



viDoc[®]

Product Manual

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1. FCC Statements

1.1 FCC Statement (Applicable in U.S.)

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.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the 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 and, if not installed and used in accordance with the instructions, 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 turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

1.2 ISED Statements (EN/FR) (Applicable in Canada)

WARNING: This Class (B) digital apparatus complies with Canadian ICES-003. Cet appareil numérique de la classe (B) est conforme à la norme NMB-003 du Canada.

Canada Compliance Statement

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

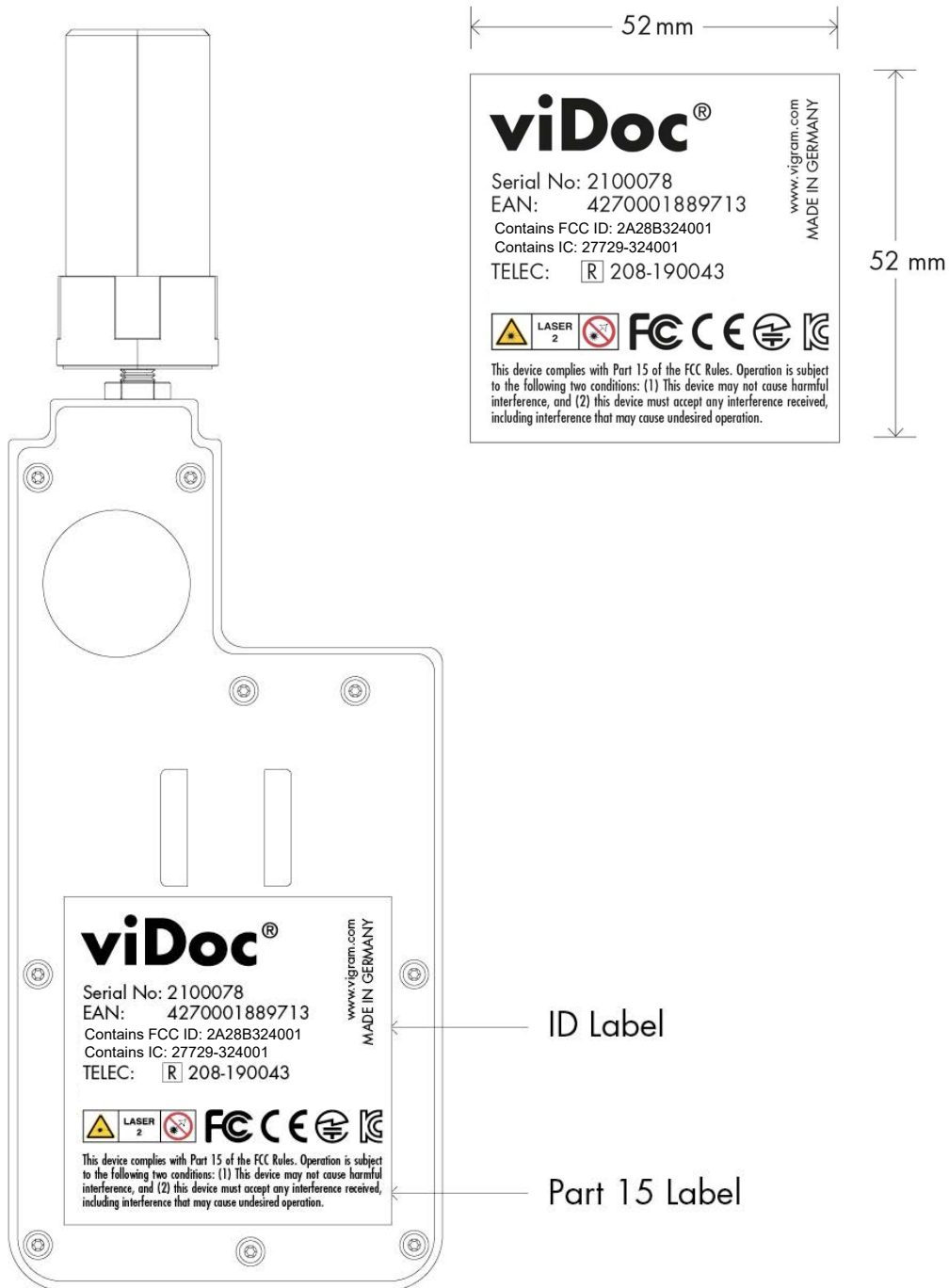
1. This device may not cause interference.
2. This device must accept any interference, including interference that may cause undesired operation of the device.

Canada Déclaration de Conformité

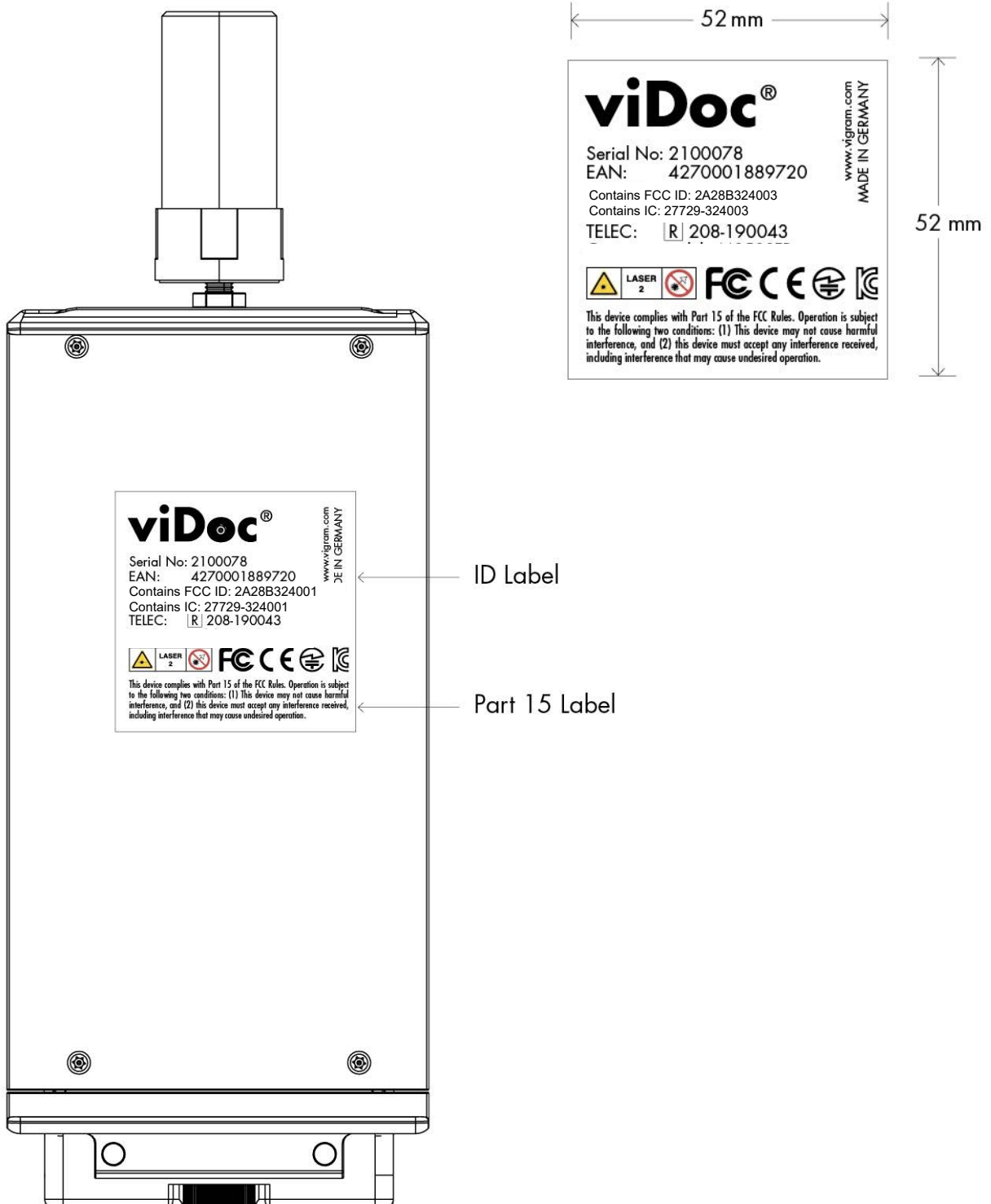
L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. L'appareil ne doit pas produire de brouillage;
2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Identification of Equipment viDoc for Smartphone ID Label & Part 15 Label



Identification of Equipment viDoc for Tablet ID Label & Part 15 Label



1.3 FCC Radiation Exposure Statement

The radiated rf output power of the instrument is below the FCC radio frequency exposure limits for portable devices according to KDB447498.

Canada

This digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus as set out in the radio interference regulations of the Canadian Department of Communications. This Category II radiocommunication device complies with Industry Canada Standard RSS-310.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de Classe B prescrites dans le règlement sur le brouillage radioélectrique édicté par le Ministère des Communications du Canada. Ce dispositif de radiocommunication de catégorie II respecte la norme CNR-310 d'Industrie Canada.

Europe

This product has been tested and found to comply with the essential requirements for a Class B device pursuant to European Council Directive 1999/5/EC on R&TTE on EMC, thereby satisfying the requirements for CE Marking and sale within the European Economic Area (EEA). These requirements are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential or commercial environment.



Australia and New Zealand

This product conforms with the regulatory requirements of the Australian Communications and Media Authority (ACMA) EMC framework, thus satisfying the requirements for RCM marking and sale within Australia and New Zealand.

**Taiwan – Battery Recycling Requirements**

The product contains a removable Lithium-ion battery. Taiwanese regulations require that waste batteries are recycled.

廢電池請回收

Waste Electrical and Electronic Equipment (WEEE)

For product recycling instructions and more information, please go to www.vigram.com

Recycling in Europe:

To recycle vigram WEEE (Waste Electrical and Electronic Equipment, products that run on electrical power.), Call +49 7576 962976-0, and ask for the “WEEE Associate”. Or, mail a request for recycling instructions to:

vigram GmbH
Jechtinger Strasse 21
D 79111 Freiburg
Germany
+49 7576 962976-0

1.4 FCC Declaration of Conformity

Pix4D Inc
1615 Platte St, 3rd Floor
Denver, CO 80202
United States
+1 415-766-0503

Declare under sole responsibility that DoC products comply with Part 15 of 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

1.4 RTTE Compliance statements

Czech

vigram GmbH tímto prohlašuje, že tento (viDoc® GNSS přijímač) je ve shodě se základními požadavky a dalšími příslušnými ustanoveními směrnice 1999/5/ES.

Danish

Undertegnede vigram GmbH erklærer herved, at følgende udstyr (viDoc® GNSS modtager) overholder de væsentlige krav og øvrige relevante krav i direktiv 1999/5/EF.

Dutch

Hierbij verklaart vigram GmbH dat het toestel (viDoc® GNSS ontvanger) in overeenstemming is met de essentiële eisen en de andere relevante bepalingen van richtlijn 1999/5/EG.

English

Hereby, vigram GmbH, declares that this equipment (viDoc® GNSS receiver) is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.

Estonian

Käesolevaga kinnitab vigram GmbH seadme (viDoc® GNSS vastuvõtja) vastavust direktiivi 1999/5/EÜ põhinõuetele ja nimetatud direktiivist tulenevatele teistele asjakohastele sätetele.

German

Hiermit erklärt vigram GmbH, dass sich das Gerät (viDoc®-GNSS-Empfänger) in Übereinstimmung mit den grundlegenden Anforderungen und den übrigen einschlägigen Bestimmungen der Richtlinie 1999/5/EG befindet.

Greek

ΜΕ ΤΗΝ ΠΑΡΟΥΣΑ vigram GmbH ΔΗΛΩΝΕΙ ΟΤΙ (viDoc® GNSS δέκτη) ΣΥΜΜΟΡΦΩΝΕΤΑΙ ΠΡΟΣ ΤΙΣ ΟΥΣΙΩΔΕΙΣ ΑΠΑΙΤΗΣΕΙΣ ΚΑΙ ΤΙΣ ΛΟΙΠΕΣ ΣΧΕΤΙΚΕΣ ΔΙΑΤΑΞΕΙΣ ΤΗΣ ΟΔΗΓΙΑΣ 1999/5/EK.

Hungarian

Alulírott, vigram GmbH nyilatkozom, hogy a (viDoc® GNSS vevő) megfelel a vonatkozó alapvető követelményeknek és az 1999/5/EC irányelv egyéb előírásainak.

Finnish

vigram GmbH vakuuttaa täten että (viDoc® GNSS-vastaanotin) tyypinen laite on direktiivin 1999/5/EY oleellisten vaatimusten ja sitä koskevien direktiivin muiden ehtojen mukainen.

French

Par la présente vigram GmbH déclare que l'appareil (viDoc® récepteur GNSS) est conforme aux exigences essentielles et aux autres dispositions pertinentes de la directive 1999/5/CE.

Icelandic

Hér með lýsir vigram GmbH yfir því að (viDoc® GNSS móttakari) er í samræmi við grunnkröfur og aðrar kröfur, sem gerðar eru í tilskipun 1999/5/EC.

Italian

Con la presente vigram GmbH dichiara che questo (Ricevitore viDoc® GNSS) è conforme ai requisiti essenziali ed alle altre disposizioni pertinenti stabilite dalla direttiva 1999/5/CE.

Latvian

Ar šo vigram GmbH deklarē, ka (viDoc® GNSS uztvērējs) atbilst Direktīvas 1999/5/EK būtiskajām prasībām un citiem ar to saistītajiem noteikumiem.

Lithuanian

Šiuo vigram GmbH deklaruoja, kad šis (viDoc® GNSS imtuvas) atitinka esminius reikalavimus ir kitas 1999/5/EB Direktyvos nuostatas.

Maltese

Hawnhekk, vigram GmbH, jiddikjara li dan (viDoc® GNSS riċevitur) jikkonforma mal-ħtiġijiet essenzjali u ma provvedimenti oħrajn relevanti li hemm fid-Direttiva 1999/5/EC.

Norwegian

vigram GmbH erklærer herved at utstyret (viDoc® GNSS-mottaker) i samsvar med de grunnleggende krav og øvrige relevante krav i direktiv 1999/5/EF.

Polish

Niniejszym vigram GmbH oświadcza, że (Odbiornik viDoc® GNSS) jest zgodny z zasadniczymi wymogami oraz pozostałymi stosownymi postanowieniami Dyrektywy 1999/5/EC.

Portuguese

vigram GmbH declara que este (Receptor GNSS viDoc®) está conforme com os requisitos essenciais e outras disposições da Directiva 1999/5/CE.

Slovak

vigram GmbH týmto vyhlasuje, že (Prijímač viDoc® GNSS) splňa základné požiadavky a všetky príslušné ustanovenia Smernice 1999/5/ES.

Slovenian

vigram GmbH izjavlja, da je ta (Sprejemnik viDoc® GNSS) skladu z bistvenimi zahtevami in ostalimi relevantnimi določili direktive 1999/5/ES.

Spanish

Por medio de la presente vigram GmbH declara que el (viDoc® GNSS receptor) cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 1999/5/CE.

Swedish

Härmed intygar vigram GmbH att denna (viDoc® GNSS-mottagare) står i överensstämmelse med de väsentliga egenskapskrav och övriga relevanta bestämmelser som framgår av direktiv 1999/5/EG.

The vigram viDoc® GNSS receiver integrates the Advanced nRF52832 Module MS50SFB Bluetooth radio module

Model: MS50SFB, FCC ID: 2ABU6-MS50SFB, IC: 20896-MS50SFB, TELEC: 208-190043

2. Safety Information

Before using the vigram® product, make sure you have read and understood all the relevant information.

WARNING - This **warning** warns of a potential hazard which, if not avoided, could result in serious injury or even death.

CAUTION: This **warning** alerts you to a possible hazard or unsafe practice that could result in minor personal injury or property damage, or irrecoverable loss of data.

NOTE - The absence of specific warnings does not mean that there are no safety risks.

2.1 Regulations and Safety

The units contain integrated Bluetooth® radio technology and can also send radio signals via the antenna of an internal radio modem or via an externally connected data communication radio (also smartphone). The regulations for using the 450 MHz radio modems vary greatly from country to country. In some countries, the machine can be used without an end-user license. For licensing information, contact your local regional distributor. Bluetooth operates in license-free bands.

WARNING - Electromagnetic radiation can cause interference in other equipment, in installations (e.g. medical equipment such as space travel or hearing aids) and in aircraft. It may also affect humans and animals.

Precautions:

Although this product complies with the strictest standards and regulations, the possibility of harm to humans and animals cannot be completely excluded. Do not use the product near petrol stations, chemical factories, in areas with potentially explosive atmospheres and where blasting occurs.

Do not use the product near medical equipment.

Do not use the product in aircraft.

Do not use the product near your body for a long period of time.

2.2 Use and Maintenance

This product is designed to withstand the rough handling and harsh environment typically encountered in construction applications. However, the receiver is a high-precision electronic instrument and should be handled with reasonable care. Dropping it even from low heights may cause slight damage to the housing, antenna or electronics.

CAUTION - Operating or storing the receiver outside the specified temperature range may damage it. Do not leave the unit unattended in the blazing sun or pouring rain.

2.3 Type Approval

Type approval or acceptance covers technical parameters of the equipment with regard to emissions that may cause interference. Type approval is granted to the manufacturer of the transmission equipment, regardless of the operation or approval of the equipment. Some countries have specific technical requirements for operation, in particular modern frequency bands. To meet these requirements, Vigram may have modified your equipment to obtain type approval.

Unauthorized modifications to the equipment will invalidate the type approval, the warranty and the operating license of the equipment.

2.4 Operation in the Vicinity of other Radio Equipment

When operating the receiver in member states of the European Union and in other countries complying with EU R&TTE requirements, in the vicinity of air navigation equipment operating between 2700 and 2900 MHz or fixed, fixed satellites (space to earth) or for mobile systems operating at 4170 MHz, a minimum distance of 10 meters must be maintained between the receiver and such radio equipment.

2.5 Exposure to High Frequency Radiation

2.5.1 For Bluetooth radio

The radiated output power of the internal Bluetooth radio is below the FCC radio frequency exposure limits. The internal wireless radio(s) operate within the guidelines of radio frequency safety standards and recommendations that reflect the consensus of the scientific community. Vigram therefore believes that the internal wireless radios are safe for consumer use. The energy emitted is far less than the electromagnetic energy emitted by wireless devices such as mobile phones. However, the use of wireless radios may be restricted in some situations or environments, such as aircraft. If you are unsure of the restrictions, you should request authorization before switching on the wireless radio.

2.6 Installing the Antenna

CAUTION - For your own safety and in view of the FCC's RF exposure requirements, always observe these precautions:

- Do not place the antenna together with other transmitting devices.

This unit is designed to operate with the antennas listed below and has a maximum gain of 4 dBi. Antennas that are not included in this list or have a gain greater than 4 dBi are strictly prohibited for use with this unit. The required antenna impedance is 50 ohms.

To reduce possible radio interference to other users, the antenna type and its gain should be selected so that the equivalent isotropically radiated power (EIRP) is not higher than that allowed for successful communication.

Approved external antennas: Four-Arm Helix Antenna Type JCH/SY.

2.7 LiPo Battery Safety

WARNING- Only charge and use the rechargeable lithium-ion battery in accordance with the instructions. Charging or using the battery in unauthorized equipment may cause an explosion or fire and result in injury and/or equipment damage. To avoid injury or damage:

- Do not charge or use the battery if it appears to be damaged or leaking.
- Only charge lithium-ion batteries using simple smartphone USB chargers or another charger specified for that battery.
- Discontinue charging a battery that emits extreme heat or a burning odor.

WARNING - Do not damage the rechargeable lithium-ion battery. A damaged battery can cause an explosion or fire and result in personal injury and/or property damage.

To avoid injury or damage:

- Do not use or charge the battery if it appears to be damaged. Signs of damage include discoloration, deformation and leaking battery fluid.
- Do not expose the battery to fire, high temperatures or direct sunlight.
- Do not immerse the unit in water.
- Do not use or store the battery in a vehicle in hot weather.
- Do not drop or puncture the battery and the unit.
- Do not open the battery or short-circuit its contacts.

WARNING - Avoid contact with the rechargeable lithium-ion battery if it appears to be leaking. Battery fluid is corrosive and contact with it can cause injury and/or property damage.

To avoid injury or damage:

- If the battery leaks, avoid contact with the battery fluid.
- If battery fluid gets into your eyes, rinse your eyes immediately with clean water and seek medical attention. Do not rub your eyes!
- If battery fluid gets on your skin or clothing, wash off the battery fluid immediately with clean water.

2.8 Limitation of Use

See the Technical Data section. The unit is intended for indoor and outdoor use. Do not use the product in potentially explosive atmospheres or in aggressive environments. The unit does not have IP certification.

WARNING - Watch out for false readings if the unit is defective, has been dropped or has been misused or modified. Carry out regular test measurements. Especially after the unit has been subjected to abnormal use and before, during and after important measurements.

CAUTION - Never attempt to repair the product yourself. In case of damage, contact a local dealer.

WARNING - Changes or modifications not expressly approved could void the user's authority to operate the equipment.

2.9 Forbidden Use

- Using the product without instructions.
- Use outside the stated limits.
- Deactivation of safety systems and removal of information and danger signs.
- Opening the unit with tools (screwdriver, etc.).
- Use of accessories from other manufacturers without explicit permission.
- Carry out modification or conversion of the product.
- Deliberate blinding of third parties; also in the dark.
- Insufficient safety precautions during surveying (e.g. when measuring on roads, construction sites, etc.).
- Deliberate or irresponsible behavior on scaffolding, when using ladders, when measuring near running machines or near machine parts or unprotected equipment.
- Aiming directly at the sun.

3. viDoc® Product Description

3.1 Introduction

This manual describes how to set up and use a viDoc® GNSS Multi-Measurement Tool. Even if you have used other Global Navigation Satellite System (GNSS) products or laser rangefinders, vigram® recommends that you take the time to read this manual to learn about the special features of your product. If you are not familiar with GNSS or laser rangefinders, visit our website for an interactive look at vigram® and viDoc® at www.vigram.com.

The viDoc® GNSS Multi-Measurement Tool (GMMT) includes a GNSS antenna, receiver, Bluetooth® radio technology, 2 laser rangefinders that can be used as a rover or for photogrammetry, and two batteries in a rugged, lightweight aluminum unit. The LED allows you to monitor the radio reception and the power supply. Bluetooth wireless technology enables wireless communication between the receiver and the controllers (smartphones/tablets).

The viDoc® does not have the option of changing settings via key combinations. To configure the receiver, a hardware-related configuration with the help of a PC/laptop is required.

The connection between viDoc® and the matching end device is made via an adjustment device (tablet) or a licensed quick-connect (SP Connect - Austria (smartphone) - additional accessories required).

3.2. viDoc® GNSS Features

- 10 mm +1 ppm RMS horizontal and vertical precision when using RTK corrections.
- Supported by version 2021-1.2 and higher of the vigram® SDK.
- Ready for many NTRIP services. Subscription required.
- Small, lightweight design - receiver only at 242g/484g (USB power cable included)
- Fully functional, ready to use, with multi-frequency GNSS tracking (GPS, GLONASS, BeiDou and Galileo).
- 2-separate and independent lithium-ion batteries provide more than four hours of GNSS rover operation per charge.
- Bluetooth wireless technology for wireless, hassle-free operation with various smartphones/tablets with SDK supporting apps such. as: vigram viDoc or similar (available in the app store).
- Power button with LED display for power and battery indicator.
- Bluetooth integrated.

3.3. Related Information

Sources of related information include the following:

- Release Notes - The release notes describe new features of the product, information not included in the manuals and any changes to the manuals. They can be downloaded from the vigram® website.
- Vigram training courses - Consider a training course to help you get the most out of your GNSS system. For more information, visit the vigram® website.

3.4 Technical Support

In case of problems with the hardware and a case of damage, you can get help at <https://vigram.zendesk.com/hc/de/categories/360003048920-viDoc>

3.5. Installation Guidelines

Mind the following guidelines when using the appliance:

When operating the receiver in member states of the European Union and in other countries complying with EU R&TTE requirements, in the vicinity of aeronautical radionavigation equipment operating between 2700 and 2900 MHz, or fixed satellites (space to earth), or for mobile systems operating at 4170 MHz, a minimum distance of 5 meters must be maintained between the receiver and such radio equipment.

Place the GNSS antenna in a location with a clear view of the sky in all directions. Do not place the antenna near vertical obstructions such as buildings, deep cuts, construction vehicles, towers or tree tops.

GNSS rover and base station receive the same satellite signals from the same satellites. The system requires five common satellites to provide RTK positioning.

