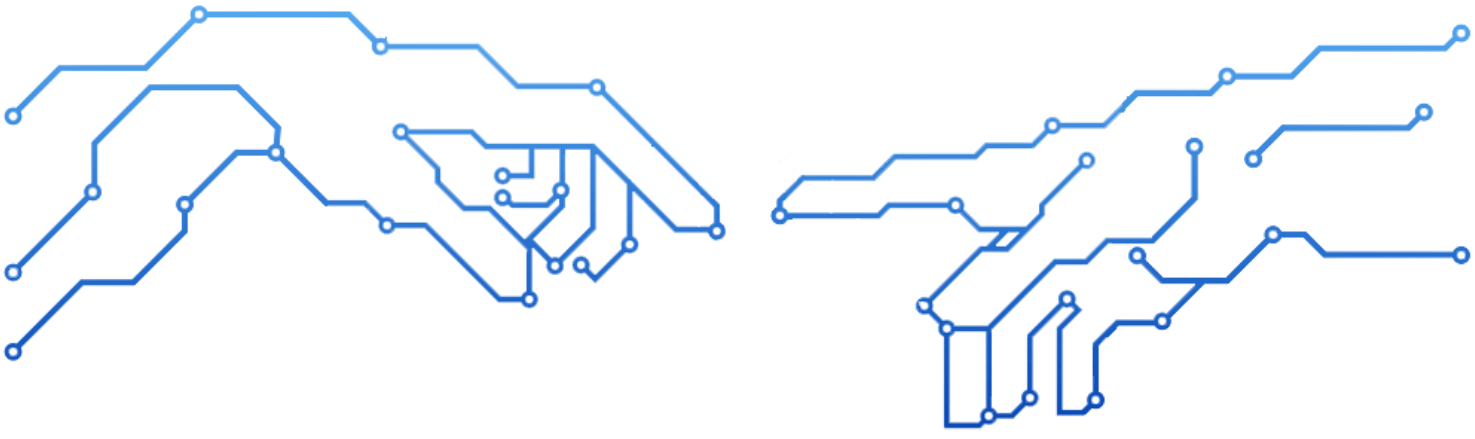
Technoration India Pvt. Ltd.

Dual-Band Multi-System GNSS Positioning Module

TR-I10

Datasheet V1.0



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ABOUT THE DOCUMENT

This document defines TECHNORATION INDIA TR-I10 GNSS positioning module. It describes the hardwareinterfaces, electrical and mechanical specifications, aiming to make customers understand the hardware design of TR-I10.

1 OVERVIEW

1.1 Introduction

TR-I10 is a high-performance dual-band (L1/L5) multi-system GNSS positioning module. It supports the global civil navigation systems, including GPS, IRNSS, BDS, GLONASS, Galileo, andQZSS.
Embedded antennas ensure TR-I10 to work at L1 and L5 bands simultaneously to increase the number of visible satellites assisting by GPS, BDS, Galileo, and IRNSS signals, which makes this module achieve high positioning accuracy and short TTFF, especially in a rough urban environment. TR-I10 supports external active antenna featured with auto-detecting and auto-switching. With a compact body and high performance, TR-I10 is widely applied to tracking applications, like the automotive, consumer, and industrial tracking.

Figure 1 TR-I10

1.2 Features

- Supports GPS, BDS, IRNSS, Galileo and QZSS systems covering L1 and L5 bands
- Supports AGPS/DGPS/SBAS (WAAS/EGNOS/MSAS/GAGAN)
- Built-in LNA & SAW for better sensitivity
- Integrated with dual-feed (L1&L5) antenna
- Supports Geo-Fence function
- Supports message broadcast service for IRNSS *
- Ultra-low power consumption around 40mA in dual-band tracking mode
- Supports external active antenna featured with auto-detecting and auto-switching
- Compact size: 26.7mm*18.5mm*7.0mm

