufacturer responsibilities

OEM/Host manufacturers are ultimately responsible for the compliance of the Host and Module. The final product must be reassessed against all the essential requirements of the FCC rule such as FCC Part 15 Subpart B before it can be placed on the US market. This includes reassessing the transmitter module for compliance with the Radio and EMF essential requirements of the FCC rules. This module must not be incorporated into any other device or system without retesting for compliance as multi-radio and combined equipment

FOR MOBILE DEVICE USAGE

Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

Cet appareil est conçu uniquement pour les intégrateurs OEM dans les conditions suivantes: (Pour utilisation de dispositif module)

- 1) Le module émetteur peut ne pas être coïmplanté avec un autre émetteur ou antenne.
- 2) Approbation du Module valable que lorsque le module est installé dans l'hôte testé ou de la série de l'hôte compatible qui ont même caractéristique de l'exposition aux RF avec la distance égale ou supérieure séparation antenne.

Tant que les 2 conditions ci-dessus sont remplies, des essais supplémentaires sur l'émetteur ne seront pas nécessaires. Toutefois, l'intégrateur OEM est toujours responsable des essais sur son produit final pour toutes exigences de conformité supplémentaires requis pour ce module installé.

IMPORTANT NOTE:

In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the Canada authorization is no longer considered valid and the IC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate Canada authorization.

NOTE IMPORTANTE:

Dans le cas où ces conditions ne peuvent être satisfaites (par exemple pour certaines configurations d'ordinateur portable ou de certaines co-localisation avec un autre émetteur), l'autorisation du Canada n'est plus considérée comme valide et l'ID IC ne peut pas être utilisé sur le produit final. Dans ces circonstances, l'intégrateur OEM sera chargé de réévaluer le produit final (y compris l'émetteur) et l'obtention d'une autorisation distincte au Canada.

End Product Labeling FOR MOBILE DEVICE USAGE

This equipment complies with ISED radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with greater than 20cm between the radiator & your body. The final end product must be labeled in a visible area with the following: "Contains IC: 3616C-022RM520NGL".

Plaque signalétique du produit final

Cet équipement est conforme aux limites d'exposition aux rayonnements ISED établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé à plus de 20 cm entre le radiateur et votre corps. Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: "Contient des IC: 3616C-022RM520NGL".

Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.

Manuel d'information à l'utilisateur final

L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à la façon d'installer ou de supprimer ce module RF dans le manuel de l'utilisateur du produit final qui intègre ce module. Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.