GNSS satellites are constantly on the move. Because you can't measure at a particular location now doesn't mean you can't measure there later when satellite coverage at the location improves. Use the GNSS apps daily to determine the best and worst satellite reception times for your location and then select measurement times that match the optimal GNSS performance. This is especially important if you are working in the worst GNSS locations.

To obtain a fixed position solution with centimeter accuracy, initialize the RTK rover receiver. For initialization to take place, the receiver must be tracking at least five satellites that the base station is also tracking. For multi-satellite constellation operation, for example GPS, Galileo, Beidou and GLONASS, the receiver must track at least six satellites. In order to continue to measure with centimeter accuracy, the rover must continuously track at least four satellites, which the base station also tracks. The radio link between the base station and the rover receiver must also be maintained.

Loss of satellite signals results in a loss of position accuracy in the centimeter range.

The housing is not waterproof, so avoid high humidity.

Avoid extreme environmental conditions when operating the unit, including:

- Water also condensing
- Heat above 35 °C
- Cold below -5 °C
- Corrosive liquids and gases

Avoid the following sources of electrical and magnetic noise:

- Petrol engines (spark plugs).
- Televisions and PC monitors.
- Alternators and generators.
- Electric motors.
- Devices with DC/AC converters.
- Fluorescent lights.
- Switching power supplies.

CAUTION - The viDoc®-GMMT is not suitable for operation on the vehicle where it is subject to strong vibrations, i.e. operation on uneven terrain. Use in these conditions may damage the receiver.

WARNING - This unit uses a rechargeable lithium-ion battery. To avoid personal injury or property damage, make sure you have read and understood the safety information at the beginning of this manual.

WARNING - Only charge and use the rechargeable lithium-ion battery according to the instructions. Charging or using the battery in unauthorized equipment may cause an explosion or fire and result in injury and/or equipment damage.

To avoid injury or damage:

- Do not charge or use the battery if it appears to be damaged or leaking.
- Stop charging a battery that gives off extreme heat or a burning smell.

For CAUTION - Do not damage the rechargeable lithium-ion battery. A damaged battery can cause an explosion or fire and result in personal injury and/or property damage.

- Do not use or charge the battery if it appears to be damaged. Signs of damage include discoloration, deformation and leaking battery fluid.
- Do not expose the battery to fire, high temperatures or direct sunlight.
- Do not immerse the battery in water.
- Do not use or store the battery in a vehicle in hot weather.
- Do not drop or puncture the battery.
- Do not open the battery or the device and do not short-circuit its contacts -> Contact support immediately!

WARNING - Avoid contact with the rechargeable lithium-ion battery if it appears to be leaking. Battery fluid is corrosive and can cause injury and/or property damage:

1. If the battery leaks, avoid contact with the battery fluid.
2. If battery fluid gets into your eyes, rinse your eyes immediately with clean water and seek medical attention. Do not rub your eyes!
3. If battery fluid gets on your skin or clothing, wash off the battery fluid immediately with clean water.

A battery that has reached the deep discharge state cannot be recharged and must be replaced. The following recommendations will ensure optimum performance and extend the life of your batteries:

1. Fully charge all new batteries before use.
2. Do not allow the batteries to discharge below 5 V.
3. Keep all batteries charged continuously when not in use.
4. If you need to store the batteries, fully charge them before storage and then charge them at least every three months.
5. The battery is supplied partially charged. Fully charge the battery before using it for the first time.
 - To charge the battery, only use a charger that is suitable for charging the lithium-ion battery.
 - If the unit has been stored for more than three months, charge the battery before using the receiver.

To charge the battery:

- Make sure the ventilation slots on the back and bottom of the unit (viDoc®) are clear.
- To power the charger, use the supplied cable.
- Plug the supplied cable (USB-C) into the viDoc®. For an explanation of the LED, see LED status indicator below.
- Charging takes approx. 3 hours per battery at room temperature.

LED Status Indicator



GREEN:
Unit switched on
and ready
for operation.



ORANGE:
Unit connected
to power supply
and the battery
is still charging.



OFF:
when the device is
switched off
or when the battery
is fully charged
when the charging
cable is plugged in.

3.6. Disposal of the Unit and/or LiPo

Discharge the lithium-ion battery before disposing of it or the unit. When disposing of the unit, ensure that it is disposed of in an environmentally friendly manner. Observe all local and national regulations for the disposal or recycling of batteries.

3.7 Using the GNSS Antenna and Mounting it

There are 2 different GNSS antennas for viDoc® according to the attached list. Working with the GNSS antenna:

- 1) Check the thread on your viDoc® and your antenna for possible dirt. (Clean only by blowing out and not with the help of a compressor).
- 2) Screw the antenna straight onto the viDoc®. Be careful not to overtighten the thread. Turn until you feel a slight resistance.

CAUTION - Do not overtighten the thread, this can lead to breakage. The antenna cannot be used again afterwards and must be replaced!

3.8. Working with a Surveyor's Pole or Tripod

- 1) Mount the viDoc® on the tripod via its threaded device on the lower part.
- 2) Turn until the unit is noticeably firm.
- 3) Only switch on the unit after this process.

CAUTION - Do not overtighten the thread, this may cause breakage.

3.9 Configure and Apply

The viDoc® has no controls to change settings or operate.

The unit can be configured in three ways:

- Via the Bluetooth protocol, connected via the same one.
- Use of a vigram® app.
- Using a third-party app that uses the vigram® SDK.

Communication always takes place via wireless Bluetooth technology.

3.10 Switch Functions

On the left side of the unit you will find the on/off switch. Press the switch in for 2 seconds. The viDoc® switches on and the LED below it lights up green. To switch the unit off, press and hold the switch again for 2 seconds. The LED flashes green and goes off. The viDoc® is switched off.

NOTE - In case of problems with the connection to the NTRIP, switch off the unit and switch it on again within 5 seconds. It is in the so-called HOT-MODE and finds its position within seconds.

3.11 Connect to the End Device (smartphone/tablet)

Make sure your battery is charged. Switch on your Bluetooth on the end device. Start your viDoc® until the LED shows green. Depending on the app you are using, you may need to search for devices. Search for viDoc® - (serial number) and select it. Depending on the app, you can already establish a connection to your device. In many cases, you will now be asked to enter your NTRIP data (additional service provider). The device then connects to your mobile terminal. In the status display, you will see after 60 seconds at the latest whether you have reached the RTK-fix mode. Now you are ready to measure.

NOTE - When using apps, you will be asked if the app is allowed to access your Bluetooth? If you answer NO, you will NOT be able to connect to the device.

NOTE - In all vigram® apps you can rent your NTRIP access, for a fee.

NOTE - For more information on your RTK, how GNSS works and similar topics, visit the vigram® Knowledge- Base.

CAUTION - Depending on the correction data service (NTRIP), accuracies may vary. Recommendations are available on request from vigram®.

CAUTION - You must be outdoors for full reception strength and there must be no tall objects within 50 meters.

3.11.1 Data Logs

The viDoc® transmits the NMEA protocol with all important metadata as standard. Depending on the app application, you have the option of reading out or processing these protocols.

3.11.2 Standard Configuration

The viDoc® is completely pre-configured and designed for the use case of static measurement and measurement in motion (Structure for Motion) up to 20km/h.

3.11.3 Firmware Innovations

The viDoc® is equipped with a bootloader that can be controlled via your app. If a firmware update is available, it can be installed by your app provider with your consent.

3.11.4 Problem Handling

The following problems may occur when using viDoc®:

Type	Solution
No NTRIP connection	Switch off the unit and restart
No satellites found	Check your antenna connection
Unit does not switch on	Check your battery is charged

3.11.5 Protocols

UBX Input/output, binary, U-blox proprietary
NMEA Input/output, ASCII
RTCM 3.3 Input/output, binary

3.12. viDoc® Laser Rangefinder Features

Accuracy: +-3mm
Measuring Unit: millimeter
Measuring Range: (without Reflection) 0.03-40m
Measuring Time: 0.1~4 seconds
Laser Class: Class II
Laser Type: 635nm, <1mW
Size: 25*45*12mm
Weight: About 9g
Voltage: DC 2.5~3.3V
Operating Temperature: 0-40 °C 32-104 °F
Storage Temperature: -25~60 °C (-13~140 °F)

3.12.1 Connecting the Laser

The laser rangefinders can only be addressed via the Bluetooth communication interface. This is done via the app used in each case, provided that it offers the interface.

3.12.2 Calibration of the Laser

Each viDoc® is subjected to a strict quality control at the factory. The lasers are individually calibrated for the specific device and their measuring accuracy (distance) is checked.

WARNING - The lasers can be misaligned by concussions. As a result, measurement inaccuracies may occur. In this case, recertification by the manufacturer vigram is required!

NOTE - The two lasers installed are different types and have different technical characteristics.

3.12.3 Using the Laser

After connecting your viDoc® to the terminal, you can activate the laser.

The lasers support 2 different modes:

Fast Mode - high sampling rate with lower accuracy (up to 10x per second)

Slow Mode - low sampling rate with high precision (up to 4 seconds)

NOTE - The use of a range laser in conjunction with the GNSS RTK is recommended in Fast Mode.

3.12.3.1 Laser Modes

Permanently ON	Laser is active and ready to measure
Laser flashes (beeps)	Bottom laser measures
Laser flashes	Front laser measures
Fast beeping	Fast Mode
Slow beep	Slow Mode
No laser on	Laser inactive

3.13 Problem Solving

In rare cases there is a hardware-related function problem. In these cases, restart your viDoc®.

3.14 Measuring Accuracy

The measuring accuracy depends on the distance, the lighting conditions, the ambient conditions and the surface. Not all surfaces are suitable for measurement with the laser.

4. Technical Data

4.1 Four-star full-frequency four-arm helical antenna 36dB

4.1.1 Product Introduction

The antenna adopts a four-arm spiral structure with a relatively stable phase center, which reduces the influence of the antenna on the measurement error.

The antenna gain is high, the beam pattern is wide, and the effect of receiving low elevation signals is good, ensuring that the antenna can receive the satellite in different attitudes.

The antenna is equipped with a high-band out-of-band suppression low-noise amplifier circuit, which can effectively resist external electromagnetic interference, and has low power consumption to ensure the endurance of the device.

The antenna is small in size and light in weight, and is suitable for use on various devices that require antenna weight, such as drones and various handheld terminals.



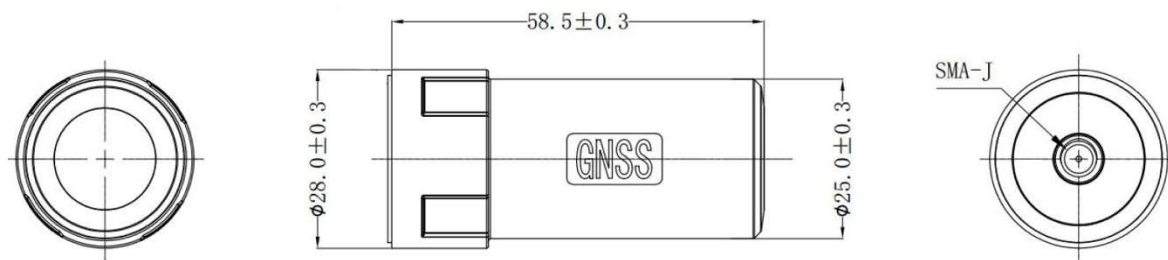
4.1.2 Application

This antenna is a Samsung seven-band four-arm helical antenna covering GPS L1 / L2, BDS B1 / B2 / B3, GLONASS L1 / L2, Galileo E1/E5. It has the characteristics of small size and light weight. It is widely used in navigation scheduling, tracking monitoring, measurement and control and other fields. Based on the four-arm helical antenna's low requirements for antenna attitude, it is especially suitable for many applications such as drone, such as aerial photography, traffic monitoring, remote telemetry, etc., and can also be applied to various handheld terminals, high-precision positioning modules, etc.

4.1.3 Technical Parameter

Electrical Specifications	
Frequency Range(MHz)	GPS L1, BDS B1, GLONASS L1: 1559~1602 Galileo: E1 GPS L2, BDS B2/B3, GLONASS L1: 1207~1278 Galileo :E5
Polarization	Right-hand circular
Gain (dBi)	90°≥2
Axial Ratio (dB)	90°≤3
LNA Gain(dB)	36±2
V.S.W.R	<2.0 : 1
Noise Figure (dB)	<2.0
DC Voltage (V)	3.3~18
Current (mA)	<30
Impedance(Ω)	50
Mechanical Specifications	
Dimensions(mm)	Φ28×58.5
Connector	SMA-J
Weight (g)	<25
Waterproof status	IP67
Environment Specifications	
Relative Humidity	95%
Operating Temperature (°C)	-40~+75
Weight (g) <25	Weight (g) <25
Storage Temperature (°C)	-55~+85
Antenna total gain	36dbi

Product size drawing (unit: mm, uninjected tolerance is ± 0.3mm)



4.2 Four-star full-frequency four-arm helical antenna 40dB

4.2.1 Product Introduction

The antenna adopts a four-arm spiral structure with a relatively stable phase center, which reduces the influence of the antenna on the measurement error.

The antenna gain is high, the beam pattern is wide, and the effect of receiving low elevation signals is good, ensuring that the antenna can receive the satellite in different attitudes.

The antenna is equipped with a high-band out-of-band suppression low-noise amplifier circuit, which can effectively resist external electromagnetic interference, and has low power consumption to ensure the endurance of the device.

The antenna is small in size and light in weight, and is suitable for use on various devices that require antenna weight, such as drones and various handheld terminals.

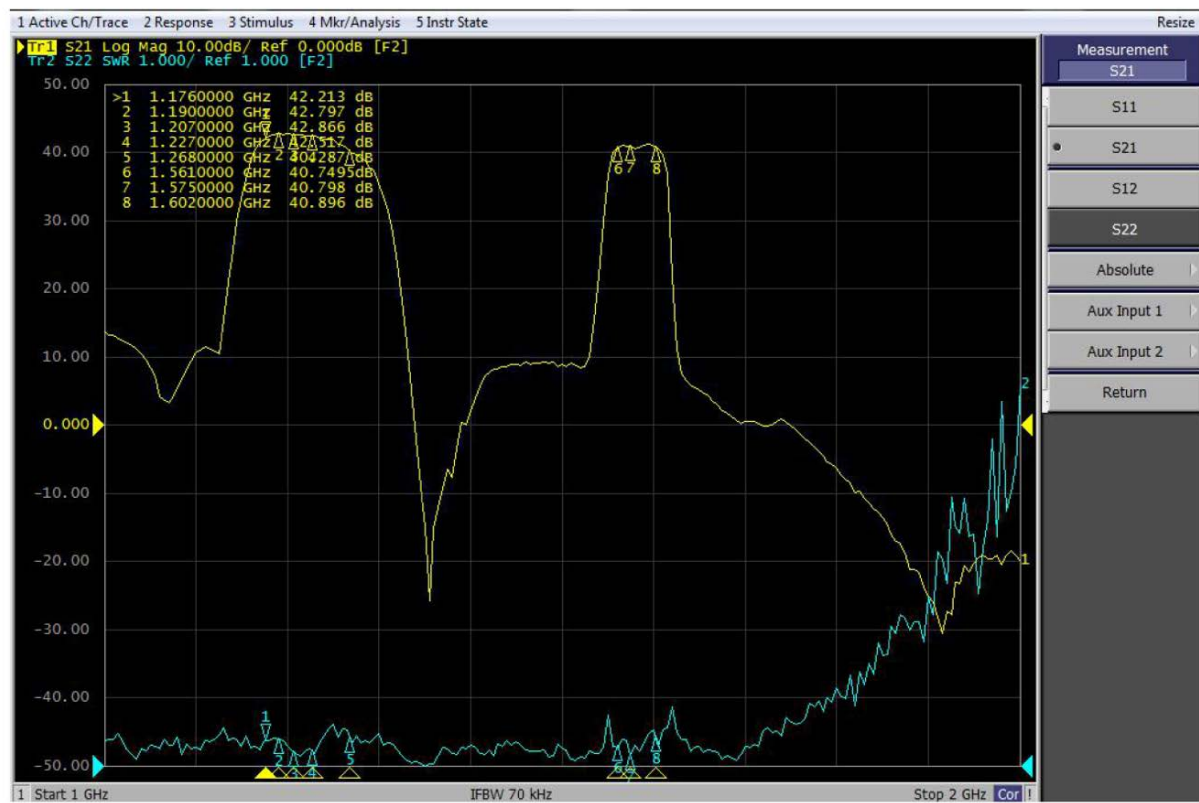


4.2.2 Application

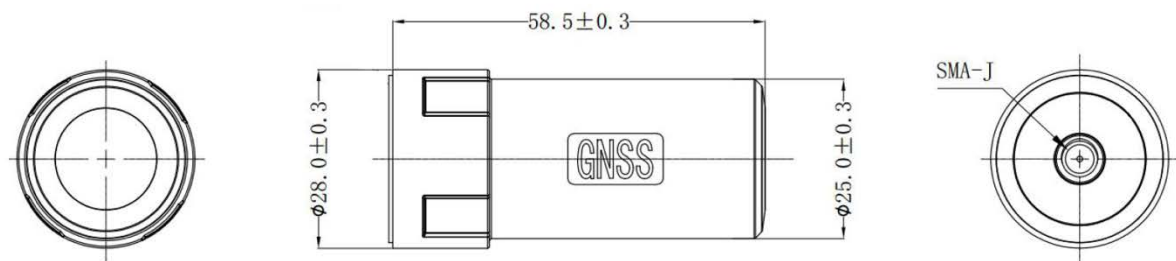
This antenna is a Samsung seven-band four-arm helical antenna covering GPS L1 / L2, BDS B1 / B2 / B3, GLONASS L1 / L2, Galileo E1/E5. It has the characteristics of small size and light weight. It is widely used in navigation scheduling, tracking monitoring, measurement and control and other fields. Based on the four-arm helical antenna's low requirements for antenna attitude, it is especially suitable for many applications such as drone, such as aerial photography, traffic monitoring, remote telemetry, etc., and can also be applied to various handheld terminals, high-precision positioning modules, etc.

4.2.3 Technical Parameter

Electrical Specifications	
Frequency Range(MHz)	GPS L1、BDS B1、GLONASS L1 : 1559~1602 GPS L2、BDS B2/B3、GLONASS L1 : 1207~1278
Polarization	Right-hand circular
Gain (dBi)	90°≥2
Axial Ratio (dB)	90°≤3
LNA Gain(dB)	40±2
V.S.W.R	<2.0 : 1
Noise Figure (dB)	<2.0
DC Voltage (V)	3.3~18
Noise Figure (dB) <2.0	Noise Figure (dB) <2.0
Current (mA)	<30
Impedance(Ω)	50
Mechanical Specifications	
Dimensions(mm)	Φ28×58.5
Connector	SMA-J
Weight (g)	<25
Waterproof status	IP67
Environment Specifications	
Relative Humidity	95%
Operating Temperature (°C)	-40~+75
Storage Temperature (°C)	-55~+85



Product size drawing (unit: mm, uninjected tolerance is ± 0.3 mm)



4.3 Frontlaser

4.3.1 Introduction

For decades, JRT has been an expert in the field of laser technology, optics, electronics, and mechanical systems that make up a laser rangefinder. We are one of the leading manufacturers in this sector. Our products are put to successful use around the world.

U8x series laser rangefinder module was developed for fast and precise distance measuring, even in difficult measurement conditions, like with poor reflect laser signal level. U8x extremely small and lightweight make it suitable for size and weight limited applications, such as portable devices, drones etc.

4.3.1.1 Features

Features of the module in L-Shape include:

1. Small size:
17mm width
31mm long
21mm height
2. Light Weight:
< 4g
3. Precise Distance Measuring
1mm resolution
4. Long Measuring Distance
20 meters

4.3.1.2 Quick Start

For quick testing shipped module please jump to section 6 Demonstration, after that reading the rest sections for more details.

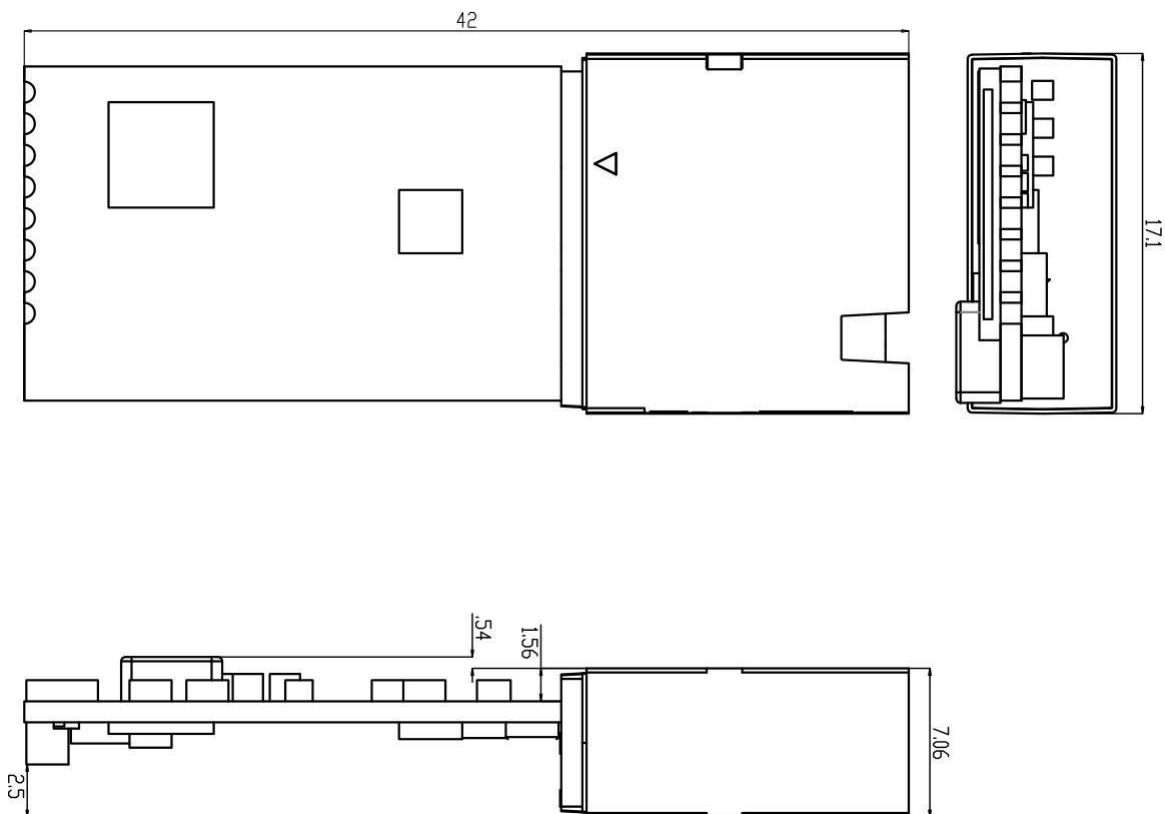
4.3.2 Key parameters

Table 2-1 key parameters

Accuracy	±3 mm
Measuring Unit	meter/inch/feet
Measuring Range (without Reflection)	0.03-20m
Measuring Time	0.1~4 seconds
Laser Class	Class II
Laser Type	620~690nm, <1mW
Size	17*41*7mm
Weight	About 4g
Voltage	DC 2.5~3.3V for U8x
Operating Temperature	0-40 °C (32-104 °F)
Storage Temperature	-25~60 °C (-13~140 °F)

4.3.3 Mechanical Data

Figure 3-1 Mechanical Size



4.3.4 Pin Information

At most 6 Pins need to control the laser rangefinder module.