* *Supported by specific firmware upgrade*

1.3 Specifications

Table 1 Specifications

Parameter	Specification	
Positioning accuracy	GNSS: <1m CEP @ Open Sky	
Velocity & Time Accuracy	GNSS	0.1m/s CEP
	PPS_1σ	20ns
Time to First Fix (TTFF)	Hot start	1s
	Cold start	30s
Sensitivity	Cold start	-149dBm
	Reacquisition	-158dBm
	Tracking	-162dBm
Operating Limit	Velocity	515 m/s
	Altitude	18,000m
Interface	UART	Adjustable: 9600bps-460800 bps; Default: 115200 bps
		Update Rate: 1 Hz (Default), up to 10 Hz
	I^2C	Max. bit rate up to 400 kbps
Protocol	NMEA 0183 V4.10	
External Antenna Interface	Antenna Type: Active	
	Antenna Power Supply: TR-I10 Module (Pin 15)	
Power Supply	VDD: 3.1V~5.0V, Typical 3.3 V	
	VDD_BAK: 1.7V~3.6V, Typical 3.3 V	
Power consumption	Operating mode (GPS+QZSS+BDS+Galileo+IRNSS)	Acquisition: 42mA@3.3V
		Tracking: 40mA@3.3V
	Backup mode	12uA@3.3V
Temperature	Operation temperature: -40°C ~ +85°C	
	Storage temperature: -40°C ~ +85°C	
Dimensions	26.7mm*18.5mm*7.0mm	
Weight	Approx. 8.5g	

1.3.1 GNSS reception

Table 2 GNSS reception

P/N	Option	GPS/QZSS		BDS		GLONASS	Galileo		IRNSS
		L1C/A	L5C	B1I	B2a	L1	E1	E5a	L5
TR-I10	A (Default)	•	•	•	•	-	•	•	•
	B	•	•	-	-	•	•	•	•
	C	•	•	-	-	-	-	-	•