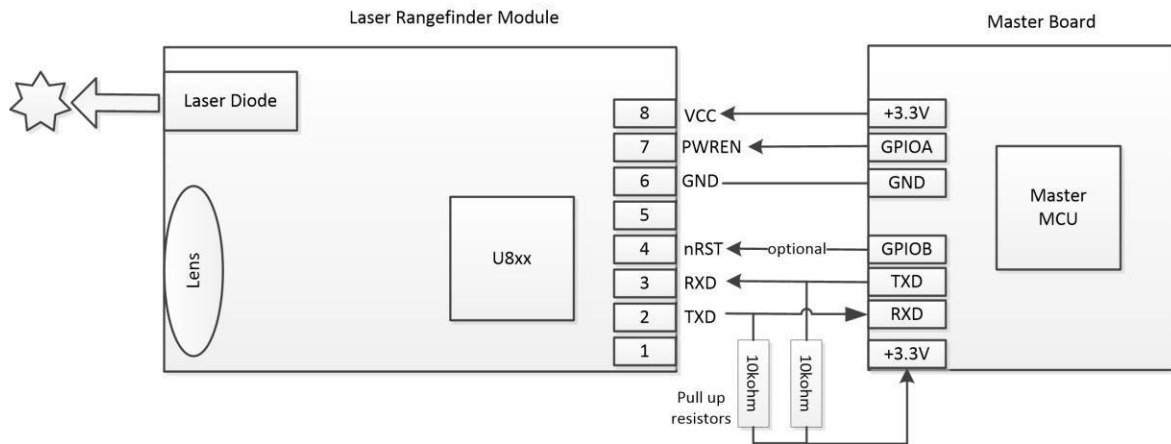


Figure 4-1 Wiring

All these pins list below:

Table 4-1 Pin List

Pin	Name	Function	Default	Description
1				Leave it unconnected
2	TXD	Digital Output	High	Module USART Transmit pin, Open Drain
3	RXD	Digital Input	High	Module USART Receive pin, Open Drain
4	nRST	Digital Input	High	Module reset pin, active LOW (optional)
5				Leave it unconnected
6	GND	Power	Ground	Module power ground
7	PWREN	Digital Input	Low	Module power up enable pin, active HIGH
8	VCC/VBAT	Power	Power	Module power supply, DC 3.3V 300mA+

We provide two types of connector according to customer's application:

4.3.4.1 Self-soldering with module stamp holes

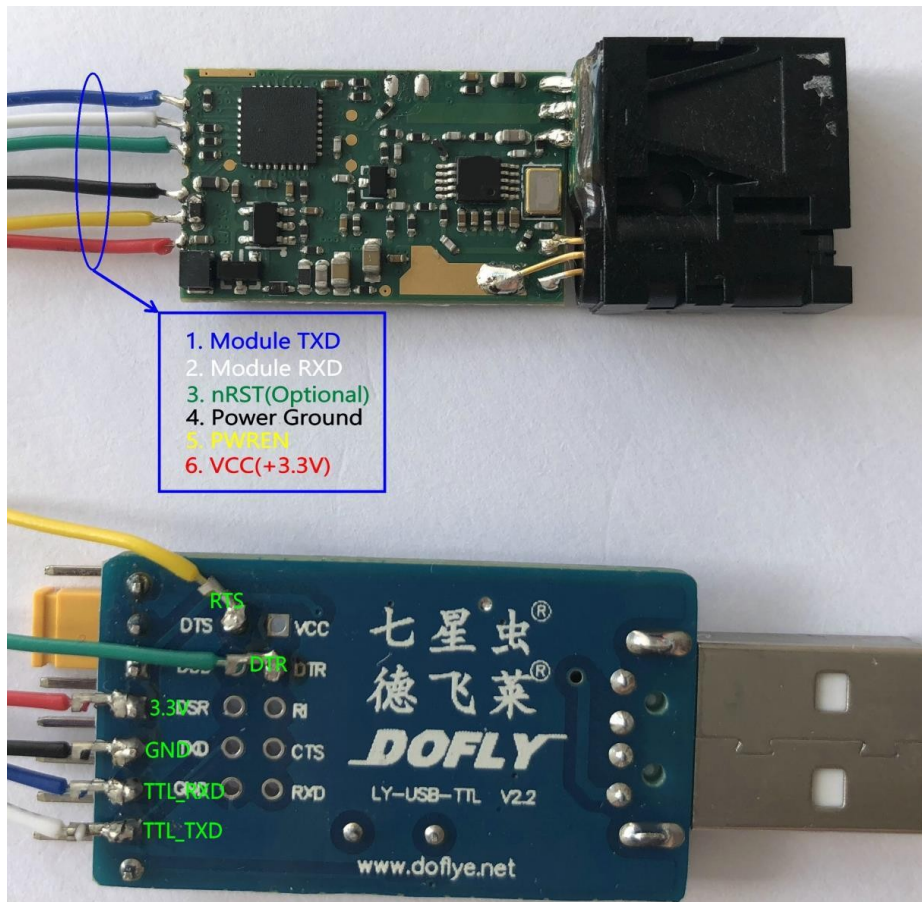


Figure 4-2 Solder Connector

4.3.4.2 Pin and 0.5mm pitch FPC connector

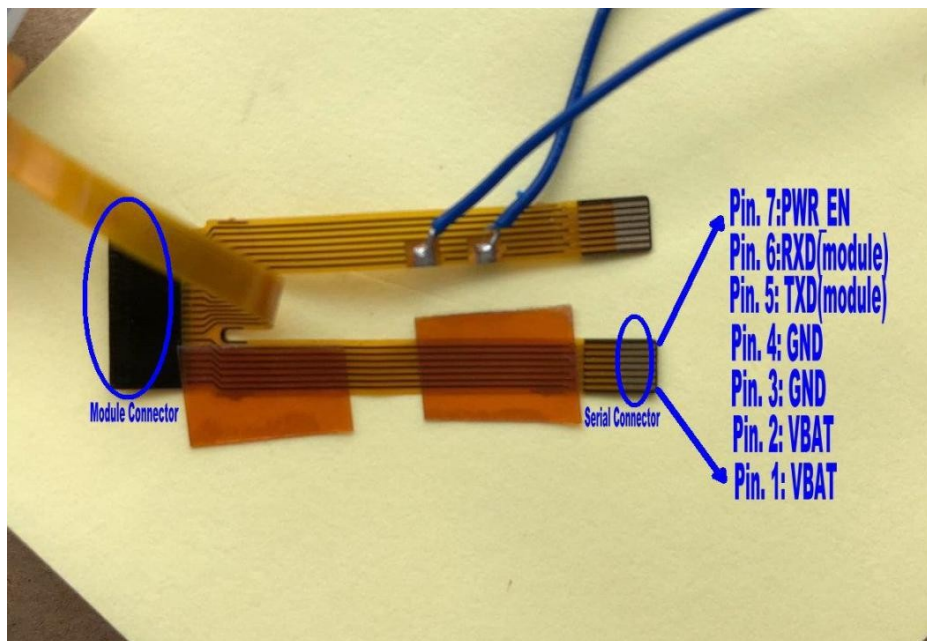


Figure 4-3 FPC connector

4.3.5 Absolute maximum ratings

!!!Note:

Exceeding one or more of the limiting values may cause module permanent damage!

Table 5-1 Absolute Max. Ratings

Operating conditions	Min	Max	Units
Voltages			
VCC	-0.3	5.5	V
GND		0	V
TXD	-0.3	VCC+0.3	V
RXD	-0.3	VCC+0.3	V
nRST	-0.3	4.0	V
PWREN	-0.3	4.0	V
Temperature			
Operating	0	+40	°C
Storage	-25	+60	°C

!!!Warning:

Please note that normal operating voltage is DC2.5~3.3V.

Voltage between DC3.3V~5.0V would not damage the module immediately, but it still will burn the module!

Don't use any power above DC3.3V.

4.3.6 Operation Protocol

4.3.6.1 USART Interface

- Baudrate : Auto Detect
- Start bits : 1 bit
- Data bits : 8 bits
- Stop bits : 1 bit
- Parity : none
- Flow control : none

!!!IMPORTANT:

Fixed baudrate 19200bps will be used under one condition:

**1. Auto baudrate stage time up (~2.5 seconds),
no auto baudrate byte 0x55 received or wrong byte received;**

4.3.6.2 Control flow char

All communication commands are issued by master board, laser rangefinder module play slave role to answer master's request. The Ask & Answer flow though USART is shown as Figure 6-1.

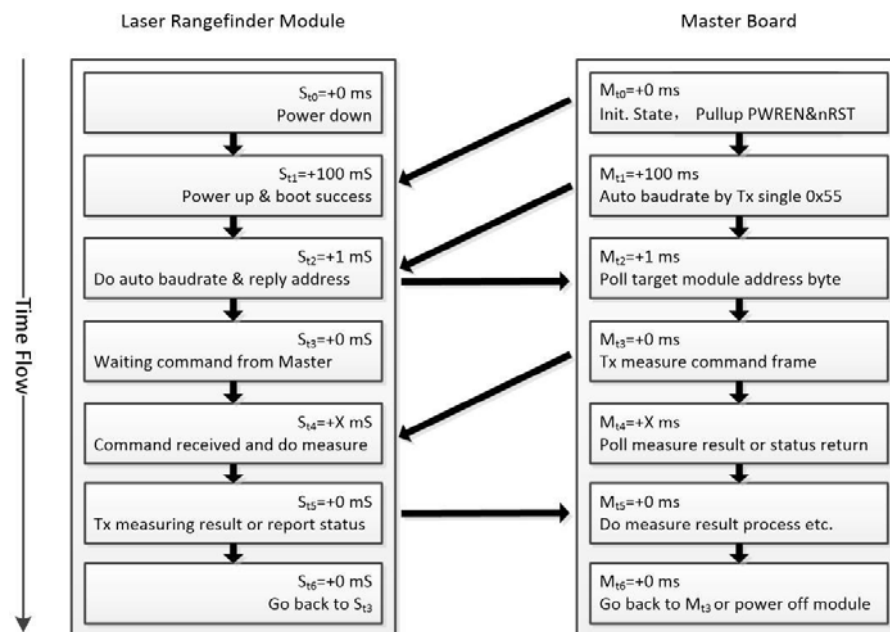


Figure 6-1 Control Flow

In initial state, Slave module (laser rangefinder) is in power down mode before Master pull up the PWREN pin. After PWREN goes high, and if nRST pin. Used please also remember to de-assert the nRST ping by pull it up, Slave will take about 100 milliseconds to do self-boot, and then entering auto baud rate detect stage.

Master transfer 1byte fixed data 0x55 to slave for auto baud rate, if success, slave will reply 1 byte data to master, which present the slave itself address. In one master and multi-slave communication situation, the self-address reply from the slaves may cause USART bus conflict, keep in mind this byte should be ignored.

Communication between master and slave has been established after the successful auto baud rate. Now master can send command frame to slave.

4.3.6.3 Command Frame

Command frame may consist 6 parts as Table 6-1 shows.

Table 6-1 command structure

Bytes	0	1		2	3	4	5	6	7	8
Bits	[7:0]	[7]	[6:0]	[7:0]	[7:0]	[7:0]	[7:0]	[7:0]	[7:0]	[7:0]
Name	Head	R/W.	Address	Register		Payload count		Payload		Checksum
Data	0xAA	0	0x51	0x00	0x20	0x00	0x01	0x00	0x00	0x72

Table 6-1 shows the 1-shot measure request command from master to slave.

In this command frame:

- Request frame always start with fixed head byte 0xAA, this byte can also be 0xEE during error reply frame from slave to master, please refer to section 6.4.16 error reply frame;
- R/W indicate bit, 0: Master write to Slave, 1: Master read from Slave
- Slave address is 0x51, address has only 7-bits, so the address is from 0x00 to 0x7F, 0x00 is the default address before master issue module address change command, 0x7F is the broadcast address reserved for one-master to multi-slaves network;
- Slave register is 0x0020 (REG_MEA_MODE, see register list 6.3.1 for more details);
- Payload data count write to register 0x0020 is 0x0001, this section may not present when R/W = 1, Master read from slave;
- The single data write to register 0x0020 is 0x0000, this section may not present when R/W = 1, Master read from slave;
- The frame checksum is 0x72, checksum = address byte + register bytes + payload count bytes + all payload bytes, byte overflow ignored;

4.3.6.3.1 Control Registers

Table 6-2 Registers

No.	Register	Name	Function
1	0x0000	REG_ERR_CODE	System status code
2	0x0006	REG_BAT_VLTG	Input voltage
3	0x0010	REG_ADDRESS	Module address
4	0x0012	REG_OFFSET	Module measure result offset
5	0x0020	REG_MEA_START	Initiate measure
6	0x0022	REG_MEA_RESULT	Measure result
7	0x01BE	REG_CTRL_LD	Laser diode control

4.3.6.4 Commands

4.3.6.4.1 Read Module Latest Status

Table 6-3 cmd. Read Module Status

Bytes	0	1	2	3	4
Name	Head	RW/Address	Register		Checksum
Data	0xAA	0x80	0x00	0x00	0x80

- Type: Read command
- Slave address: 0x00
- Register address: 0x0000
- Function: master read out the module's status after previous command executed;
- Reply from slave:

Table 6-4 cmd. Reply Read Module Status

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x80	0x00	0x00	0x00	0x01	0xYY	0xZZ	Checksum

Byte 0xZZ is the status code replied from slave, see status codes Table 6-24 for details.

4.3.6.4.2 Read Hardware Version Number

Table 6-5 cmd. Read HW version

Bytes	0	1	2	3	4
Name	Head	RW/Address	Register		Checksum
Data	0xAA	0x80	0x00	0x0A	0x8A

- Type: Read command
- Slave address: 0x00
- Register address: 0x000A
- Function: master read out the module's HW version number;
- Reply from slave:

Table 6-6 cmd. Reply Read HW version

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x80	0x00	0x0A	0x00	0x01	0xVV	0xYY	sum

HW version number is 0xVYYY.

4.3.6.4.3 Read Software Version Number

Table 6-7 cmd. Read HW version

Bytes	0	1	2	3	4
Name	Head	RW/Address	Register		Checksum
Data	0xAA	0x80	0x00	0x0C	0x8C

- Type: Read command
- Slave address: 0x00
- Register address: 0x000C
- Function: master read out the module's SW version number;
- Reply from slave:

Table 6-8 cmd. Reply Read SW version

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x80	0x00	0x0C	0x00	0x01	0xVV	0xYY	sum

SW version number is 0xVYYY.

4.3.6.4.4 Read Module Serial Number

Table 6-9 cmd. Read Serial version

Bytes	0	1	2	3	4
Name	Head	RW/Address	Register		Checksum
Data	0xAA	0x80	0x00	0x0E	0x8E

- Type: Read command
- Slave address: 0x00
- Register address: 0x000E
- Function: master read out the module's serial number;
- Reply from slave:

Table 6-10 cmd. Reply Read Serial Number

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x80	0x00	0x0E	0x00	0x01	0xSS	0xNN	sum

HW version number is 0xSSNN.

4.3.6.4.5 Read Input Voltage

Table 6-11 cmd. Read HW version

Bytes	0	1	2	3	4
Name	Head	RW/Address	Register		Checksum
Data	0xAA	0x80	0x00	0x06	0x86

- Type: Read command
- Slave address: 0x00
- Register address: 0x0006
- Function: master read out the module's input voltage in mV with BCD encode;
- Reply from slave:

Table 6-12 cmd. Reply Read HW version

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x80	0x00	0x06	0x00	0x01	0x32	0x19	sum

Input voltage = 3219mV.

4.3.6.4.6 Read Measure Result

Table 6-13 cmd. Read Measure Result

Bytes	0	1	2	3	4
Name	Head	RW/Address	Register		Checksum
Data	0xAA	0x80	0x00	0x22	0xA2

- Type: Read command
- Slave address: 0x00
- Register address: 0x0022
- Function: master read out the distance measure result;
- Reply from slave:

Table 6-14 cmd. Reply Measure Result

Bytes	0	1	2	3	4	5	6:9	10:11	8
Name	Head	RW/ Address	Register		Payload count		Payload Distance	Payload SQ	Check sum
Data	0xAA	0x00	0x00	0x22	0x00	0x03	0xAABBCCDD	0x0101	Check sum

4.3.6.4.7 Set Module Address

Table 6-15 cmd. Set Module Address

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x00	0x00	0x10	0x00	0x01	0x00	0xYY	sum

- Type: Write command
- Slave address: 0x00
- Register address: 0x0010
- Function: master set slave's address, this address will not lost after module power off;
- Reply from slave:

Table 6-16 cmd. Reply Set Module Address

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x00	0x00	0x10	0x00	0x01	0x00	0xYY	sum

Slave address set to 0xYY (!!!Beware: address only take bit[6:0], other bits will be ignored).

!!! Note: Do not set slave address to broadcast address 0x7F, this address is reserved for one master to multi-slave network which needs all slave to measure distance at the same time, and no slave reply measure result until master ask one of them to.

4.3.6.4.8 Set Module Measure Offset

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x00	0x00	0x12	0x00	0x01	0xZZ	0xYY	sum

- Type: Write command
- Slave address: 0x00
- Register address: 0x0012
- Function: master set slave's measure offset. For example, if the offset 0xZZYY = 0x7B(+123) , it means the final output of measure result will **PLUS** 123 millimeters , if the offset 0xZZYY = 0xFF85(-123), it means the final output of measure result will **MINUS** 123 millimeters.
- Reply from slave:

Table 6-17 cmd. Reply Set Module Address

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x00	0x00	0x12	0x00	0x01	0xZZ	0xYY	sum

4.3.6.4.9 Turn On or Turn Off Laser

Table 6-18 cmd. Turn on/off Laser

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x00	0x01	0xBE	0x00	0x01	0x00	0xZZ	Checksum

- Type: Write command
- Slave address: 0x00
- Register address: 0x01BE
- Function: turn on or turn off laser beam,
if 0xZZ = 0x01 laser on, 0xZZ = 0x00 laser off.
- Reply from slave:

Table 6-19 cmd. Reply Turn On/Off Laser

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x00	0x01	0xBE	0x00	0x01	0x00	0xZZ	Checksum

4.3.6.4.10 Start 1-shot Auto Distance Measure

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x00	0x00	0x20	0x00	0x01	0x00	0x00	0x21

- Type: Write command
- Slave address: 0x00
- Register address: 0x0020
- Function: Initiate slave to do 1-shot measure in auto mode,
for measure modes please refer to section 6.5.
- Reply from slave:

Table 6-20 cmd. Reply 1-shot Auto Measure

Bytes	0	1	2	3	4	5	6:9	10:11	8
Name	Head	RW/ Address	Register		Payload count		Payload Distance	Paylo adSQ	Chec ksum
Data	0xAA	0x00	0x00	0x22	0x00	0x03	0xAABBCCDD	0x0101	Chec ksum

- Type: Reply from slave
- Slave address: 0x00
- Register address: 0x0022
- Function: Reply measure result to master, measure result = 0xAABBCCDD millimeters
(frame byte6 = 0xAA, byte7 = 0xBB, byte8 = 0xCC, byte9 = 0xDD) and signal quality = 0x101,
less signal quality number stands for stronger laser signal and more reliable distance result.

4.3.6.4.11 Start 1-shot Slow Distance Measure

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x00	0x00	0x20	0x00	0x01	0x00	0x01	0x22

- Type: Write command
- Slave address: 0x00
- Register address: 0x0020
- Function: Initiate slave to do 1-shot measure in slow mode.
- Reply from slave: same as 1-shot auto mode.

4.3.6.4.12 Start 1-shot Fast Distance Measure

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x00	0x00	0x20	0x00	0x01	0x00	0x02	0x23

- Type: Write command
- Slave address: 0x00
- Register address: 0x0020
- Function: Initiate slave to do 1-shot measure in fast mode.
- Reply from slave: same as 1-shot auto mode.

4.3.6.4.13 Start Continuous Auto Distance Measure

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x00	0x00	0x20	0x00	0x01	0x00	0x04	0x25

- Type: Write command
- Slave address: 0x00
- Register address: 0x0020
- Function: Initiate slave to do continuous measure in auto mode.
- Reply from slave: same as 1-shot auto mode.

4.3.6.4.14 Start Continuous Slow Distance Measure

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x00	0x00	0x20	0x00	0x01	0x00	0x05	0x26

- Type: Write command
- Slave address: 0x00
- Register address: 0x0020
- Function: Initiate slave to do continuous measure in slow mode.
- Reply from slave: same as 1-shot auto mode.

4.3.6.4.15 Start Continuous Fast Distance Measure

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x00	0x00	0x20	0x00	0x01	0x00	0x06	0x27

- Type: Write command
- Slave address: 0x00
- Register address: 0x0020
- Function: Initiate slave to do continuous measure in fast mode.
- Reply from slave: same as 1-shot auto mode.

4.3.6.4.16 Error Reply from Slave

If any error occurred during measuring stage, laser rangefinder module will reply error report frame:

Table 6-21 Error Reply

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xEE	0x00	0x00	0x00	0x00	0x01	0x00	0x0F	0x10

- Type: Reply from slave
- Slave address: 0x00
- Register address: 0x0000
- Function: report error status code to master, the error code = 0x000F, please refer section 6.6 status codes for its meaning.

4.3.6.4.17 Exit from Continuous Measure

Master transfer one byte 0x58 (upper case character 'X') to stop continuous measure mode immediately.

4.3.6.4.18 Start Multi-slaves Measure

Master send out 1-shot measure commands to slave address 0x7F, that will make all online slaves to measure distance at the same time, but none of them will return its measure result to master until master ask each one to return the measure result. Before master send out the reading measure result command, master should read the slave's status code to make sure there was no error occurred during this slave measuring.

Table 6-22 Broadcast Measuring

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x7F	0x00	0x20	0x00	0x01	0x00	0x00	0xA0

- Type: Write command
- Slave address: 0x00
- Register address: 0x0020
- Function: Initiate all slave to do 1-shot measure in auto mode
- Reply from slave: NO REPLY

After sending this command out, master polling each slave address for their status, if slave replies its status code with 0x0000, means no error, then send Read measure Result command to read back the distance. Measure result for each slave will NOT overwrite until next successful measure command with a new distance result.

4.3.6.5 Measure Modes

There are 2 types of measure mode, 1-shot and continuous.

- 1-shot gives only 1 measure result for each distance measure request command;
- Continuous measuring continuous to reply distance result as more as 255 times if master not break the measuring cycles. To break the continuous measuring, master need to send 1 byte 0x58 (upper case character 'X' in ASCII) during measuring.

Each measure mode has 3 working attributes:

- Auto, module returns Measure Result & Signal Quality(SQ), Less SQ value stands for more reliable distance result, in this mode module adjust reading speed according to the laser reflect level;
- Slow, distance read for higher accuracy;
- Fast, distance read for lower accuracy, but higher speed.

Table 6-23 Measuring Modes

Attribute Modes	Auto	Slow	Fast
1-shot	1-shot Auto	1-shot Slow	1-shot Fast
Continuous	Continuous Auto	Continuous Slow	Continuous Fast
Measure Speed	Auto	Slow	Fast
Measure Accuracy	Auto	High	Low

4.3.6.6 Status Codes

Table 6-24 status codes

Status Code	Description
0x0000	No error
0x0001	Power input too low, power voltage should $\geq 2.2V$
0x0002	Internal error, don't care
0x0003	Module temperature is too low($< -20^{\circ}C$)
0x0004	Module temperature is too high($> +40^{\circ}C$)
0x0005	Target out of range
0x0006	Invalid measure result
0x0007	Background light too strong
0x0008	Laser signal too weak
0x0009	Laser signal too strong
0x000A	Hardware fault 1
0x000B	Hardware fault 2
0x000C	Hardware fault 3
0x000D	Hardware fault 4
0x000E	Hardware fault 5
0x000F	Laser signal not stable
0x0010	Hardware fault 6
0x0011	Hardware fault 7
0x0081	Invalid Frame

4.3.7 Demonstration

4.3.7.1 Wiring to USB2TTL converter

For test purpose, Pin nRST was tied to serial DTR line, and Pin. PWREN tied to RTS line. When DTR/RTS asserted, DTR/RTS line goes low, so de-assert DTR to power module and de-assert RTS to release nRST, module then start to boot.

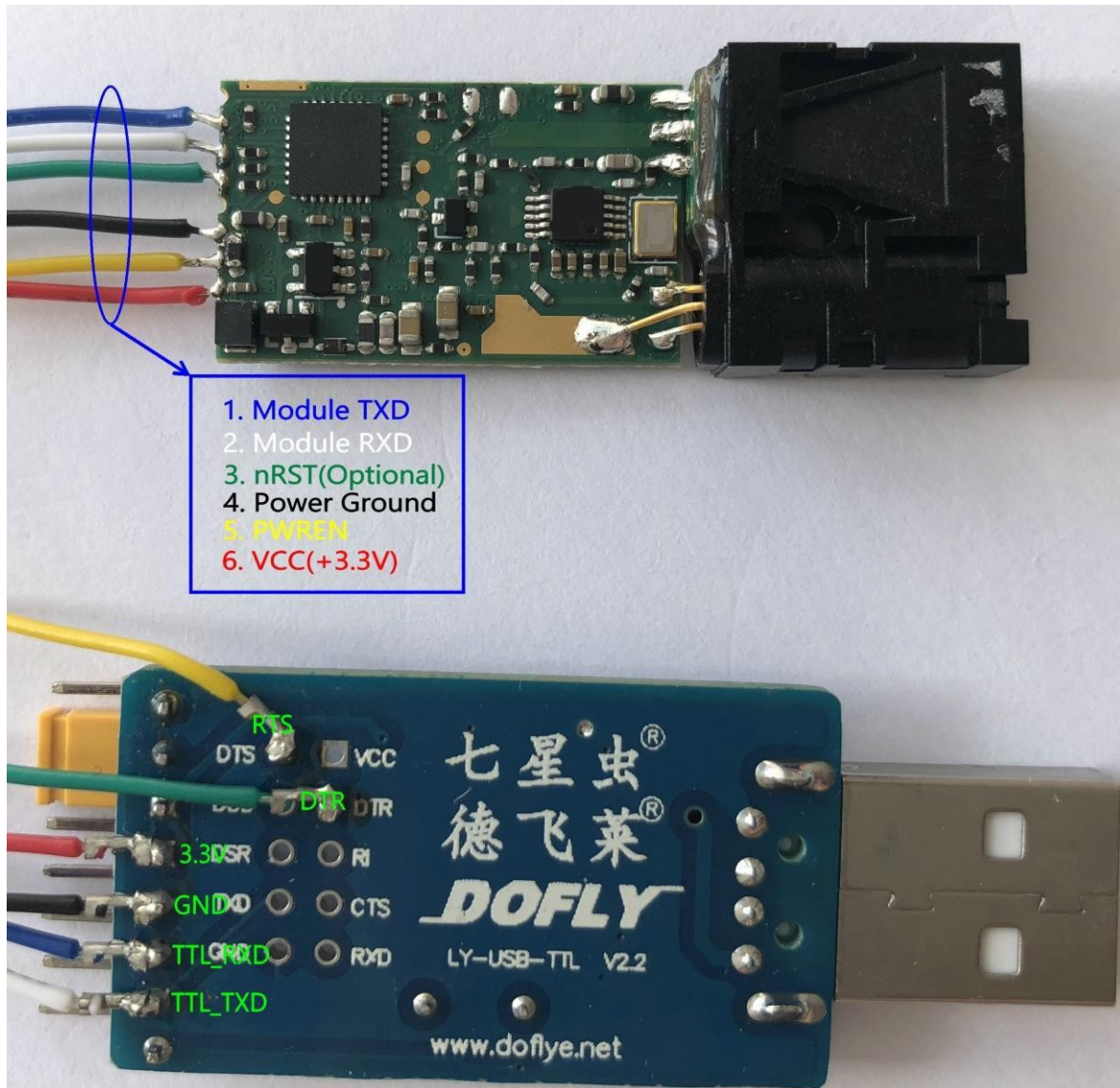


Figure 7-1 Wiring

4.3.7.2 Serial Port Test Software

Before start the command test, we need to:

1. Plug & Install CH341 USB2TTL converter driver on your computer;
2. Download & install the trial version serial port test software before start, software download page : <http://www.geshe.com/en/support/download>;
3. Start the software and follow the steps:

After starting the PC soft you have 2 options:

1. Create a new project;
2. load configuration file and do some modify according to your serial port number;

Create New Project from scratch;

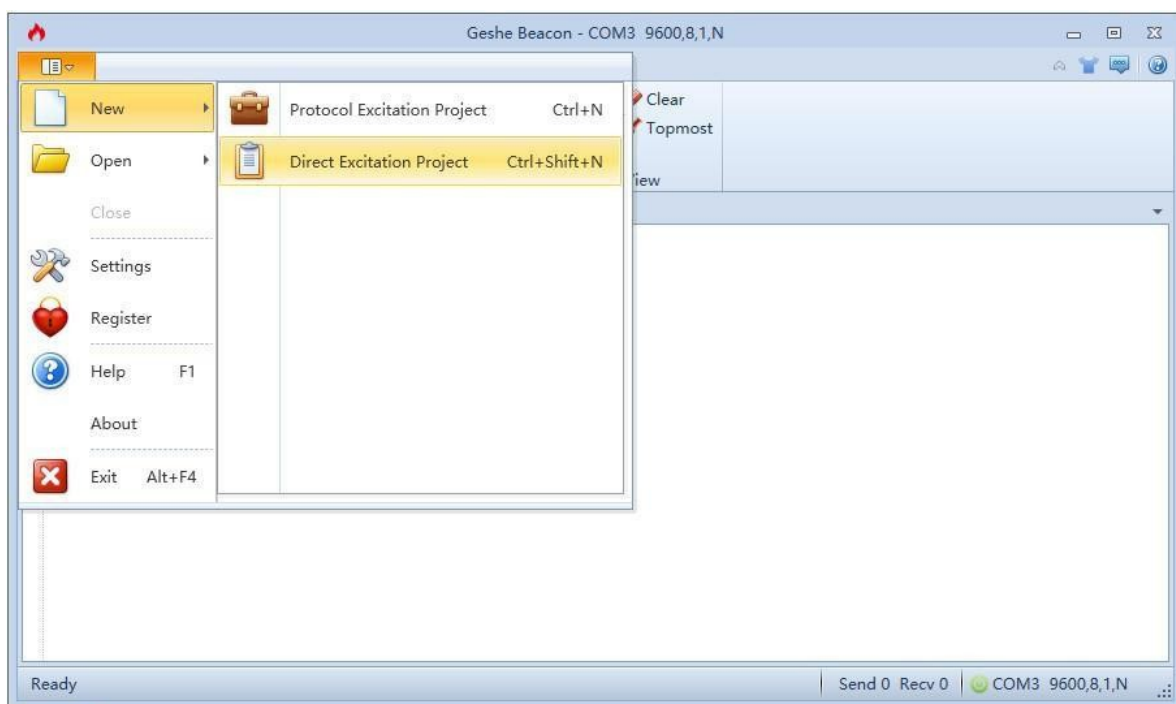


Figure 7-2 Create New Project

Load Configuration file “GeseDemoConfig.bsp” from test file folder

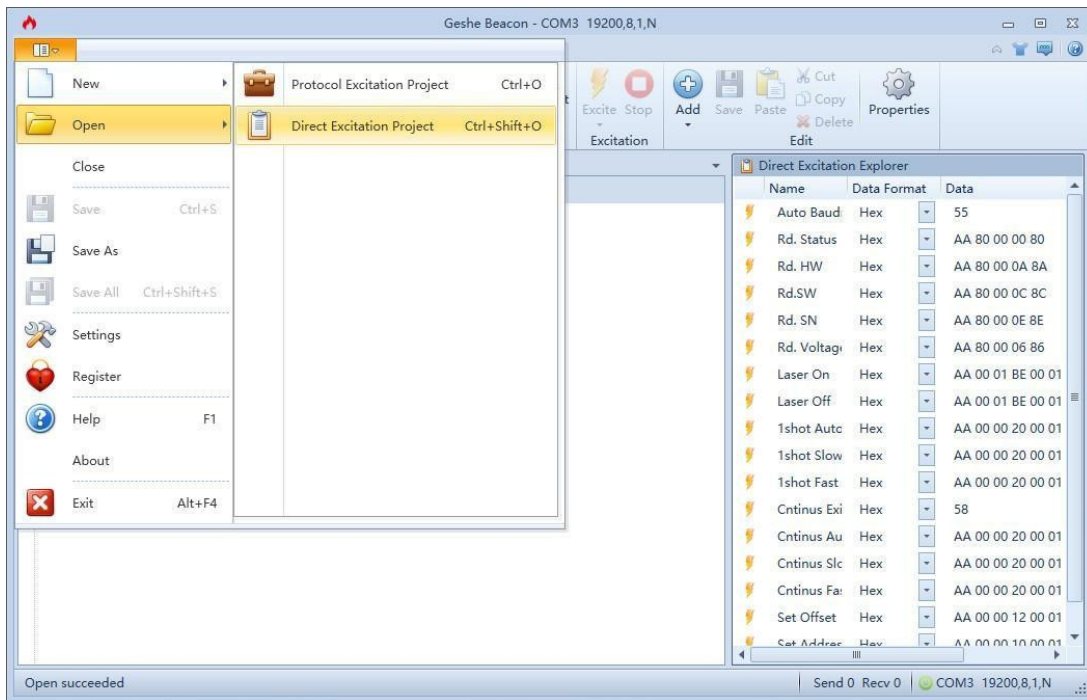
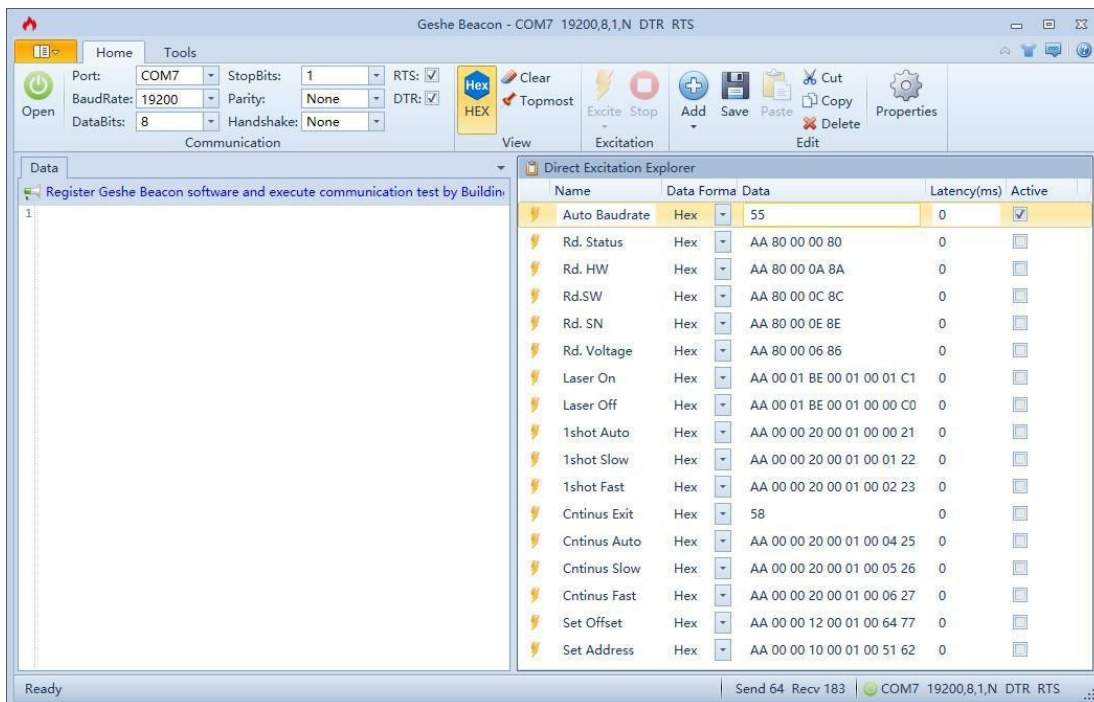


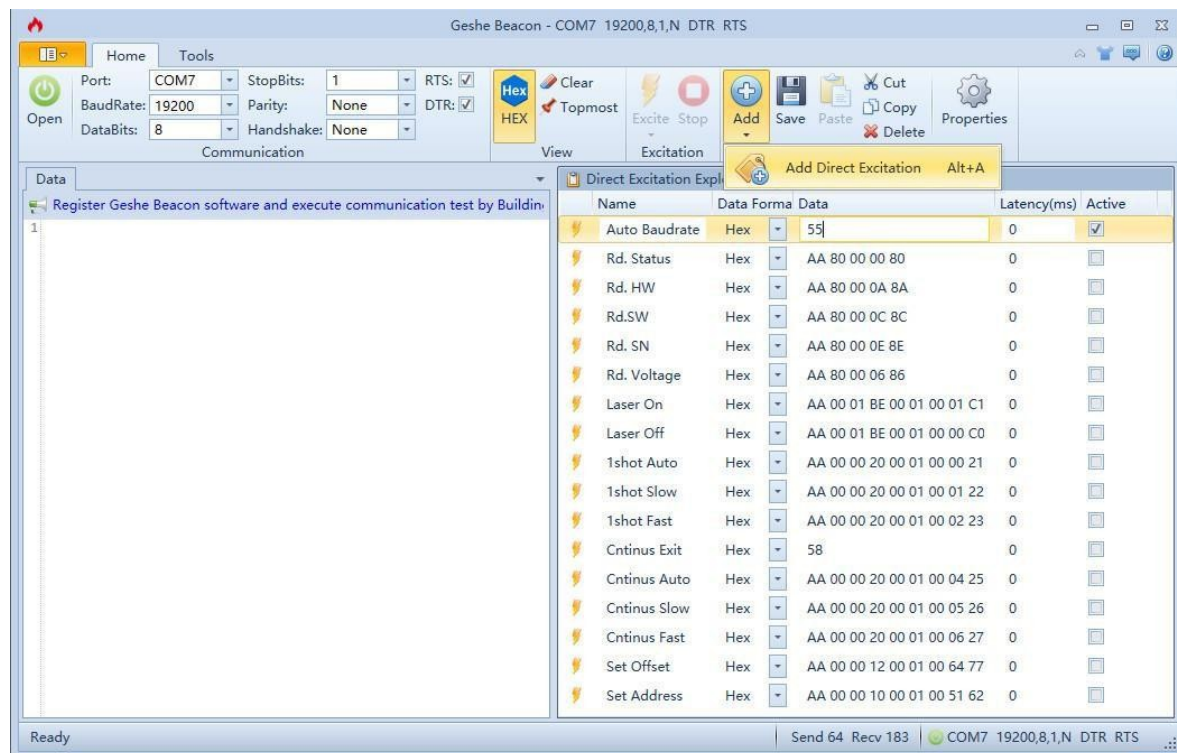
Figure 7-3 Load Config. File

Serial Port parameters Configuration, select the Port No. after plug the USB2TTL converter according to your computer, COM7 on my computer. Baud rate can be any of you want, 9600bps 19200bps, 115200bps etc.

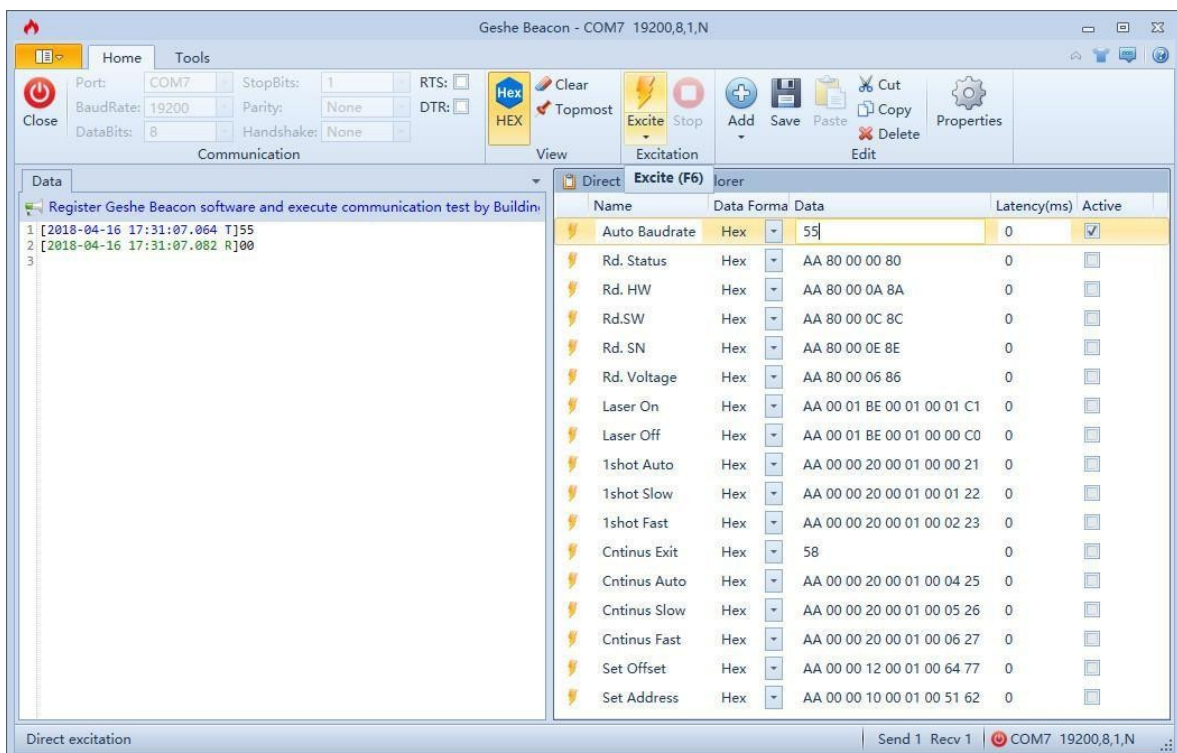
Remember to assert RTS/DTR box to power off module before start test.



If you chose to create new project, you have to add your commands by clicking ICO ADD to add commands, after that, Click ICO OPEN to turn serial port on.



First release the PWREN and nRST by de-assert RTS/DTR box, and wait 100 milliseconds for module boot, then do the auto baudrate stage by assert the 1st command Active box, click ICO EXCITE to transmit command 0x55 to laser rangefinder module, Module reply its address right after the auto baudrate success. Now it's ready to receive further commands from master.



More commands and reply transfer between the laser rangefinder module and the master.

The screenshot displays the 'Geshe Beacon - COM7 19200,8,1,N DTR RTS' application window. The interface includes a top toolbar with various control buttons like 'Close', 'Port', 'BaudRate', 'StopBits', 'Parity', 'Handshake', 'RTS', 'DTR', 'Hex', 'Clear', 'Topmost', 'Excite', 'Stop', 'Add', 'Save', 'Paste', 'Copy', 'Delete', and 'Properties'. Below the toolbar, there are two main panels. The left panel, titled 'Data', shows a log of communication data with timestamps and hexadecimal values. The right panel, titled 'Direct Excitation Explorer', lists various commands with their names, data formats, data values, latencies, and active status. The 'Cntrinus Exit' command is highlighted in yellow.

Name	Data Form	Data	Latency(ms)	Active
Auto Baudrate	Hex	55	0	☐
Rd. Status	Hex	AA 80 00 00 80	0	☐
Rd. HW	Hex	AA 80 00 0A 8A	0	☐
Rd. SW	Hex	AA 80 00 0C 8C	0	☐
Rd. SN	Hex	AA 80 00 0E 8E	0	☐
Rd. Voltage	Hex	AA 80 00 06 86	0	☐
Laser On	Hex	AA 00 01 BE 00 01 00 01 C1	0	☐
Laser Off	Hex	AA 00 01 BE 00 01 00 00 C0	0	☐
1shot Auto	Hex	AA 00 00 20 00 01 00 00 21	0	☐
1shot Slow	Hex	AA 00 00 20 00 01 00 01 22	0	☐
1shot Fast	Hex	AA 00 00 20 00 01 00 02 23	0	☐
Cntrinus Exit	Hex	58	0	☒
Cntrinus Auto	Hex	AA 00 00 20 00 01 00 04 25	0	☐
Cntrinus Slow	Hex	AA 00 00 20 00 01 00 05 26	0	☐
Cntrinus Fast	Hex	AA 00 00 20 00 01 00 06 27	0	☐
Set Offset	Hex	AA 00 00 12 00 01 00 64 77	0	☐
Set Address	Hex	AA 00 00 10 00 01 00 51 62	0	☐

4.4 Bottomlaser

4.4.1 Introduction

For decades, JRT has been an expert in the field of laser technology, optics, electronics, and mechanical systems that make up a laser rangefinder. We are one of the leading manufacturers in this sector. Our products are put to successful use around the world.

M8xx series laser rangefinder module was developed for fast and precise distance measuring, even in difficult measurement conditions, like with poor reflect laser signal level. M8x extremely small and lightweight make it suitable for size and weight limited applications, such as portable devices, drones etc.

4.4.1.1 Features

Features of the module include:

1. Small size:
25mm width
45mm long
12mm height
2. Light Weight:
< 9g
3. Precise Distance Measuring
1mm resolution
4. Long Measuring Distance
40 meters

4.4.1.2 Quick Start

For quick testing shipped module please jump to section 6 Demonstration, after that reading the rest sections for more details.

4.4.2 Key parameters

Table 2-1 key parameters

Accuracy	± 3 mm
Measuring Unit	millimeter
Measuring Range (without Reflection)	0.03-40m
Measuring Time	0.1~4 seconds
Laser Class	Class II
Laser Type	635nm, <1mW
Size	25*45*12mm
Weight	About 9g
Voltage	DC 2.5~3.3V
Operating Temperature	0-40 °C (32-104 °F)
Storage Temperature	-25~60 °C (-13~140 °F)

4.4.3 Mechanical Data

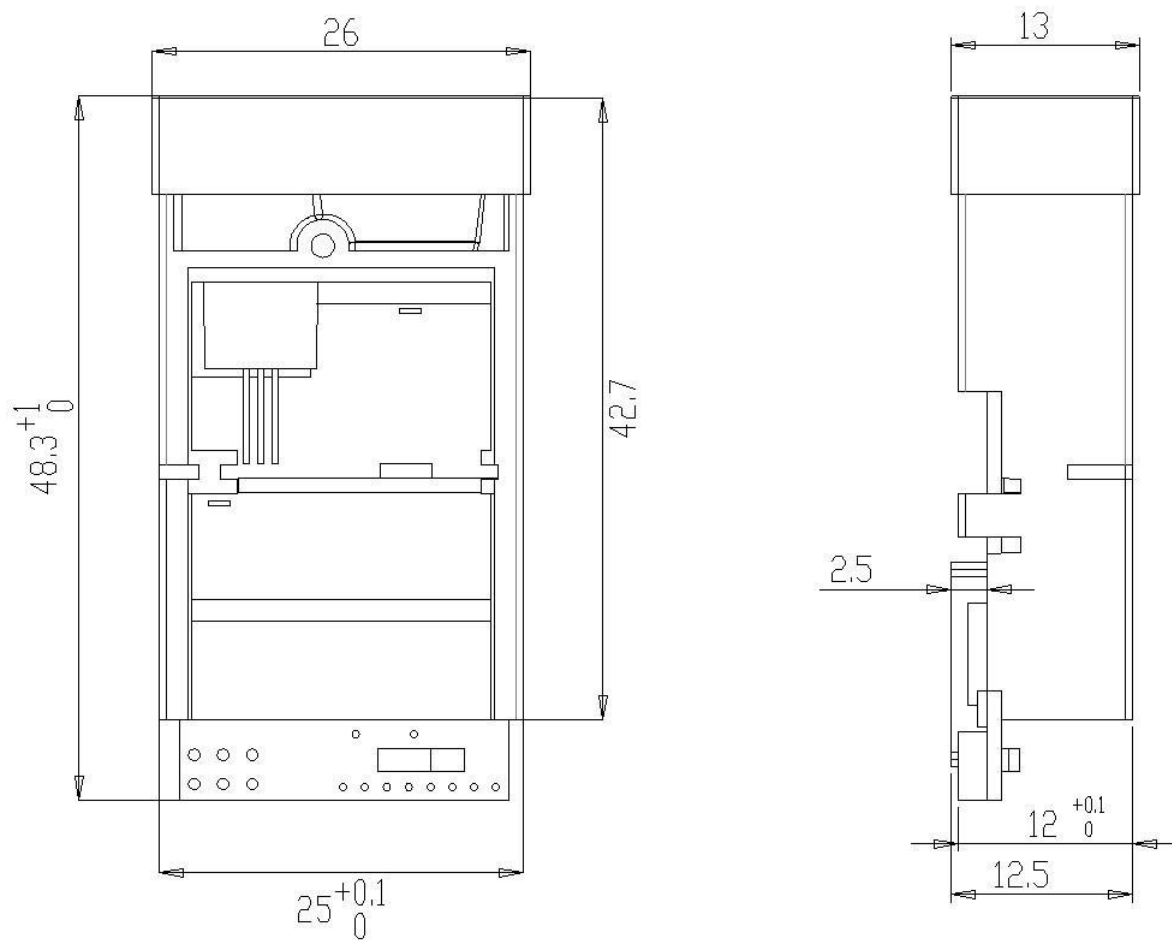
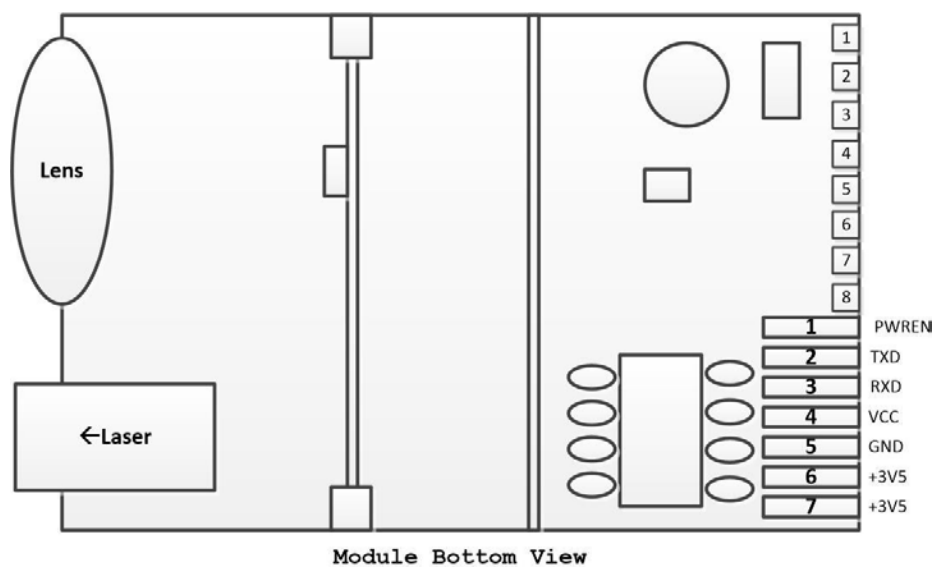


Figure 3-1 Mechanical Size

4.4.4 Pin Information

At most 5 Pins need to power and control the laser rangefinder module.