1.4 Block diagram

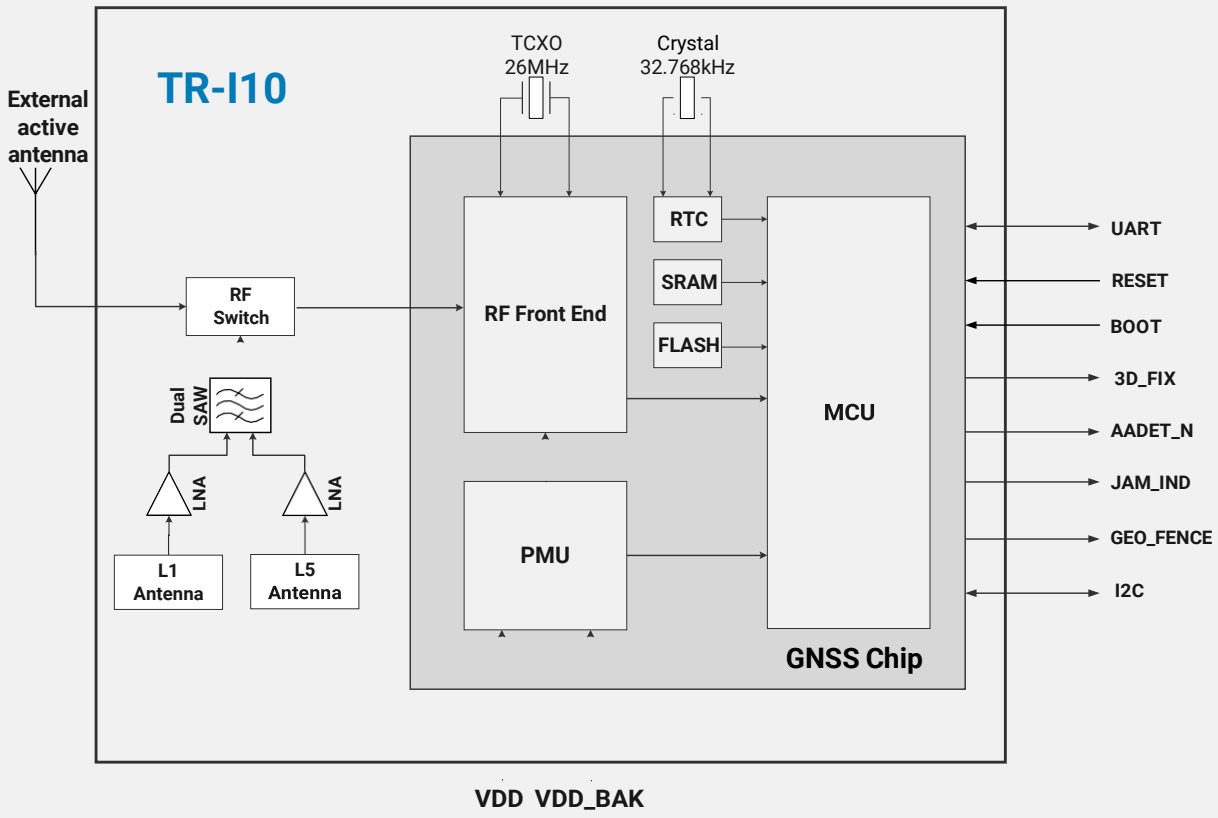

Figure 2 Block diagram

2 APPLICATION INTERFACES

2.1 Pin definition

2.1.1 Pin assignment

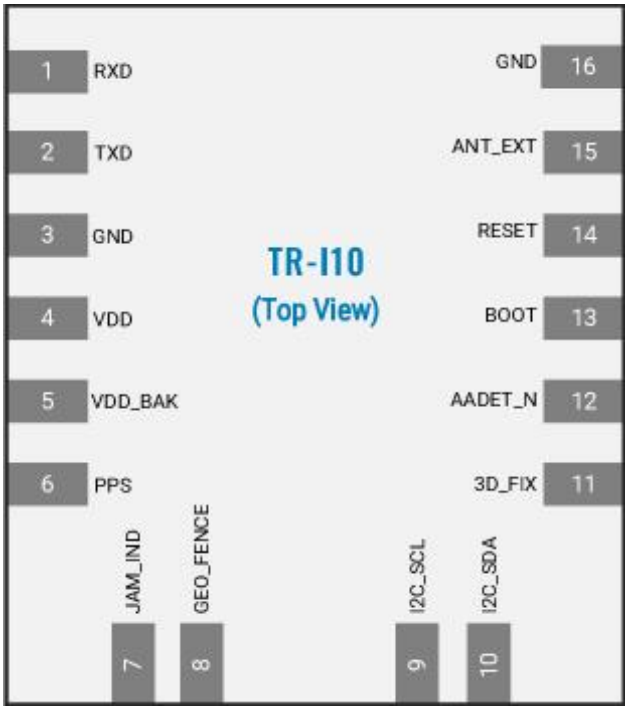

Figure 3 Pin assignment

2.1.2 Pin description

Table 3 Pin description

Pin name	Pin No.	I/O	DC characteristics	Comment
RXD	1	I	V_{IL} min=0V V_{IL} max=0.4V V_{IH} min=2.6V V_{IH} max=3.6V	UART port is used for NMEA output, and firmware upgrade.
TXD	2	O	V_{OL} max=0.4V V_{OH} min=2.6V V_{OH} nom=3.0V	

GND	3, 16	VSS		Assure a good GND connection to all GND pins of the module, preferably with a large ground plane.
VDD	4	Power	V_{max}=5V V_{min}=3.1V V_{nom}=3.3V	Main voltage supply. Provide clean and stable supply. Assure load current is not less than 150mA.
VDD_BAK	5	Power	V_{max}=3.6V V_{min}=1.7V V_{nom}=3.3V	Backup power supply voltage input. Backup power is needed in order to enable warm start and hot start features.
PPS	6	O	V_{OL} max=0.4V V_{OH} min=2.6V V_{OH} nom=3.0V	Time pulse output. If unused, keep it floating.
JAM_IND	7	O	V_{OL} max=0.4V V_{OH} min=2.6V V_{OH} nom=3.0V	Jamming detection indicator. If unused, keep it floating.
GEO_FENCE	8	O	V_{OL} max=0.4V V_{OH} min=2.6V V_{OH} nom=3.0V	Geo-fence boundary indicator. If unused, keep it floating.
I2C_SCL	9	O	V_{IL} max=0.4V V_{IH} min=2.6V V_{OL} max=0.4V V_{OH} min=2.6V V_{OH} nom=3.0V	I2C serial clock. If unused, keep it floating.
I2C_SDA	10	I/O		I2C serial data. If unused, keep it floating.
3D_FIX	11	O	V_{OL} max=0.4V V_{OH} min=2.6V V_{OH} nom=3.0V	3D fix indicator. The pin is at high level by default. After 3d-fix, the pin turns to low level.
AADET_N	12	O	V_{OL} max=0.4V V_{OH} min=2.6V V_{OH} nom=3.0V	Active antenna Indicator. If unused, keep it floating.
BOOT	13	I	V_{IL} min=0 V V_{IL} max=0.4V V_{IH} min=2.6V V_{IH} nom=3.3V	Mode selection. Keep it floating or Hi-Z when system powers up or resets, and the module enters into full on mode; keep low level when system powers up or resets, and the module enters into BOOT mode.
RESET	14	I	V_{IL} min=0 V V_{IL} max=0.4V V_{IH} min=2.6V V_{IH} nom=3.3V	External reset, low active.
ANT_EXT	15	I		External active antenna pin