All these pins list below:

Table 4-1 Pin List

Pin	Name	Function	Default	Description
1	PWREN	Digital Input	Low	Module power up enable pin, active HIGH
2	TXD	Digital Output	High	Module USART Transmit pin, Open-Drain
3	RXD	Digital Input	High	Module USART Receive pin, Open-Drain
8	VCC/VBAT	Power	Power	Power supply, DC 2.5V~3.3V 300mA+
5	GND	Power	Ground	Module power ground

Application may need more than one laser range finder module to read out each distance. In multi-slave applications, beware to set address for each laser module before it be connected to the network to avoid the addressing conflict. After factory stage all modules address was set to 0x00 as default.

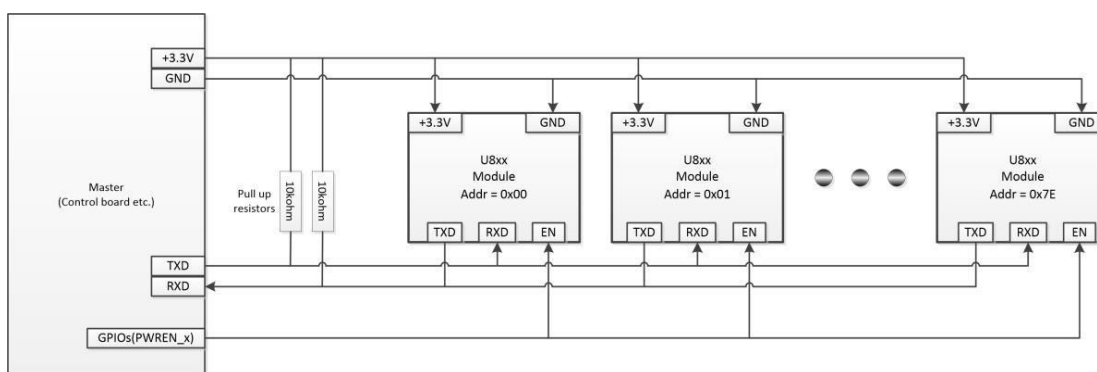


Figure 4-1 Multi-Module Wiring

4.4.4.1 Self-soldering with module on board pads

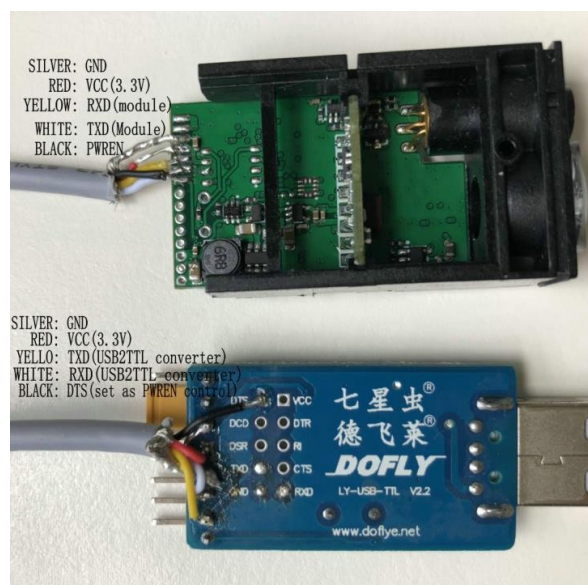


Figure 4-2 Solder Connector

!!! Figure 4-2 Solder Connector shows NO pull-up resistor for module TXD/RXD, because the USB2TTL converter has internal pull-up resistors for TXD/RXD pins. But please keep in mind module TXD/RXD pins are OPEN-DRAIN which without internal pull-up resistors.

4.4.5 Absolute maximum ratings

!!!Note: Exceeding one or more of the limiting values may cause module permanent damage!

Table 5-1 Absolute Max. Ratings

Operating conditions	Min	Normal	Max	Units
Voltages				
VCC	-0.3	3.0	5.5	V
GND		0	0	V
TXD	-0.3		VCC+0.3	V
RXD	-0.3		VCC+0.3	V
PWREN	-0.3	VCC	4.0	V
Temperature				
Operating	0		+40	°C
Storage	-25		+60	°C

!!! Warning: Please note that normal operating voltage is DC2.5~3.3V. Voltage between DC3.3V~5.0V would not damage the module immediately, but it still will burn the module! Don't use any power above DC3.3V.

4.4.6 Operation Protocol

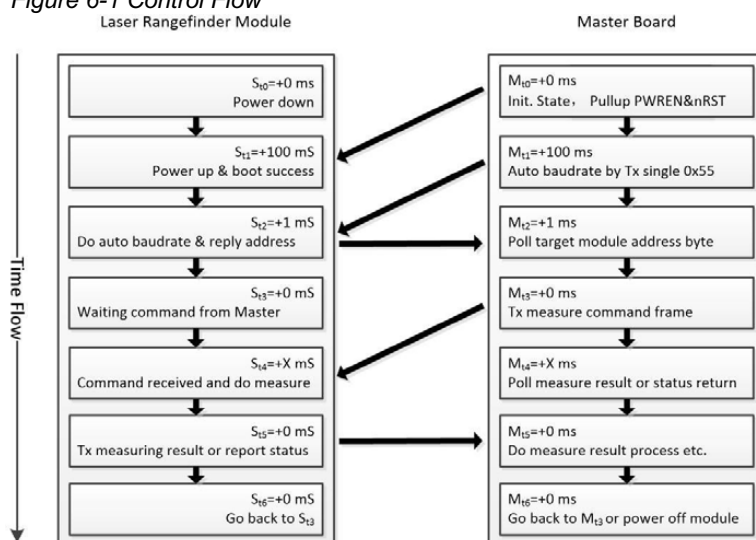
4.4.6.1 USART Interface

- Baudrate : Auto Detect
- Start bits : 1 bit
- Data bits : 8 bits
- Stop bits : 1 bit
- Parity : none
- Flow control : none

4.4.6.2 Control flow char

All communication commands are issued by master board, laser rangefinder module play slave role to answer master's request. The Ask & Answer flow though USART is shown as Figure 6-1.

Figure 6-1 Control Flow
Laser Rangefinder Module



In initial state, Slave module (laser rangefinder) is in power down mode before Master pull up the PWREN pin. After PWREN goes high, and if nRST pin. Used please also remember to de-assert the nRST pin by pull it up, Slave will take about 100 milliseconds to do self-boot, and then entering auto baud rate detect stage.

Master transfer 1byte fixed data 0x55 to slave for auto baud rate, if success, slave will reply 1-byte data to master, which present the slave itself address. In one master and multi-slave communication situation, the self-address reply from the slaves may cause USART bus conflict, keep in mind this byte should be ignored.

Communication between master and slave has been established after the successful auto baud rate. Now master can send command frame to slave.

!!!!IMPORTANT: Fixed baudrate 19200bps will be used under one condition:

1. Auto baudrate stage time up (~2.5 seconds),
no auto baudrate byte 0x55 received or wrong byte received;

4.4.6.3 Command Frame

Command frame may consist 6 parts as Table 6-1 shows.

Table 6-1 command structure

Bytes	0	1		2	3	4	5	6	7	8
Bits	[7:0]	[7]	[6:0]	[7:0]	[7:0]	[7:0]	[7:0]	[7:0]	[7:0]	[7:0]
Name	Head	R/W.	Address	Register		Payload count		Payload		Checksum
Data	0xAA	0	0x51	0x00	0x20	0x00	0x01	0x00	0x00	0x72

Table 6-1 shows the 1-shot measure request command from master to slave.

In this command frame:

- Request frame always start with fixed head byte 0xAA, this byte can also be 0xEE during error reply frame from slave to master, please refer to section 6.4.16 error reply frame;
- R/W indicate bit, 0: Master write to Slave, 1: Master read from Slave
- Slave address is 0x51, address has only 7-bits, so the address is from 0x00 to 0x7F, 0x00 is the default address before master issue module address change command, 0x7F is the broadcast address reserved for one-master to multi-slave network;
- Slave register is 0x0020 (REG_MEA_MODE, see register list 6.3.1 for more details);
- Payload data count write to register 0x0020 is 0x0001, this section may not present when R/W = 1, Master read from slave;
- The single data write to register 0x0020 is 0x0000, this section may not present when R/W = 1, Master read from slave;
- The frame checksum is 0x72, checksum = address byte + register bytes + payload count bytes + all payload bytes, byte overflow ignored;

4.4.6.3.1 Control Registers

Table 6-2 Registers

No.	Register	Name	Function
1	0x0000	REG_ERR_CODE	System status code
2	0x0006	REG_BAT_VLTG	Input voltage
3	0x0010	REG_ADDRESS	Module address
4	0x0012	REG_OFFSET	Module measure result offset
5	0x0020	REG_MEA_START	Initiate measure
6	0x0022	REG_MEA_RESULT	Measure result
7	0x01BE	REG_CTRL_LD	Laser diode control

4.4.6.4 Commands

4.4.6.4.1 Read Module Latest Status

Table 6-3 cmd. Read Module Status

Bytes	0	1	2	3	4
Name	Head	RW/Address	Register		Checksum
Data	0xAA	0x80	0x00	0x00	0x80

- Type: Read command
- Slave address: 0x00
- Register address: 0x0000
- Function: master read out the module's status after previous command executed;
- Reply from slave:

Table 6-4 cmd. Reply Read Module Status

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x80	0x00	0x00	0x00	0x01	0xYY	0xZZ	Checksum

Byte 0xZZ is the status code replied from slave, see status codes Table 6-24 for details.

4.4.6.4.2 Read Hardware Version Number

Bytes	0	1	2	3	4
Name	Head	RW/Address	Register		Checksum
Data	0xAA	0x80	0x00	0x0A	0x8A

- Type: Read command
- Slave address: 0x00
- Register address: 0x000A
- Function: master read out the module's HW version number;
- Reply from slave:

Table 6-6 cmd. Reply Read HW version

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x80	0x00	0x0A	0x00	0x01	0xVV	0xYY	sum

HW version number is 0xVVYY.

4.4.6.4.3 Read Software Version Number

Table 6-7 cmd. Read HW version

Bytes	0	1	2	3	4
Name	Head	RW/Address	Register		Checksum
Data	0xAA	0x80	0x00	0x0C	0x8C

- Type: Read command
- Slave address: 0x00
- Register address: 0x000C
- Function: master read out the module's SW version number;
- Reply from slave:

Table 6-8 cmd. Reply Read SW version

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x80	0x00	0x0C	0x00	0x01	0xVV	0xYY	sum

SW version number is 0xVVYY.

4.4.6.4.4 Read Module Serial Number

Table 6-9 cmd. Read Serial version

Bytes	0	1	2	3	4
Name	Head	RW/Address	Register		Checksum
Data	0xAA	0x80	0x00	0x0E	0x8E

- Type: Read command
- Slave address: 0x00
- Register address: 0x000E
- Function: master read out the module's serial number;
- Reply from slave:

Table 6-10 cmd. Reply Read Serial Number

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x80	0x00	0x0E	0x00	0x01	0xSS	0xNN	sum

HW version number is 0xSSNN.

4.4.6.4.5 Read Input Voltage

Table 6-11 cmd. Read HW version

Bytes	0	1	2	3	4
Name	Head	RW/Address	Register		Checksum
Data	0xAA	0x80	0x00	0x06	0x86

- Type: Read command
- Slave address: 0x00
- Register address: 0x0006
- Function: master read out the module's input voltage in mV with BCD encode;
- Reply from slave:

Table 6-12 cmd. Reply Read HW version

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x80	0x00	0x06	0x00	0x01	0x32	0x19	sum

Input voltage = 3219mV.

4.4.6.4.6 Read Measure Result

Table 6-13 cmd. Read Measure Result

Bytes	0	1	2	3	4
Name	Head	RW/Address	Register		Checksum
Data	0xAA	0x80	0x00	0x22	0xA2

- Type: Read command
- Slave address: 0x00
- Register address: 0x0022
- Function: master read out the distance measure result;
- Reply from slave:

Table 6-14 cmd. Reply Measure Result

Bytes	0	1	2	3	4	5	6:9	10:11	8
Name	Head	RW/Address	Register		Payload count		Payload Distance	Payload SQ	Checksum
Data	0xAA	0x00	0x00	0x22	0x00	0x03	0xAABBCCDD	0x0101	Checksum

4.4.6.4.7 Set Module Address

Table 6-15 cmd. Set Module Address

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x00	0x00	0x10	0x00	0x01	0x00	0xYY	sum

- Type: Write command
- Slave address: 0x00
- Register address: 0x0010
- Function: master set slave's address, this address will not lost after module power off;
- Reply from slave:

Table 6-16 cmd. Reply Set Module Address

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x00	0x00	0x10	0x00	0x01	0x00	0xYY	sum

Slave address set to 0xYY (!!!Beware: address only take bit[6:0], other bits will be ignored).

!!! Note: Do not set slave address to broadcast address 0x7F, this address is reserved for one master to multi-slave network which needs all slave to measure distance at the same time, and no slave reply measure result until master ask one of them to.

4.4.6.4.8 Set Module Measure Offset

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x00	0x00	0x12	0x00	0x01	0xZZ	0xYY	sum

- Type: Write command
- Slave address: 0x00
- Register address: 0x0012
- Function: master set slave's measure offset. For example, if the offset 0xZZYY = 0x7B(+123) , it means the final output of measure result will **PLUS** 123 millimeters , if the offset 0xZZYY = 0xFF85(-123), it means the final output of measure result will **MINUS** 123 millimeters.
- Reply from slave:

Table 6-17 cmd. Reply Set Module Address

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x00	0x00	0x12	0x00	0x01	0xZZ	0xYY	sum

4.4.6.4.9 Turn On or Turn Off Laser

Table 6-18 cmd. Turn on/off Laser

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x00	0x01	0xBE	0x00	0x01	0x00	0xZZ	Checksum

- Type: Write command
- Slave address: 0x00
- Register address: 0x01BE
- Function: turn on or turn off laser beam,
if 0xZZ = 0x01 laser on, 0xZZ = 0x00 laser off.
- Reply from slave:

Table 6-19 cmd. Reply Turn On/Off Laser

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x00	0x01	0xBE	0x00	0x01	0x00	0xZZ	Checksum

4.4.6.4.10 Start 1-shot Auto Distance Measure

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x00	0x00	0x20	0x00	0x01	0x00	0x00	0x21

- Type: Write command
- Slave address: 0x00
- Register address: 0x0020
- Function: Initiate slave to do 1-shot measure in auto mode, for measure modes please refer to section 6.5.
- Reply from slave:

Table 6-20 cmd. Reply 1-shot Auto Measure

Bytes	0	1	2	3	4	5	6:9	10:11	8
Name	Head	RW/Address	Register		Payload count		Payload Distance	Payload SQ	Checksum
Data	0xAA	0x00	0x00	0x22	0x00	0x03	0xAABBCCDD	0x0101	Checksum

- Type: Reply from slave
- Slave address: 0x00
- Register address: 0x0022
- Function:
Reply measure result to master, measure result = 0xAABBCCDD millimeters (frame byte6 = 0xAA, byte7 = 0xBB, byte8 = 0xCC, byte9 = 0xDD) and signal quality = 0x101, less signal quality number stands for stronger laser signal and more reliable distance result.

4.4.6.4.11 Start 1-shot Slow Distance Measure

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x00	0x00	0x20	0x00	0x01	0x00	0x01	0x22

- Type: Write command
- Slave address: 0x00
- Register address: 0x0020
- Function: Initiate slave to do 1-shot measure in slow mode.
- Reply from slave: same as 1-shot auto mode.

4.4.6.4.12 Start 1-shot Fast Distance Measure

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x00	0x00	0x20	0x00	0x01	0x00	0x02	0x23

- Type: Write command
- Slave address: 0x00
- Register address: 0x0020
- Function: Initiate slave to do 1-shot measure in fast mode.
- Reply from slave: same as 1-shot auto mode.

4.4.6.4.13 Start Continuous Auto Distance Measure

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x00	0x00	0x20	0x00	0x01	0x00	0x04	0x25

- Type: Write command
- Slave address: 0x00
- Register address: 0x0020
- Function: Initiate slave to do continuous measure in auto mode.
- Reply from slave: same as 1-shot auto mode.

4.4.6.4.14 Start Continuous Slow Distance Measure

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x00	0x00	0x20	0x00	0x01	0x00	0x05	0x26

- Type: Write command
- Slave address: 0x00
- Register address: 0x0020
- Function: Initiate slave to do continuous measure in slow mode.
- Reply from slave: same as 1-shot auto mode.

4.4.6.4.15 Start Continuous Fast Distance Measure

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x00	0x00	0x20	0x00	0x01	0x00	0x06	0x27

- Type: Write command
- Slave address: 0x00

- Register address: 0x0020
- Function: Initiate slave to do continuous measure in fast mode.
- Reply from slave: same as 1-shot auto mode.

4.4.6.4.16 Error Reply from Slave

If any error occurred during measuring stage, laser rangefinder module will reply error report frame:

Table 6-21 Error Reply

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xEE	0x00	0x00	0x00	0x00	0x01	0x00	0x0F	0x10

- Type: Reply from slave
- Slave address: 0x00
- Register address: 0x0000
- Function: report error status code to master, the error code = 0x000F, please refer section 6.6 status codes for its meaning.

4.4.6.4.17 Exit from Continuous Measure

Master transfer one byte 0x58 (upper case character 'X') to stop continuous measure mode immediately.

4.4.6.4.18 Start Multi-slaves Measure

Master send out 1-shot measure commands to slave address 0x7F, that will make all online slaves to measure distance at the same time, but none of them will return its measure result to master until master ask each one to return the measure result. Before master send out the reading measure result command, master should read the slave's status code to make sure there was no error occurred during this slave measuring.

Table 6-22 Broadcast Measuring

Bytes	0	1	2	3	4	5	6	7	8
Name	Head	RW/Address	Register		Payload count		Payload		Checksum
Data	0xAA	0x7F	0x00	0x20	0x00	0x01	0x00	0x00	0xA0

- Type: Write command
- Slave address: 0x00
- Register address: 0x0020
- Function: Initiate all slave to do 1-shot measure in auto mode
- Reply from slave: NO REPLY

After sending this command out, master polling each slave address for their status, if slave replies its status code with 0x0000, means no error, then send Read-measure-Result command to read back the distance. Measure result for each slave will NOT overwrite until next successful measure command with a new distance result.

4.4.6.5 Measure Modes

There are 2 types of measure mode, 1-shot and continuous.

- 1-shot gives only 1 measure result for each distance measure request command;
- Continuous measuring continuous to reply distance result as more as 255 times if master not break the measuring cycles. To break the continuous measuring, master need to send 1 byte 0x58 (upper case character 'X' in ASCII) during measuring.

Each measure mode has 3 working attributes:

- Auto, module returns Measure Result & Signal Quality (SQ), Less SQ value stands for more reliable distance result, in this mode module adjust reading speed according to the laser reflect level;
- Slow, distance read for higher accuracy;

Fast, distance read for lower accuracy, but higher speed.

Table 6-23 Measuring Modes

Attribute Modes	Auto	Slow	Fast
1-shot	1-shot Auto	1-shot Slow	1-shot Fast
Continuous	Continuous Auto	Continuous Slow	Continuous Fast
Measure Speed	Auto	Slow	Fast
Measure Accuracy	Auto	High	Low

4.4.6.6 Status Code

Table 6-24 status codes

Status Code	Description
0x0000	No error
0x0001	Power input too low, power voltage should $\geq 2.2V$
0x0002	Internal error, don't care
0x0003	Module temperature is too low($< -20^{\circ}C$)
0x0004	Module temperature is too high($> +40^{\circ}C$)
0x0005	Target out of range
0x0006	Invalid measure result
0x0007	Background light too strong
0x0008	Laser signal too weak
0x0009	Laser signal too strong
0x000A	Hardware fault 1
0x000B	Hardware fault 2
0x000C	Hardware fault 3
0x000D	Hardware fault 4
0x000E	Hardware fault 5
0x000F	Laser signal not stable
0x0010	Hardware fault 6
0x0011	Hardware fault 7
0x0081	Invalid Frame

4.4.7 Demonstration

4.4.7.1 Wiring to USB2TTL converter

For test purpose, Pin PWREN tied to RTS line. When RTS asserted, RTS line goes low, so de-assert RTS to power module, module then start to boot.

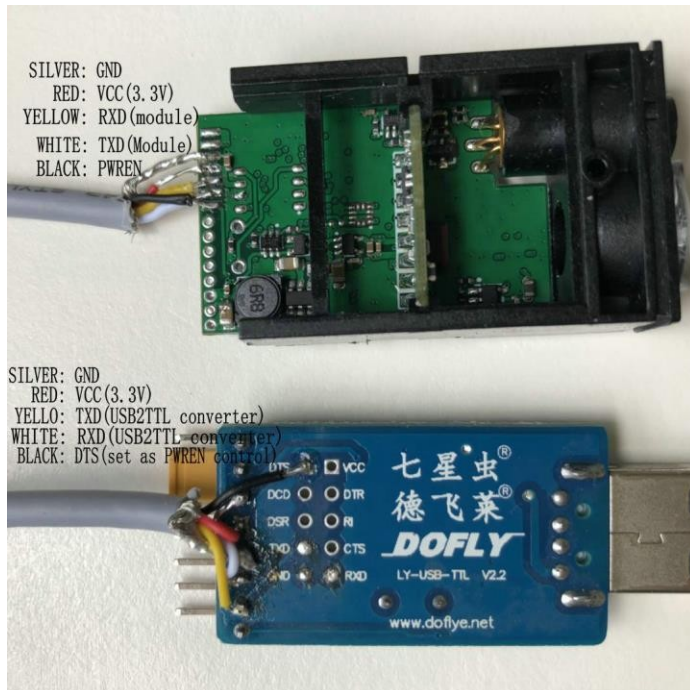


Figure 7-1 Wiring

4.4.7.2 Serial Port Test Software

Before start the command test, we need to:

1. Plug & Install CH341 USB2TTL converter driver on your computer;
2. Download & install the trial version serial port test software before start, software download page : <http://www.geshe.com/en/support/download>;
3. Start the software and follow the steps:

After starting the PC soft you have 2 options:

1. Create a new project;
2. load configuration file and do some modify according to your serial port number;

Create New Project from scratch.

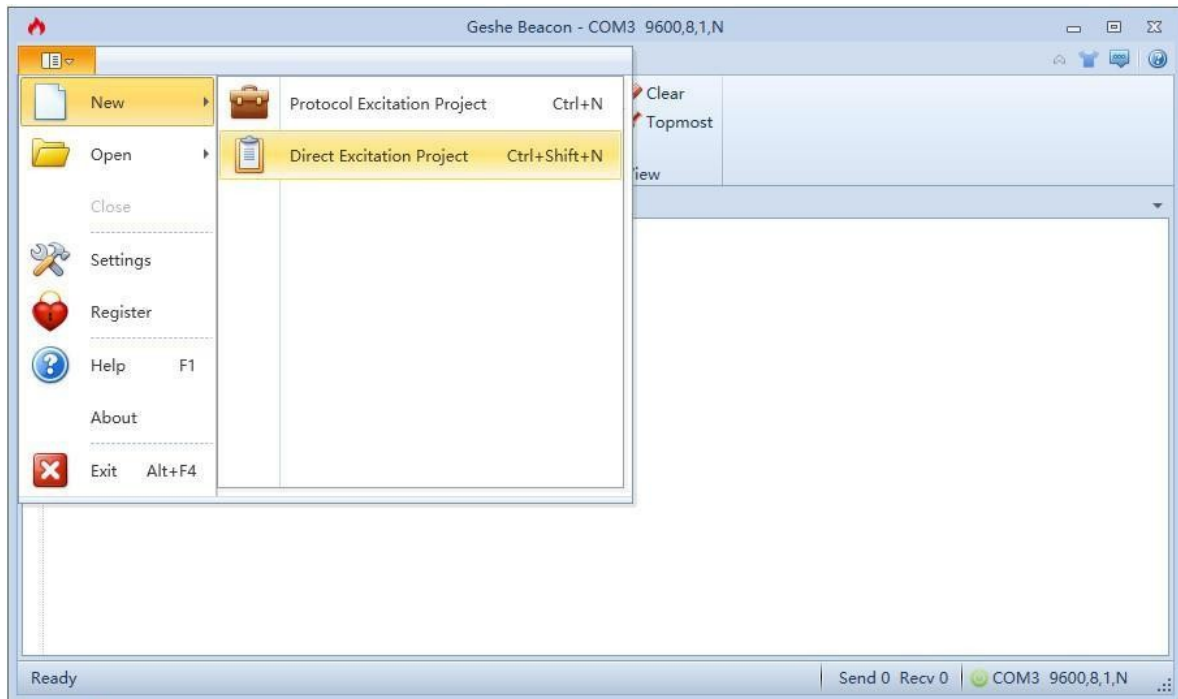


Figure 7-2 Create New Project

Load Configuration file “GeseDemoConfig.bsp” from test file folder

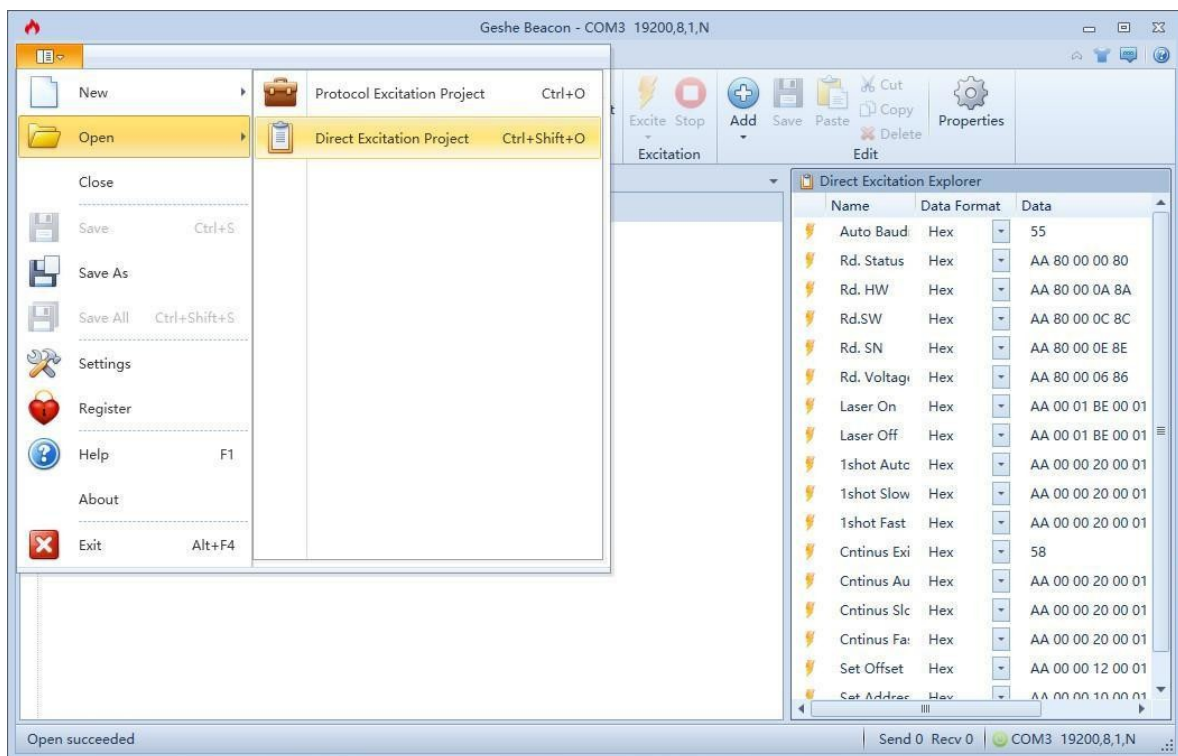
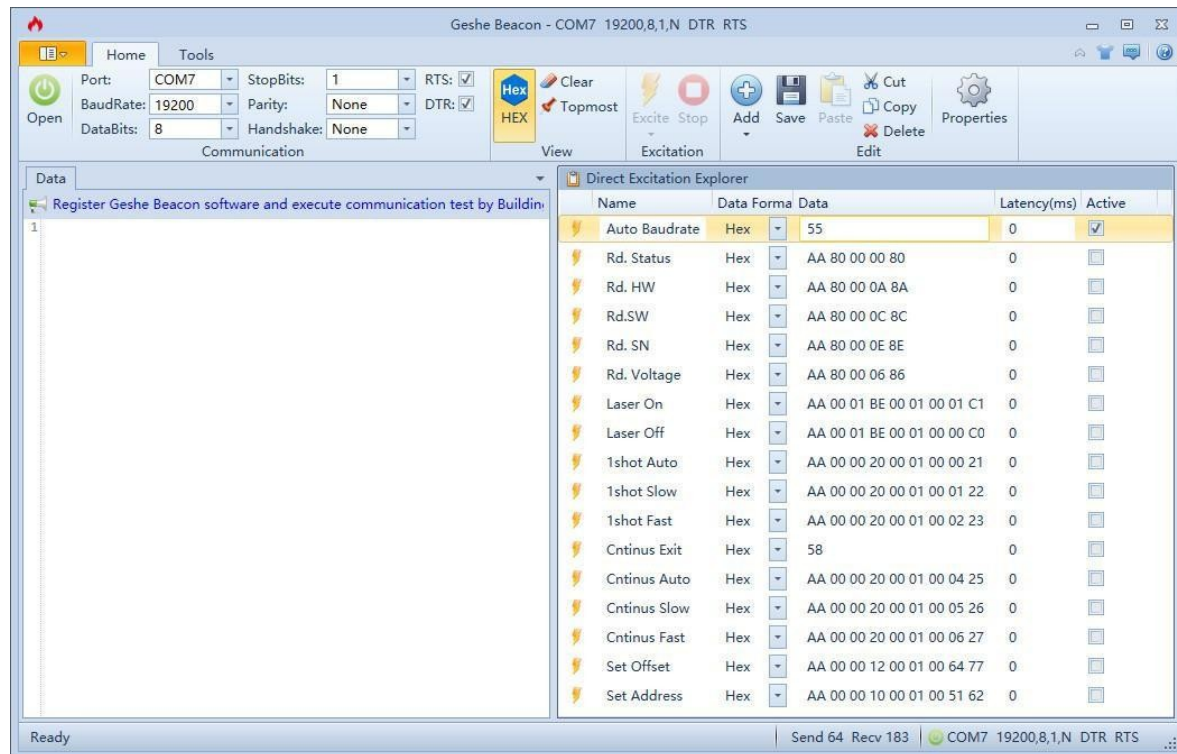
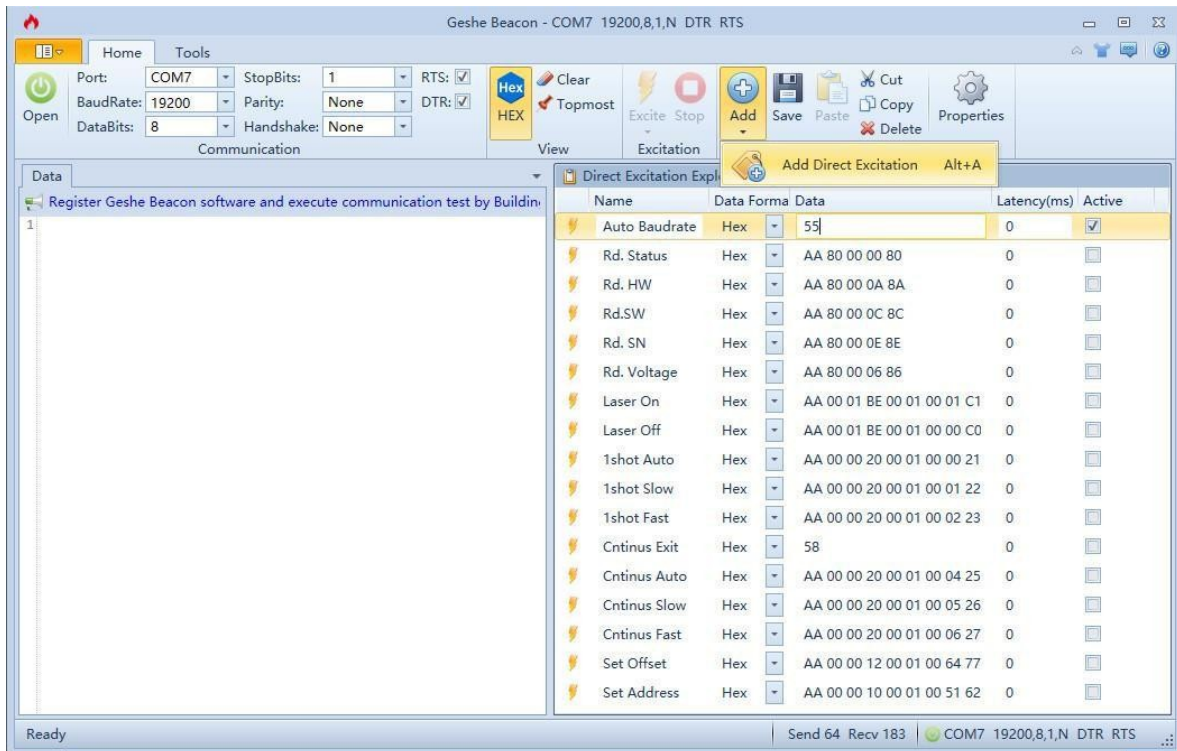


Figure 7-3 Load Config. File

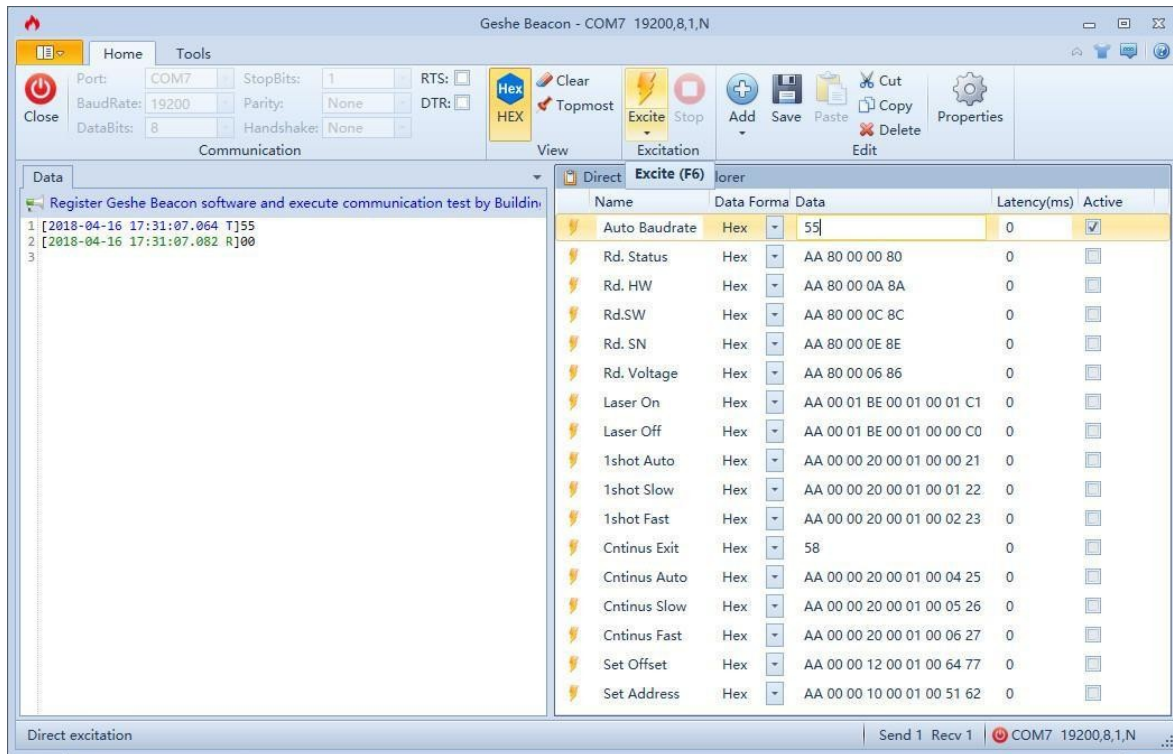
Serial Port parameters Configuration, select the Port No. after plug the USB2TTL converter according to your computer, COM7 on my computer. Baud rate can be any of you want, 9600bps 19200bps, 115200bps etc.
Remember to assert RTS box to power off module before start test.



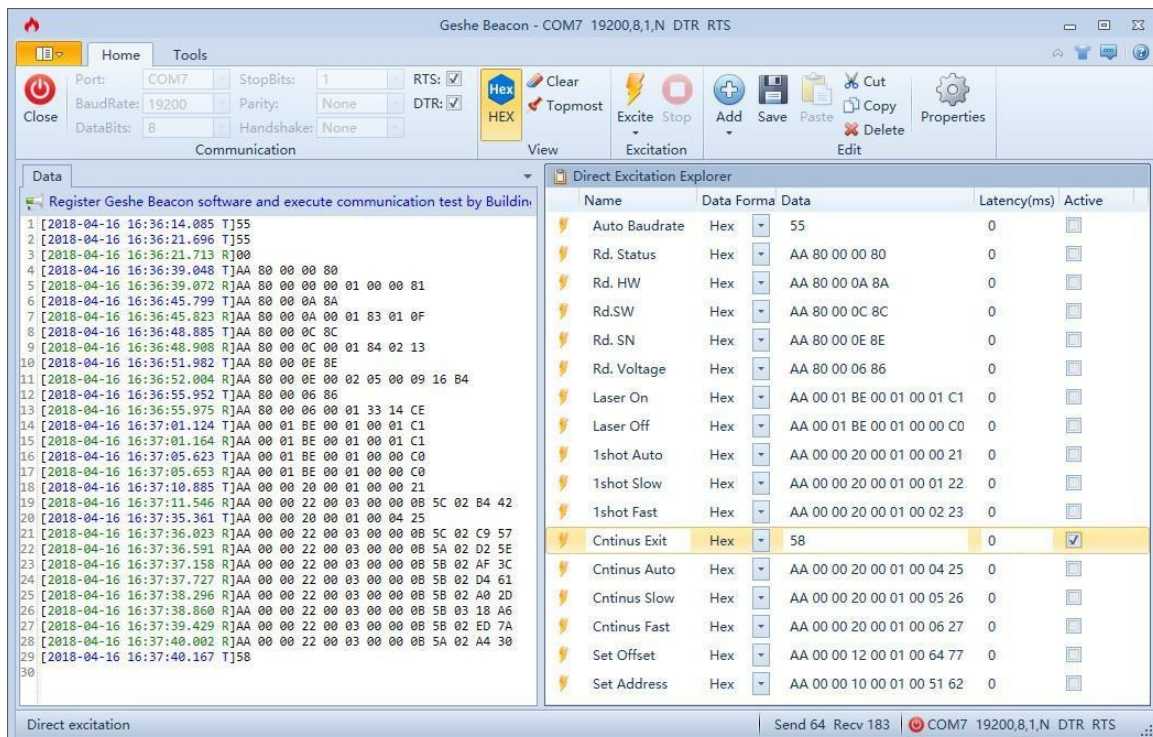
If you chose to create new project, you have to add your commands by clicking ICO ADD to add commands, after that, Click ICO OPEN to turn serial port on.



First release the PWREN by de-assert RTS box, and wait 100 milliseconds for module boot, then do the auto baud rate stage by assert the 1st command Active box, click ICO EXCITE to transmit command 0x55 to laser rangefinder module, Module reply its address right after the auto baud rate success. Now it's ready to receive further commands from master.



More commands and reply transfer between the laser rangefinder module and the master.



4.5 Advanced nRF52832 Module MS50SFB Specification



The MS50SFB is a compact and small size Bluetooth 5.0 module with ultra-low power consumption and optional antenna types; The module has the large number of GPIOs and excellent RF performance.

Features

- Frequency: 2402 to 2480 MHz Max. Output power: +4dBm Single power supply: 1.8 – 3.9V
- Range: up to 60 meters in open space Chip: nRF52832 (Nordic)
- GPIO Quantity: 32
- 512kB Flash and 64kB RAM Module size: 20.0 x 12.0 x 2.0 mm NFC type A interface
- ARM Cortex-M4F processor Metal shielding with marking
- UART communication protocol (Slave / Master optional)
- 3 optional antenna types: PCB antenna, chip antenna, IPEX connector
- Operating Temperature range: -25 to 80 degree Celsius

Application

- Medical devices Heart rate monitor
- Blood pressure monitor Blood glucose meter Thermometer
- Sport facilities Weighing machine
- Sports and fitness sensors Accessories
- 3D glasses and gaming controller Mobile accessories
- Remote controllers / Toys Electronic devices
- Cycle computer

Certification

- Full Bluetooth Declaration ID: D039669
- FCC ID:2ABU6-MS50SFB
- TELEC: 208-190043
- IC: 20896-MS50SFB
- CE, RCM, WPC, RoHS & REACH certified

4.5.1 Product introduction

The MS50SFB is a compact and small size Bluetooth 5.0 module with ultra-low power consumption and optional antenna types; The module has the large number of GPIOs and excellent RF performance. Therefore, it can apply to a wide range of Bluetooth connected products. With an ARM CortexTM M4(F) MCU, up to 512KB flash, 64KB RAM, embedded 2.4GHz, MS50SFB can save the R&D and time cost.

The module is highly integrated that contains all the necessary components from radio to a different antenna and a completely implemented Bluetooth protocol stack and programming UART communication protocol.

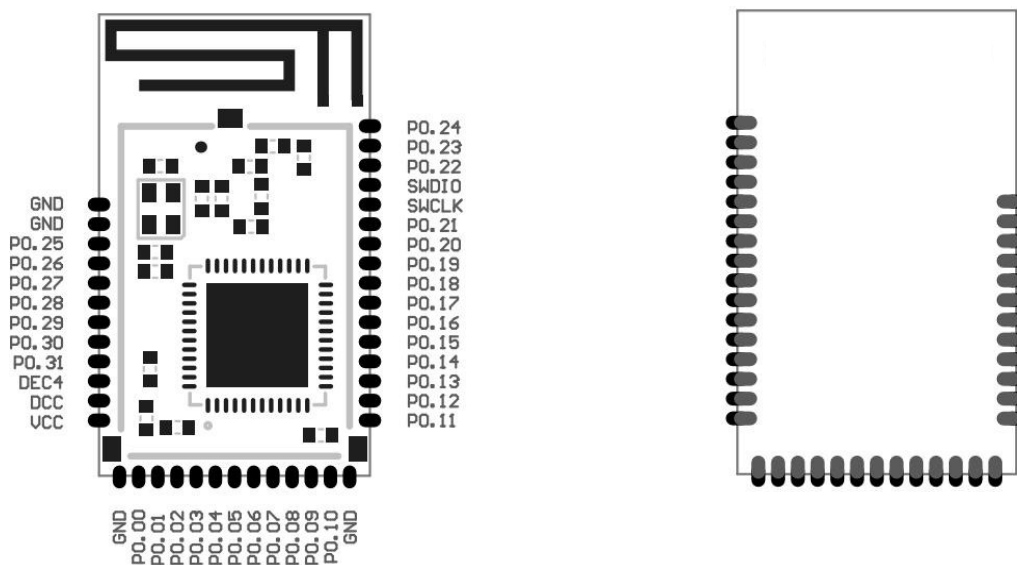
4.5.1.1 Ordering information

Ordering number	Description
MS50SFB-001	306030058, nRF52832-QFAA BT 5.0 Module, PCB Antenna
MS50SFB-002	306030059, nRF52832-QFAA BT 5.0 Module, Chip Antenna
MS50SFB-003	306030060, nRF52832-QFAA BT 5.0 Module, IPEX connector for external antenna

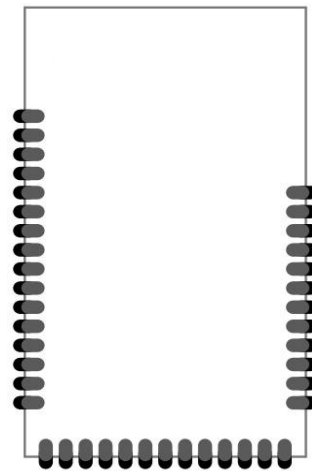
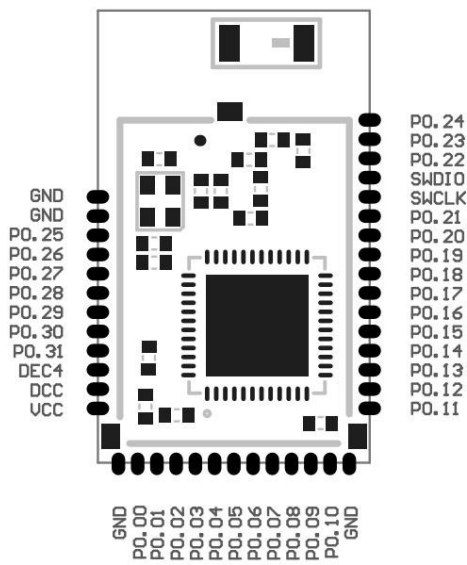
4.5.2 Pin description

4.5.2.1 Pin assignment

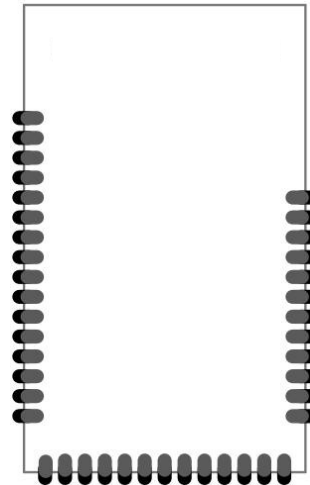
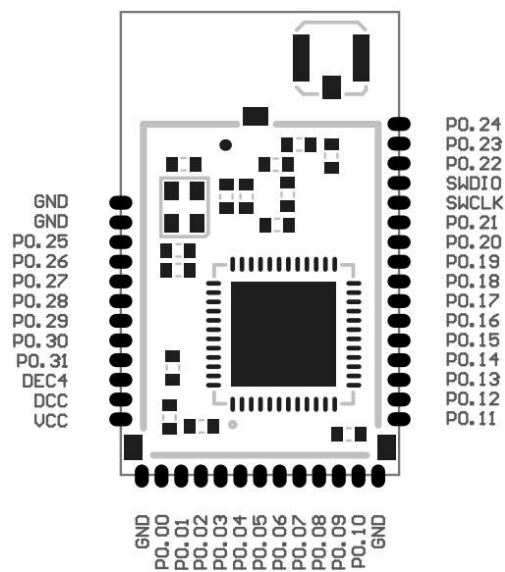
4.5.2.1.1 MS50SFB/PCB antenna