2.2 Power management

TR-I10 has two kinds of power supply: VDD and VDD_BAK. The main power is supplied through VDD pin, and the backup power is supplied through VDD_BAK. For a better positioning performance,it is recommended to use an LDO with 150mA current at least.
VDD_BAK supplies power for RTC domain. If the VDD is off, VDD_BAK will be activated to keep the orbit information for a quick startup (hot start) and a shorter TTFF time.
***Note**: If no backup power supply, VDD will supply to VDD_BAK through a diode.*

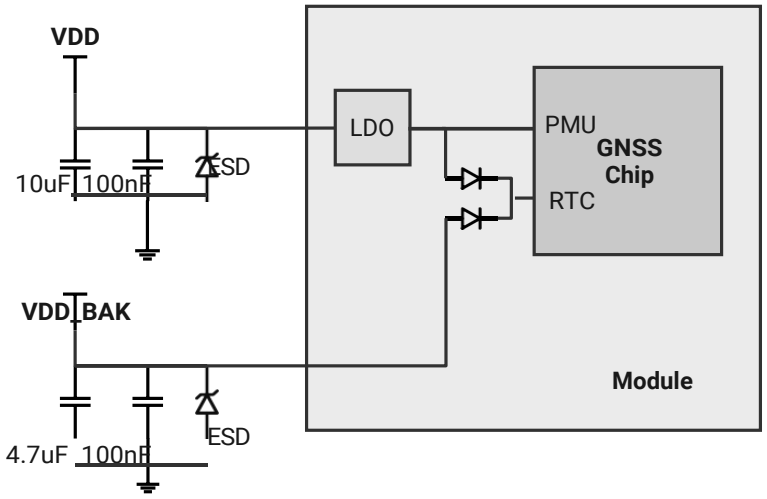

Figure 4 Power input reference circuit

2.2.1 Full on mode

Full on mode consists of tracking mode and acquisition mode. In acquisition mode, the module searches satellites, and determines the visible satellites, coarse carrier frequency as well as code phase of satellite signals. Acquisition completed, it will automatically switch to tracking mode. In tracking mode, the module tracks satellites and demodulates the navigation data from specific satellites.
Both VDD and VDD_BAK pins are valid or only VDD is valid, the module enters into full on mode automatically.

2.2.2 Backup mode

If the power for VDD pin is off, the real-time clock (RTC) and battery backed RAM (BBR) are supplied through the VDD_BAK pin, and the module will enter into backup mode automatically. In backup mode, acquiring and tracking stops, and UART is not accessible. But orbit information and time will be maintained and allows a Hot or Warm start. Two ways to enter backup mode as below:

- Cut off VDD supply and keep VDD_BAK supply, and backup mode will be activated automatically. Reconnect the VDD supply, the module wakes the full on mode up.
- Send "$PHD,06,41,TN,BB,<duration>,3*xx" command to enter into backup mode. After the specific duration, the module wakes the full on mode up.
  For example:
  *Send "$PHD,06,41,TN,BB,60000,3*40" command, and the system keeps backup mode for60000ms. After 60000ms, the module turns to full on mode.*

2.3 RESET

Reset pin is used to reset system. TR-I10 module can be reset by driving RESET to low level voltage. Keep RESET pin floating if not used. Do not reserve any pull-up or pull-down circuit for thispin.

2.4 BOOT

Boot pin is used to upgrade the module. Keep BOOT pin Hi-Z or floating during an external reset or system power-on, the module enters full on mode.

How to enter the Boot mode?
Drive **BOOT** pin to low or connect **BOOT** pin to GND directly (not by pull-down resistance) during system powers up or the external reset happens. The system enters Boot mode after **BOOT** pin is released from low to floating state.

Note: Do not reserve any pull-up or pull-down circuit for this pin.

2.5 UART

The Universal Asynchronous Receiver / Transmitter (UART) provides serial communication with external device. It performs serial-to-parallel & parallel-to-serial data conversion during receiving & transmitting respectively.

- UART port is used for NMEA output and firmware upgrade
- Range: 9600bps ~ 460800 bps, the default baud rate is 115200 bps.

2.6 I2C

The I2C interface is a serial input & output port, operating as a master & slave device.