4.5.2.1.2 MS50SFB/Ceramic chip antenna



4.5.2.1.3 MS50SFB3/IPEX antenna

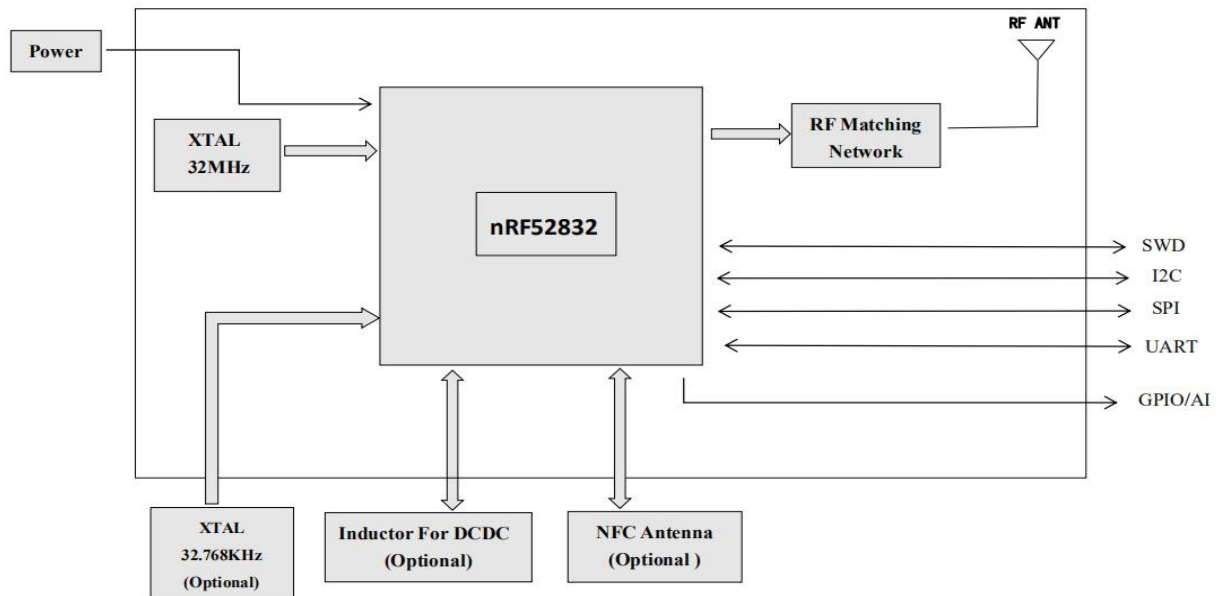


4.5.2.2 Pin definition

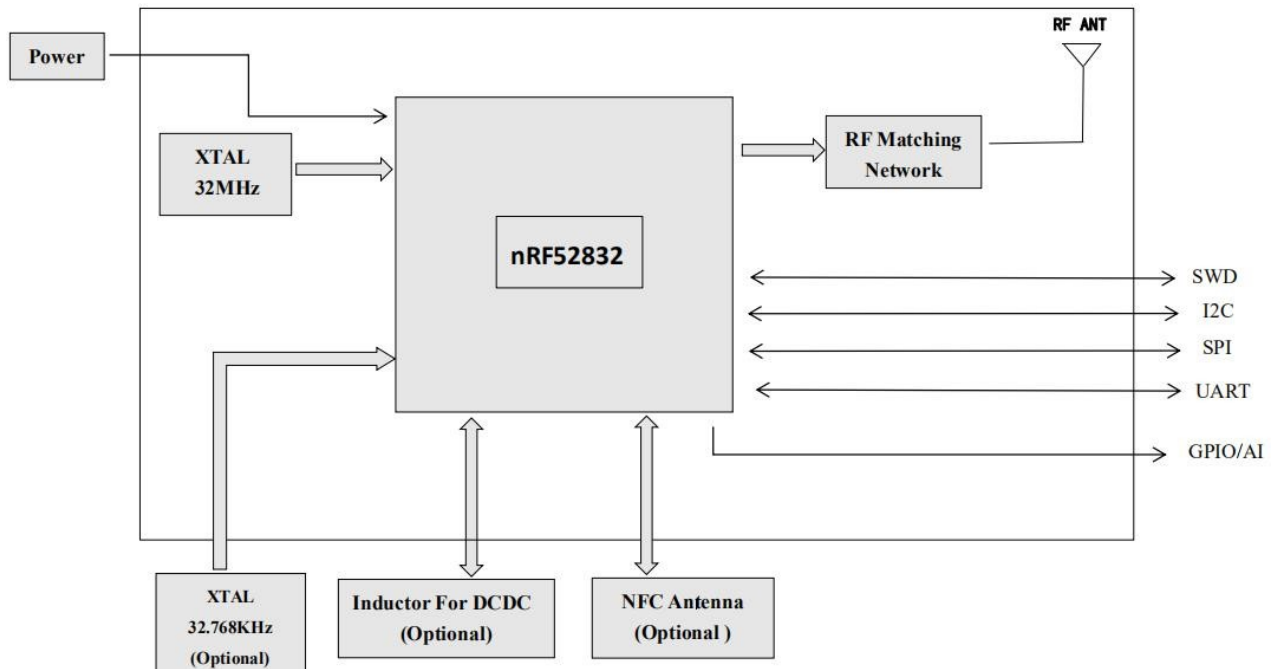
Symbol	Type	Description
P0.00	Digital I/O	General purpose I/O
XL1	Analog input	Connection for 32.768 kHz crystal (LFXO)
P0.00	Digital I/O	General purpose I/O
XL2	Analog input	Connection for 32.768 kHz crystal (LFXO)
P0.02	Digital I/O	General purpose I/O
AIN 0	Analog input	SAADC/COMP/LPCOMP input
P0.03	Digital I/O	General purpose I/O
AIN 1	Analog input	SAADC/COMP/LPCOMP input
P0.04	Digital I/O	General purpose I/O
AIN 2	Analog input	SAADC/COMP/LPCOMP input
P0.05	Digital I/O	General purpose I/O
AIN 3	Analog input	SAADC/COMP/LPCOMP input
P0.06	Digital I/O	General purpose I/O
P0.07	Digital I/O	General purpose I/O
P0.08	Digital I/O	General purpose I/O
NFC1	NFC input	NFC antenna connection
P0.09	Digital I/O	General purpose I/O
NFC2	NFC input	NFC antenna connection
P0.10	Digital I/O	General purpose I/O
GND	Ground	
P0.11	Digital I/O	General purpose I/O
P0.13	Digital I/O	General purpose I/O
P0.14	Digital I/O	General purpose I/O
TRACEDATA[3]		Trace port output
P0.15	Digital I/O	General purpose I/O
TRACEDATA[2]		Trace port output
P0.16	Digital I/O	General purpose I/O
TRACEDATA[1]		Trace port output
P0.17	Digital I/O	General purpose I/O
P0.18	Digital I/O	General purpose I/O
TRACEDATA[0] / SWO		Single wire output
P0.19	Digital I/O	General purpose I/O
P0.20	Digital I/O	General purpose I/O
TRACECLK		Trace port clock output
P0.21	Digital I/O	General purpose I/O
nRESET		Configurable as pin reset
P0.22	Digital I/O	General purpose I/O
P0.23	Digital I/O	General purpose I/O
P0.24	Digital I/O	General purpose I/O
P0.25	Digital I/O	General purpose I/O
P0.26	Digital I/O	General purpose I/O
P0.27	Digital I/O	General purpose I/O
P0.28	Digital I/O	General purpose I/O
AIN4	Analog input	SAADC/COMP/LPCOMP input
P0.29	Digital I/O	General purpose I/O
AIN4	Analog input	SAADC/COMP/LPCOMP input
GND	Ground	
P0.29	Digital I/O	General purpose I/O
AIN5	Analog input	SAADC/COMP/LPCOMP input
P0.30	Digital I/O	General purpose I/O
AIN6	Analog input	SAADC/COMP/LPCOMP input
P0.30	Digital I/O	General purpose I/O
AIN7	Analog input	SAADC/COMP/LPCOMP input
SWCLK	Digital I/O	Serial wire debug I/O for debug and programming
DCC	Power	DC/DC regulator output
VCC	Power	

4.5.2.3 Block diagram

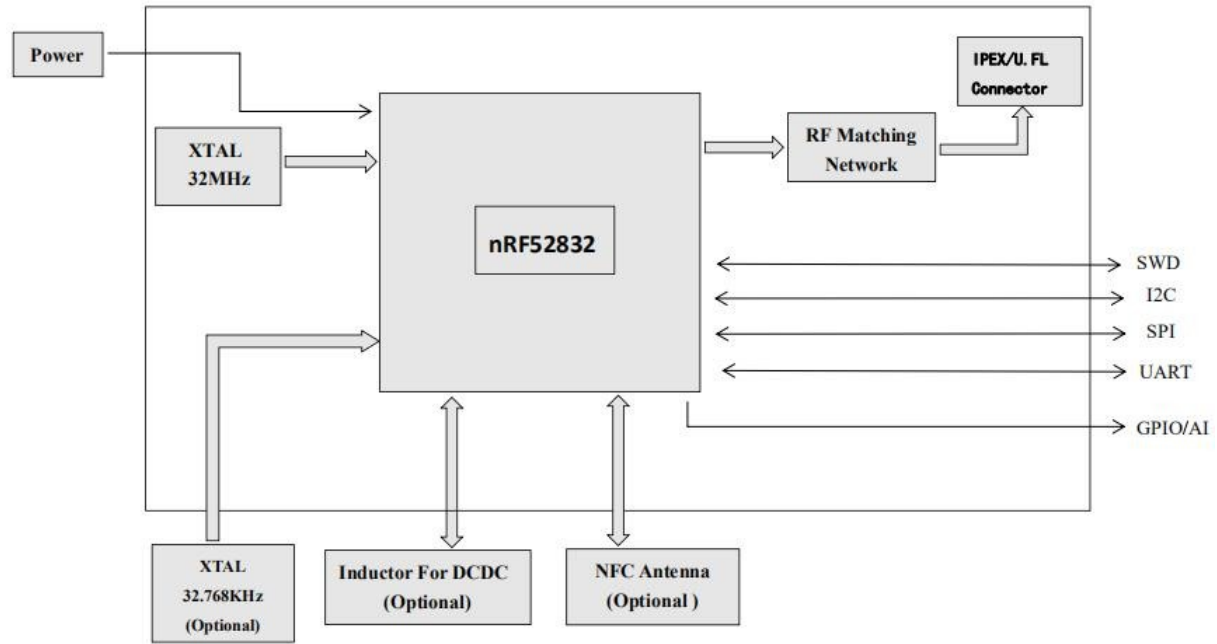
4.5.2.3.1 MS50SFB/PCB antenna



4.5.2.3.2 MS50SFB/Ceramic chip antenna

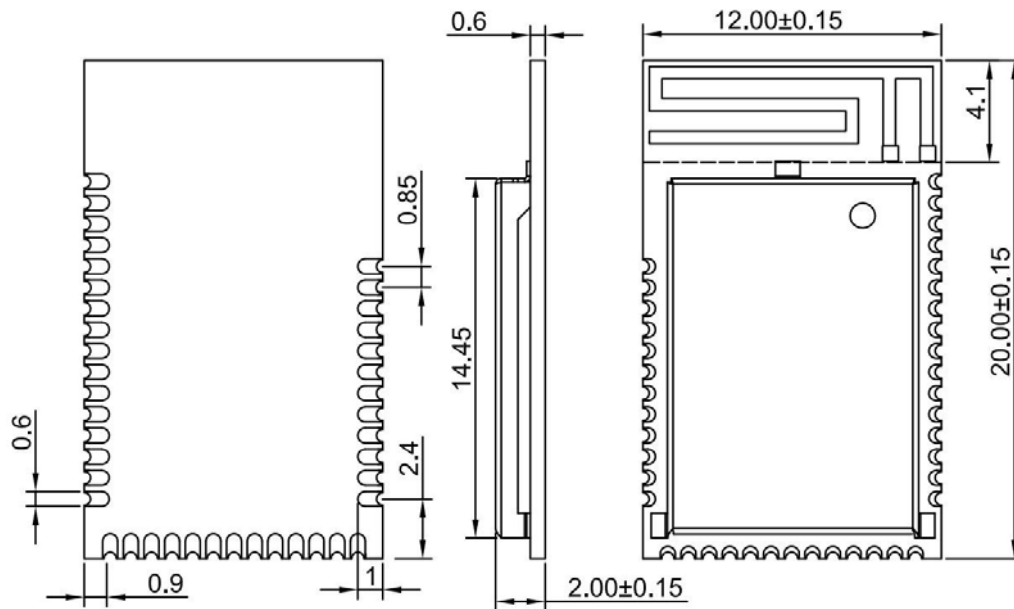


4.5.2.3.3 MS50SFB/IPEX antenna



4.5.2.4 Mechanical drawing

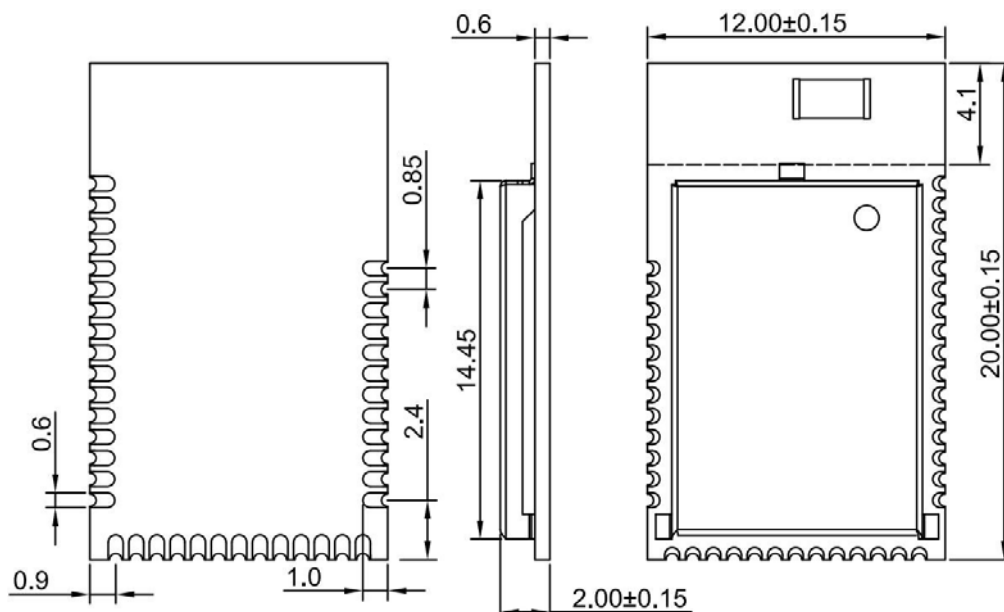
4.5.2.4.1 MS50SFB/PCB antenna



Unit: mm

Tolerance: +/- 1.0, default

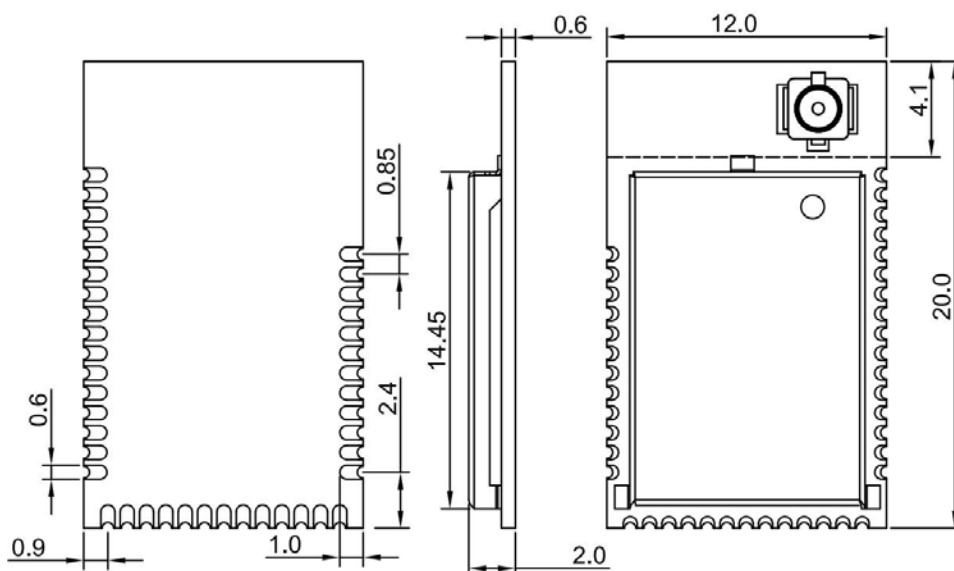
4.5.2.4.2 MS50SFB/Ceramic chip antenna



Unit: mm

Tolerance: +/- 1.0, default

4.5.2.4.3 MS50SFB/IPEX antenna



Unit: mm

Tolerance: +/- 1.0, default

4.5.3 Electrical specification

The electrical specifications of the module are directly related to the Nordic semiconductor Specifications for the nRF52832 chipset. The below information is only the extract from nRF52832 specification. For more detailed information, please refer to the up-to-date specification of the chipset available on the Nordic semiconductor website.

4.5.3.1 Absolute maximum ratings

	Min.	Max.	Unit
Supply voltages			
VDD	-0.3	+3.9	V
VSS		0	V
I/O pin voltage			
VI/O, VDD≤3.6 V	-0.3	VDD+0.3V	V
VI/O, VDD>3.6 V	-0.3	3.9V	V
NFC antenna pin current			
I _{NFC1/2}		80	mA
Radio			
RF input level		10	dBm
Environmental QFN48, 6×6 mm package			
Storage temperature	-40	+125	°C
MSL(moisture sensitivity level)		2	
ESD HBM		4	kV
ESD CDM(charged device model)		1000	V

Important: Maximum ratings are the extreme limits to which the chip can be exposed for a limited amount of time without permanently damaging it. Exposure to absolute maximum ratings for prolonged periods of time may affect the reliability of the device.

4.5.3.2 Recommended operating conditions

The operating conditions are the physical parameters that the chip can operate within.

Symbol	Parameter	Notes	Min.	Nom.	Max	Units
VDD	Supply voltage, independent of DCDC enable		1.7	3.0	3.6	V
TR_VDD	Supply rise time (0 V to 1.7 V)				60	ms
TA	Operating temperature		-40	25	85	°C

Important: The on-chip power-on reset circuitry may not function properly for rise times longer than the specified maximum.

4.5.3.3 Electronic characteristic

4.5.3.3.1 General radio characteristics

Symbol	Description	Min.	Typ.	Max.	Units
f_{OP}	Operating frequencies	2360		2500	MHz
$f_{PLL,PROG.}$	PLL programming resolution		2		kHz
$f_{PLL,CH,SP}$	PLL channel spacing		1		MHz
$f_{DELTA,1M}$	Frequency deviation @ 1 Msps		±170		kHz
$f_{DELTA,BLE,1}$	Frequency deviation @ BLE 1 Msps		±250		kHz
$f_{DELTA,2M}$	Frequency deviation @ 2 Msps		±320		kHz
$f_{DELTA,BLE,2}$	Frequency deviation @ BLE 2 Msps		±500		kHz
f_{skSPS}	On-the-air data rate	1		2	Msps

4.5.3.3.2 Radio current consumption (Transmitter)

Symbol	Description	Min.	Typ.	Max.	Units
$I_{TX,PLUS4dBm,DCDC}$	TX only run current(DCDC,3V)PRF=+4 dBm		7.5		mA
$I_{TX,PLUS4dBm}$	TX only run current PRF=+4 dBm		16.6		mA
$I_{TX,0dBm,DCDC}$	TX only run current(DCDC,3V)PRF=0 dBm		5.3		mA
$I_{TX,0dBm}$	TX only run current PRF=0 dBm		11.6		mA
$I_{TX,MINUS4dBm,DC}$	TX only run current DCDC,3V PRF=-4 dBm		4.2		mA
$I_{TX,MINUS4dBm}$	TX only run current PRF=-4 dBm		9.3		mA
$I_{TX,MINUS8dBm,DC}$	TX only run current DCDC,3V PRF=-8 dBm		3.8		mA
$I_{TX,MINUS8dBm}$	TX only run current PRF=-8 dBm		8.4		mA
$I_{TX,MINUS12dBm,DC}$	TX only run current DCDC,3V PRF=-12 dBm		3.5		mA
$I_{TX,MINUS12dBm}$	TX only run current PRF=-12 dBm		7.7		mA
$I_{TX,MINUS16dBm,DC}$	TX only run current DCDC,3V PRF=-16 dBm		3.3		mA
$I_{TX,MINUS16dBm}$	TX only run current PRF=-16 dBm		7.3		mA
$I_{TX,MINUS20dBm,DC}$	TX only run current DCDC,3V PRF=-20 dBm		3.2		mA
$I_{TX,MINUS20dBm}$	TX only run current PRF=-20 dBm		7.0		mA
$I_{TX,MINUS40dBm,DC}$	TX only run current DCDC,3V PRF=-40 dBm		2.7		mA
$I_{TX,MINUS40dBm}$	TX only run current PRF=-40 dBm		5.9		mA
$I_{START,TX,DCDC}$	TX only run current DCDC,3V PRF=4 dBm		4.0		mA
$I_{START,TX}$	TX only run current PRF=4 dBm		8.8		mA

4.5.3.3.3 Radio current consumption (Receiver)

Symbol	Description	Min.	Typ.	Max.	Units
$I_{RX,1M,DCDC}$	RX only run current (DCDC, 3V) 1Msps / 1Msps BLE		5.4		mA
$I_{RX,1M}$	RX only run current 1Msps / 1Msps BLE		11.7		mA
$I_{RX,2M,DCDC}$	RX only run current (DCDC, 3V) 2Msps / 2Msps BLE		5.8		mA
$I_{RX,2M}$	RX only run current 2Msps / 2Msps BLE		12.9		mA
$I_{START,RX,DCDC}$	RX start-up current (DCDC 3V)		3.5		mA
$I_{START,RX,LDO}$	RX start-up current (LDO 3V)		7.5		mA

4.5.3.3.4 Transmitter specification

Symbol	Description	Min.	Typ.	Max.	Units
P_{RF}	Maximum output power		4	6	dBm
P_{RFC}	RF power control range		24		dB
P_{RFCR}	RF power accuracy			±4	dB
$P_{RF1,1}$	1st Adjacent Channel Transmit Power 1 MHz (1 Msps Nordic proprietary mode)		-25		dBc
$P_{RF2,1}$	2nd Adjacent Channel Transmit Power 2 MHz (1 Msps Nordic proprietary mode)		-50		dBc
$P_{RF1,2}$	1st Adjacent Channel Transmit Power 2 MHz (2 Msps Nordic proprietary mode)		-25		dBc
$P_{RF2,2}$	2nd Adjacent Channel Transmit Power 4 MHz (2 Msps Nordic proprietary mode)		-50		dBc
$P_{RF1,2,BLE}$	1st Adjacent Channel Transmit Power 2 MHz (2 Msps BLE mode)		-20		dBc
$P_{RF2,2,BLE}$	2nd Adjacent Channel Transmit Power 4 MHz (2 Msps BLE mode)		-50		dBc

4.5.3.3.5 Receiver operation

Symbol	Description	Min.	Typ.	Max.	Units
$P_{RX,MAX}$	Maximum received signal strength at < 0.1% BER		0		dBm
$P_{SENS,IT,1M}$	Sensitivity, 1Msps nRF mode1		-93		dBm
$P_{SENS,IT,SP,1M,BLE}$	Sensitivity, 1Msps BLE ideal transmitter, <=37 bytes BER=1E-32		-96		dBm
$P_{SENS,IT,LP,1M,BLE}$	Sensitivity, 1Msps BLE ideal transmitter >=128 bytes BER=1E-43		-95		dBm

1. Typical sensitivity applies when ADDR0 is used for receiver address correlation. When ADDR[1...7] are used for receiver address correlation, the typical sensitivity for this mode is degraded by 3dB.
2. As defined in the Bluetooth Core Specification v4.0 Volume 6: Core System Package (Low Energy Controller Volume)
3. Equivalent BER limit < 10E-04
4. Typical sensitivity applies when ADDR0 is used for receiver address correlation. When ADDR[1...7] are used for receiver address correlation, the typical sensitivity for this mode is degraded by 3dB

Symbol	Description	Min.	Typ.	Max.	Units
$P_{SENS,IT,LP,1M,BLE}$	Sensitivity, 1Msps BLE ideal transmitter >=128 bytes BER=1E-43		-95		dBm
$P_{SENS,IT,2M}$	Sensitivity, 2Msps nRF mode4		-89		dBm
$P_{SENS,IT,SP,2M,BLE}$	Sensitivity, 2Msps BLE ideal transmitter, Packet length<=37bytes		-93		dBm
$P_{SENS,DT,SP,2M,BLE}$	Sensitivity, 2Msps BLE dirty transmitter, Packet length<=37bytes proprietary mode)		-93		dBm
$P_{SENS,IT,LP,2M,BLE}$	Sensitivity, 2Msps BLE ideal transmitter >= 128bytes		-92		dBm
$S_{SENS,DT,LP,2M,BLE}$	Sensitivity, 2Msps BLE dirty transmitter, Packet length >= 128bytes		-92		dBm

4.5.3.3.6 RX selectivity

Symbol	Description	Min.	Typ.	Max.	Units
C/I _{1M,co-channel}	1 Msps mode, Co-Channel interference		9		dBm
C/I _{1M,-1MHz}	1 Msps mode, Adjacent (-1 MHz) interference		-2		dBm
C/I _{1M,+1MHz}	1 Msps mode, Adjacent (+1 MHz) interference		-10		dBm
C/I _{1M,-2MHz}	1 Msps mode, Adjacent (-2 MHz) interference		-19		dBm
C/I _{1M,+2MHz}	1 Msps mode, Adjacent (+2 MHz) interference		-42		dBm
C/I _{1M,-3MHz}	1 Msps mode, Adjacent (-3 MHz) interference		-38		dBm
C/I _{1M,+3MHz}	1 Msps mode, Adjacent (+3 MHz) interference		-48		dB
C/I _{1M,±6MHz}	1 Msps mode, Adjacent (≥6 MHz) interference		-50		dB
C/I _{1MBLE,co-channel}	1 Msps BLE mode, Co-Channel interference		6		dB
C/I _{1MBLE,-1MHz}	1 Msps BLE mode, Adjacent (-1 MHz) interference		-2		dB
C/I _{1MBLE,+1MHz}	1Msps BLE mode, Adjacent (+1 MHz) interference		-9		dB
C/I _{1MBLE,-2MHz}	1Msps BLE mode, Adjacent (-2 MHz) interference		-22		dB
C/I _{1MBLE,+2MHz}	1Msps BLE mode, Adjacent (+2 MHz) interference		-46		dB
C/I _{1MBLE,>3MHz}	1Msps BLE mode, Adjacent (≥3 MHz) interference		-50		dB
C/I _{1MBLE,image}	Image frequency Interference -22 dB		-22		dB
C/I _{1MBLE,image,1MHz}	Adjacent (1 MHz) interference to in-band image frequency		-35		dB
C/I _{2M,co-channel}	2Msps mode, Co-Channel interference		10		dB
C/I _{2M,-2MHz}	2 Msps mode, Adjacent (-2 MHz) interference		6		dB
C/I _{2M,+2MHz}	2 Msps mode, Adjacent (+2 MHz) interference		-14		dB
C/I _{2M,-4MHz}	2 Msps mode, Adjacent (-4 MHz) interference		-20		dB
C/I _{2M,+4MHz}	2 Msps mode, Adjacent (+4 MHz) interference		-44		dB
C/I _{2M,-6MHz}	2 Msps mode, Adjacent (-6 MHz) interference		-42		dB
C/I _{2M,+6MHz}	2 Msps mode, Adjacent (+6 MHz) interference		-47		dB
C/I _{2M,≥12MHz}	2 Msps mode, Adjacent (≥12 MHz) interference		-52		dB
C/I _{2MBLE,co-channel}	2 Msps BLE mode, Co-Channel interference		7		dB
C/I _{2MBLE,±2MHz}	2 Msps BLE mode, Adjacent (±2 MHz) interference		0		dB
C/I _{2MBLE,±4MHz}	2 Msps BLE mode, Adjacent (±4 MHz) interference		-47		dB

$C/I_{2\text{MBLE}, \geq 6\text{MHz}}$	2 Msps BLE mode, Adjacent (≥ 6 MHz) interference		-49		dB
$C/I_{2\text{MBLE}, \text{image}}$	Image frequency Interference		-21		dB
$C/I_{2\text{MBLE}, \text{image}, 2\text{MHz}}$	Adjacent (2 MHz) interference to in-band image frequency		-36		dB

4.5.3.3.7 RX intermodulation

Symbol	Description	Min.	Typ.	Max.	Units
$P_{\text{IMD}, 1\text{M}}$	IMD performance, 1Msps (3MHz, 4MHz, and 5MHz offset)		-33		dBm
$P_{\text{IMD}, 1\text{M}, \text{BLE}}$	IMD performance, BLE 1Msps (3MHz, 4MHz, and 5MHz offset)		-30		dBm
$P_{\text{IMD}, 2\text{M}}$	IMD performance, 2Msps (6MHz, 8MHz, and 10MHz offset)		-33		dBm
$P_{\text{IMD}, 2\text{M}, \text{BLE}}$	IMD performance, BLE 2Msps (6MHz, 8MHz, and 10MHz offset)		-32		dBm

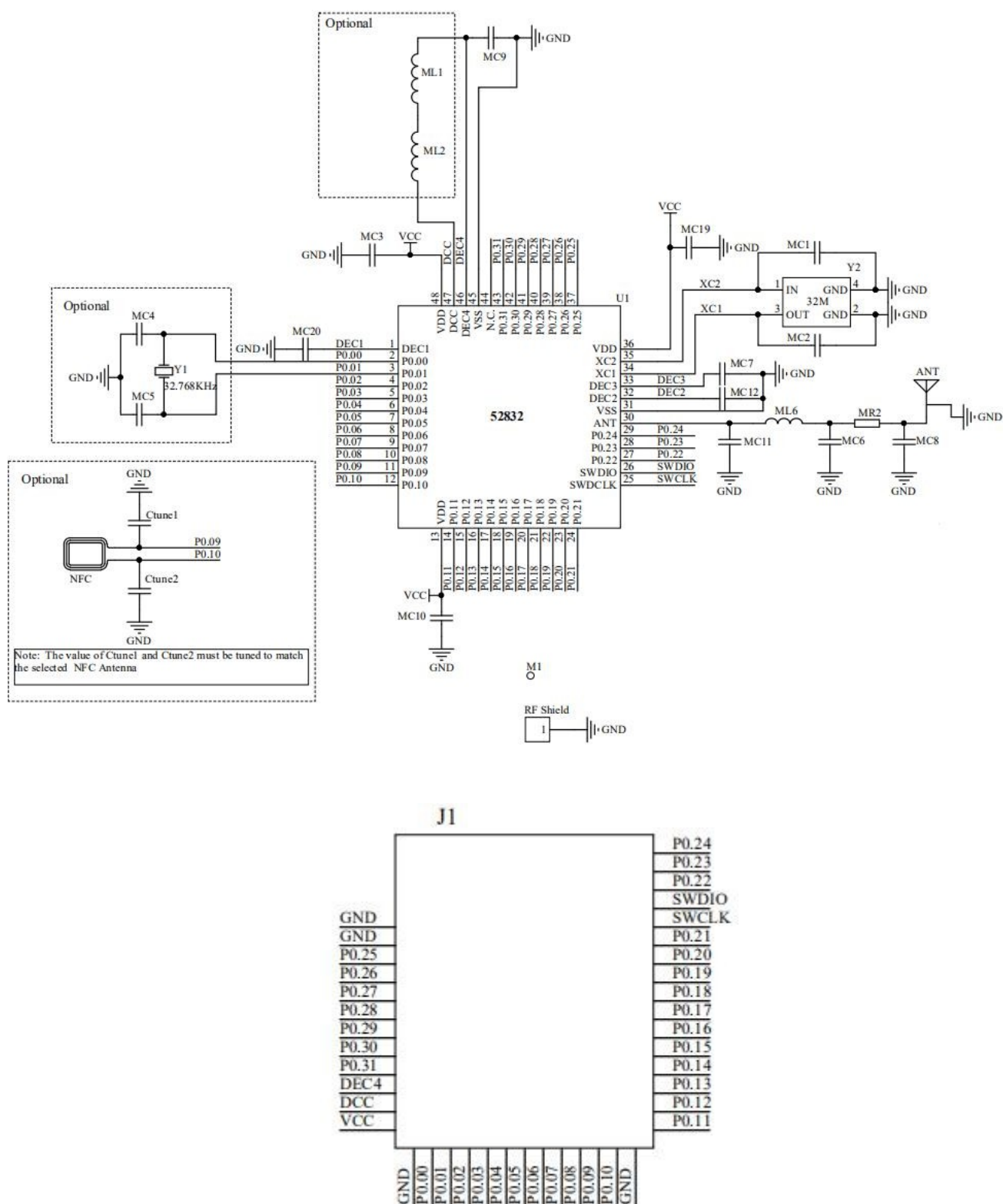
4.5.3.3.8 Radio timing

Symbol	Description	Min.	Typ.	Max.	Units
t_{TXEN}	Time between TXEN task and READY event after channel FREQUENCY configured		140		us
$t_{\text{TXEN}, \text{FAST}}$	Time between TXEN task and READY event after channel FREQUENCY configured (Fast Mode)		40		us
$t_{\text{TXDISABLE}}$	Time between DISABLE task and DISABLED event when the radio was in TX and mode is set to 1Msps		6		us
$t_{\text{TXDISABLE}, 2\text{M}}$	Time between DISABLE task and DISABLED event when the radio was in TX and mode is set to 2Msps		4		us
t_{RXEN}	Time between the RXEN task and READY event after channel FREQUENCY configured in default mode		140		us
$t_{\text{RXEN}, \text{FAST}}$	Time between the RXEN task and READY event after channel FREQUENCY configured in fast mode		40		us
t_{SWITCH}	The minimum time taken to switch from RX to TX or TX to RX (channel FREQUENCY unchanged)		20		us
$t_{\text{RXDISABLE}}$	Time between DISABLE task and DISABLED event when the radio was in RX		0		us
t_{TXCHAIN}	TX chain delay		0.6		us
t_{RXCHAIN}	RX chain delay		9.4		us
$t_{\text{RXCHAIN}, 2\text{M}}$	RX chain delay in 2Msps mode		5		us

4.5.3.3.9 Received signal strength indicator (RSSI) specifications

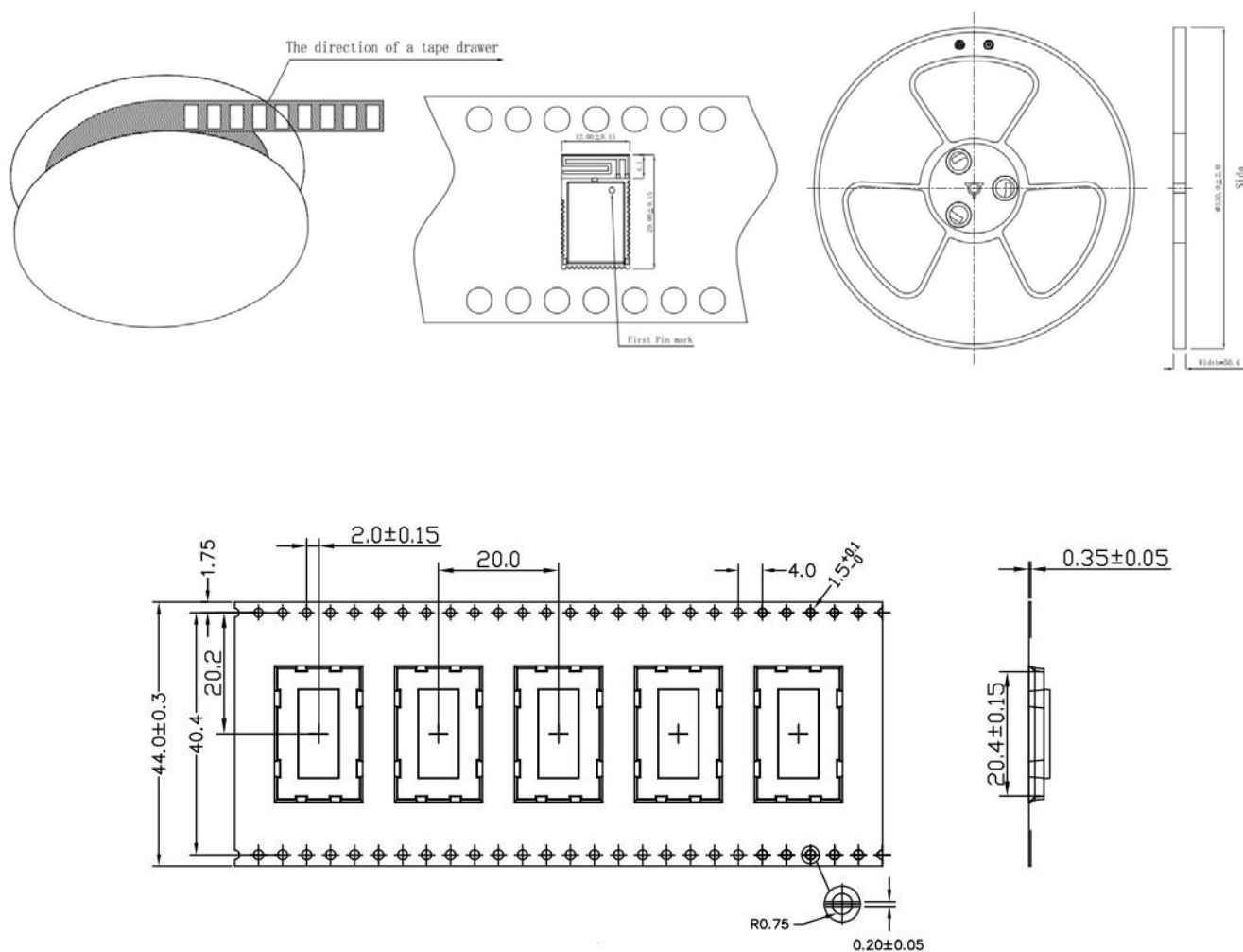
Symbol	Description	Min.	Typ.	Max.	Units
RSSI _{ACC}	RSSI Accuracy Valid range -90 to -20 dBm		±2		dB
RSSI _{RESOLUTION}	RSSI resolution		1		dB
RSSI _{PERIOD}	Sample period		0.25		us

4.5.4 Electrical schematic



4.5.5 Package information

4.5.5.1 Package dimension

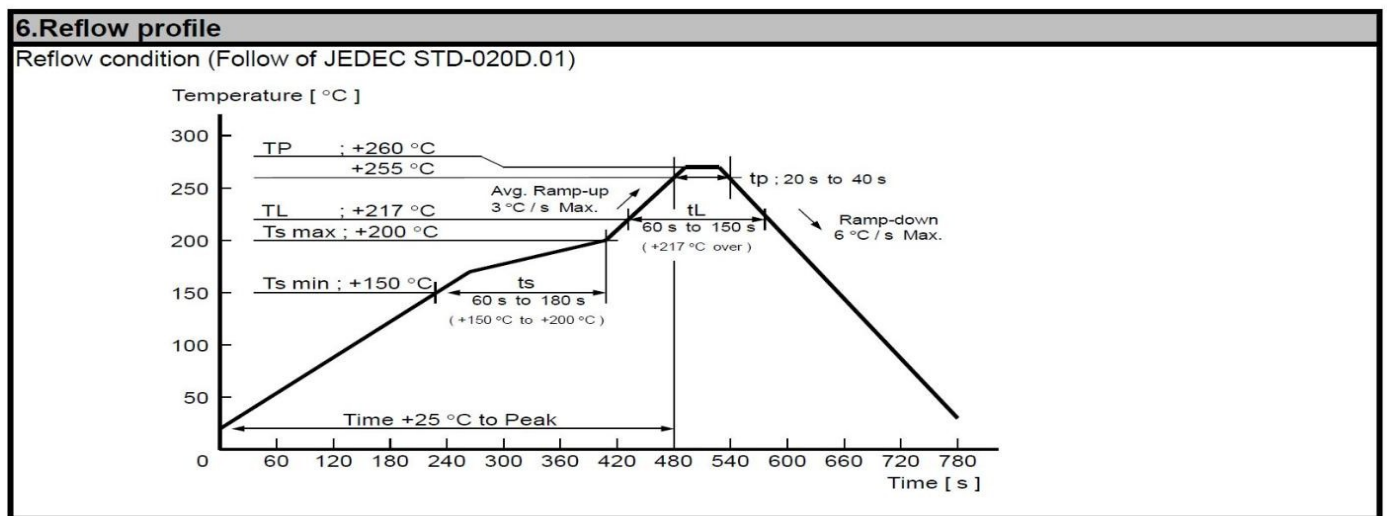


Details	Reel-MS50SFB1	Reel-MS50SFB2	Reel-MS50SFB3
Quantity(module)	850PCS	850PCS	850PCS
Tape Weight	515g	515g	515g
Single module Weight	0.68g	0.7g	0.72g
Gross Weight	1120g	1130g	1150g
Dimension	W : 44mm T : 0.35mm		

4.5.2 Mark on metal shield



4.5.3 Reflow and soldering



Profile Feature	Sn-Pb Assembly	Pb-Free Assembly
Solder Paste	Sn63/Pb37	Sn96.5/Ag3/Cu0.5
Preheat Temperature min (Tsmin)	100°C	150°C
Preheat Temperature max (Tsmax)	150°C	200°C
Preheat Time (Tsmin to Tsmax)(ts)	60-120 sec	60-120 sec
Average ramp-up rate (Tsmax to Tp)	3°C/second max	3°C/second max
Liquidous Temperature (TL)	183°C	217°C
Time (tL)Maintained Above (TL)	60-90 sec	30-90 sec
Peak Temperature (Tp)	220-235°C	230-250°C
Average ramp-down rate (Tp to Tsmax)	6°C/second max	6°C/second max
Time 25°C to peak temperature	6 minutes max	8 minutes max

4.5.4 Certification

4.5.4.1 Full Bluetooth Declaration ID

Please kindly check the DID number for MS50SFB: D039669.

Minew technologies meet the Bluetooth specification maintained by Bluetooth SIG, and all the product produced by Minew is properly tested and comply with the Bluetooth license agreements.

Minew is one of the associate member of Bluetooth SIG. The requirement of listing products by companies is become the members of the SIG and also pay the listed fees for each product required.

Please Kindly check the below Link to know more info: <https://www.bluetooth.com/develop-with-bluetooth/qualification-listing>.

The Minew Bluetooth Low Energy modules based on Nordic Semiconductor SoCs are listed as a "End product".

4.5.4.2 Europe (CE)

MS50SFB module is being tested and is expected to be compliant against the EU-Radio Equipment standards. OEM integrator should consult with qualified test house to verify all regulatory requirements have been met for their complete device.

4.5.4.3 United States (FCC)

Please kindly check the FCC ID for MS50SFB: 2ABU6-MS50SFB.

MS50SFB module is being tested and is expected to be compliant against the Federal Communications Commission standards.

As for the OEM integration:

Only OEM integrator have right to intend this device under the following conditions:

Any other transmitter or antenna must not be co-located with the antenna and transmitter. The module shall be only used with the integral antenna(s) that has been originally tested and certified with this module.

As long as the two conditions below are met, further transmitter testing will not be required.

(1) This device may not cause harmful interference, and

(2) this device must accept any interference received, including interference that may cause undesired operation. However, the OEM integrator shall test their end-product for any additional compliance requirements with this module installed (for example, digital device emission, PC peripheral requirements, etc.).

If these conditions cannot be met (for example certain laptop configuration or co-location with another transmitter), then the FCC authorization for this module in combination with the host equipment is no longer considered valid and the final product shall not use the FCC ID of the module. In these circumstances, the OEM integrator shall be re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

The OEM shall be verifying end product compliance with FCC Part 15, sub-part B limits for unintentional radiators through an accredited test facility.

4.5.4.4 Canada (IC)

Please kindly check the IC ID for MS50SFB: 20896-MS50SFB.

Minew's modules have been certified for use in Canada under Industry Canada (IC) Radio Standards Specification (RSS) RSS-210 and RSSGen. Modular approval permits the installation of a module in a host device without the need to rectify the device.

As for the labeling & user Information Requirements, MS50SFB is assigned the IC ID number: 20896-MS50SFB

Labeling Requirements for the Host Device (from Section 3.2.1, RSS-Gen, Issue 3, December 2010): The host device shall be properly labeled to identify the module within the host device.

User Manual Notice for License-Exempt Radio Apparatus (from Section 7.1.3 RSS-Gen, Issue 3, December 2010): User manuals for license-exempt radio apparatus shall contain the following or equivalent notice in a conspicuous location in the user manual or alternatively on the device or both: This device complies with Industry Canada license 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.

Transmitter Antenna (from Section 7.1.2 RSS-Gen, Issue 3, December 2010):

User manuals for transmitters shall display the following notice in a conspicuous location:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

4.5.4.5 Japan (TELEC)

Please kindly check the TELEC ID for MS50SFB: 208-190043.

The MS50SFB is approved for use in the Japanese market.

4.5.4.6 Australia / New Zealand (RCM)

The MS50SFB has been tested to comply with the AS/NZS 4268:2017, Radio equipment and systems –Short range devices – Limits and methods of measurement. It may be used as evidence in obtaining permission to use the Regulatory Compliance Mark (RCM).

Information on registration as a Responsible Party, license and labeling requirements may be found at the following websites:

Australia: <http://www.acma.gov.au/theACMA/radiocommunications-short-range-devices-standard-2004>

New Zealand: <http://www.rsm.govt.nz/compliance>.

Only Australian-based and New Zealand-based companies who are registered may be granted permission to use the RCM. An Australian-based or New Zealand-based agent or importer may also register as a Responsible Party to use the RCM on behalf of a company not in Australia or New Zealand.

4.5.4.7 India (WPC)

The MS50SFB has been tested to comply with the wireless planning & coordination (WPC) Wing of the Ministry of Communications standard. WPC created in 1952, is the National Radio Regulatory Authority responsible for Frequency Spectrum Management, including licensing and caters for the needs of all wireless users (Government and Private) in the country.

It exercises the statutory functions of the Central Government and issues licenses to establish, maintain and operate wireless stations. WPC is divided into major sections like Licensing and Regulation (LR), New Technology Group (NTG) and Standing Advisory Committee on Radio Frequency Allocation (SACFA). SACFA makes the recommendations on major frequency allocation issues, formulation of the frequency allocation plan, making recommendations on the various issues related to International Telecom Union (ITU), to sort out problems referred to the committee by various wireless users, Siting clearance of all wireless installations in the country etc.

4.5.4.8 Environmental

4.5.4.8.1 RoHS

MS50SFB modules are in compliance with Directive 2011/65/EU, 2015/863/EU of the European Parliament and the Council on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

4.5.4.8.2 Reach

MS50SFB modules listed below do not contain the 191 SVHC (Substance of Very High Concern), as defined by Directive EC/1907/2006 Article according to REACH Annex XVII.

4.5.5 Notes & cautions

We cannot assure that the specification has no errors and omission even though this specification is under collate and check strictly.

This specification is under the protection of laws and regulations of copyright, please do not copy and duplicate at any form, or do not transmit part or full of this specification in any wire and wireless network in any form, or do not edit or translate to any other format, word, code, etc.

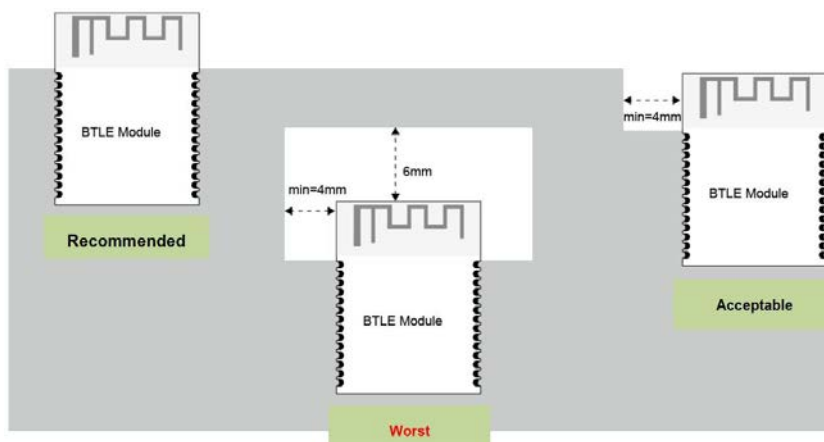
4.5.5.1 Design notes

- (1) It is critical to following the recommendations of this document to ensure the module meets the specifications.
- (2) The module should be placed at the edge of the circuit board as far as possible to keep away from other circuits.
- (3) Antenna should be kept away from other circuits. It can prevent low radiation efficiency and the normal use of other circuits from being affected.
- (4) The landing of components should be appropriate and that is better for reducing the parasitic inductance.
- (5) Please refuse to supply voltage that is not within the range of specification.
- (6) Please make sure the module or its surface may not suffer from the physical shock or extreme stress.

4.5.5.2 Layout notes

To make sure wireless performance is at its best condition, please layout the MS50SFB1 and MS50SFB2 module on the carrier board as below instructions and picture.

- (1) Placement of the antenna
The antenna area of module shall lay clearance completely and should not be blocked by the metal. Otherwise, it will have effect on antenna performance (As the picture indicated below).
- (2) Placement of top-layer
The placement of top-layer in carrier board shall be lay copper completely to reduce the signal line in carrier board or other interference.
- (3) Clearance
The upper and below area of antenna (including the case) shall have 4mm or more than 4mm clearance to reduce the influences for antenna.



*The Grey area above is Carrier board.

4.5.5.3 Installation and soldering

- (1) Please do not lay copper under the module antenna. It can prevent the influence of signal radiation and the transmission distance from being affected.

4.5.5.4 Handling and storage

- (1) Due to the fact that CMOS components are included in the module, it is better to eliminate static electricity at any methods when transporting or working with the module. Moreover, it is strongly recommended adding anti-ESD components to circuit design to hinder damage from real-life ESD events. Anti-ESD methods can be also used in mechanical design.



- (2) Please store the modules within -40°C to $+125^{\circ}\text{C}$ before and after installation and make sure the modules is away from the direct sunlight exposure for a long duration. Modules should be far away from humid and salty air conditions, and any corrosive gasses or substances.
- (3) Please not to wash the module. No-Clean Paste is used in production. The metal shield may be oxidized by the washing process and may lead to chemistry reaction with No-Clean Paste. If modules goes through the washing process, functions of the module may not guaranteed.

4.5.5.5 Life support applications

- (1) The module is not design for life support device or system and not allowed to be used in destructive devices or system in any direct, or indirect ways. Minew is not responsible for compensation of any losses when applying modules under such application as described above.
- (2) Minew shall not responsible for the customer's products or application.

4.5.6 Disclaimer

The factory has passed the ISO9001 quality management system, ISO14001 environmental management system and OAHS18000 occupational health and safety assessment. Each product has been rigorously tested (transmission power test, sensitivity test, power consumption test, stability test, aging test, etc.).

*** NOTICES:**

- (1) The Bluetooth trade mark is owned by the Bluetooth SIG Inc. USA.
- (2) All other trademarks listed herein are owned by their respective owners.
- (3) All specifications are subject to change without notice.
- (4) Please do not use this specification for produce, sell or illegal purpose without Minew's authorization.
- (5) Minew have right to interpret all the items above.

4.5.7 Contact information

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