- Master / Slave transmitting & receiving
- Speed support: 100Kps, 400Kps

Note: I2C_SCL and I2C_SDA have been pulled up to 3.0V internally with 4.7KΩ resistors.

2.7 PPS

An extremely accurate time pulse signal “Pulse Per Second” (PPS) generated by GNSS can be outputto designated pin. It is useful in timing applications. The pulse interval can be adjusted by changing internal parameters.

2.8 3D_FIX

3D_FIX defaults low level. It will output a high level after successful positioning.

2.9 JAM_IND

JAM_IND is used to detect if there is any jammer interfering the device. If a jammer interference exists, JAM_IND pin will produce a low level; otherwise it produces a high level.

2.10 AADET_N

AADET_N pin is used to detect whether there is an external active antenna. It outputs a low level if an external active antenna is detected; a high level if no external active antenna is detected. Keep AADET_N pin floating if not used.

Note:

1) Active antenna requires a DC supply through Pin 15 (ANT_EXT pin).
2) The current supplying to active antenna should be in the range of 2mA to 35mA. Any current out of the range cannot indicate an active antenna status.

2.11 GEO_FENCE interface

The GEO_FENCE signal is used for geo-fence boundary indication. If not used, keep it floating.

2.12 ANT_EXT (External Antenna)

ANT_EXT pin is designed for an external active antenna connection. When an external active antennais connected, TR-I10 can automatically detect its presence and automatically switch to use it. Recommended circuit design for an external antenna:

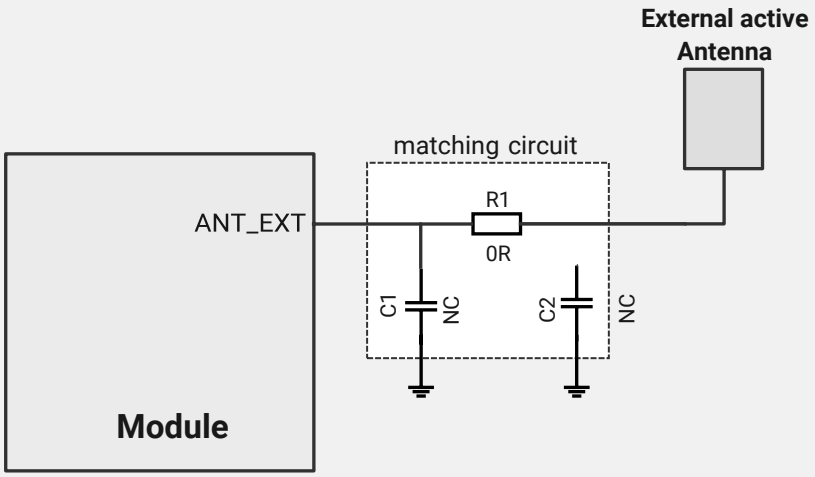

Figure 5 External antenna reference design

Note:

1) Active antenna requires a DC supply through Pin 15 (ANT_EXT pin).
2) The current supplying to active antenna should be in the range of 2mA to 35mA.

3 ELECTRICAL CHARACTERISTICS

3.1 Absolute maximum ratings

This product contains devices to protect the inputs from high static voltages damage, however it is advisable to take normal precautions to avoid application of any voltage higher than the specified maximum rated voltages. Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device.

Table 4 Absolute maximum ratings

Symbol	Parameter	Min.	Max.	Unit
VDD	Power input for the main power domain	-0.3	6	V
VDD_BAK	Backup supply	-0.5	3.63	V
I/O pin voltage	I/O pin voltage	-0.5	3.63	V
P_{ANT_EXT}	Input power at external antenna		TBD	dBm
$T_{storage}$	Storage temperature	-40	+85	℃

3.2 Operating conditions

Table 5 Operating conditions

Symbol	Parameter	Min.	Typ.	Max.	Unit
VDD	Power input for the main power domain	3.1	3.3	5.0	V
VDD_BAK	Backup supply	1.7	3.3	3.6	V
ICC_{max}	Maximum operating current @ VDD			60	mA
T_{env}	Operating temperature	-40	+25	+85	℃

3.3 Power consumption

Table 6 Power consumption

Module	Condition	Acquisition	Tracking	Backup
TR-I10	(GPS+QZSS+BDS+Galileo+IRNSS) @3.3V	42mA	40mA	12uA

4 MECHANICAL SPEFICATIONS

4.1 Mechanical dimensions

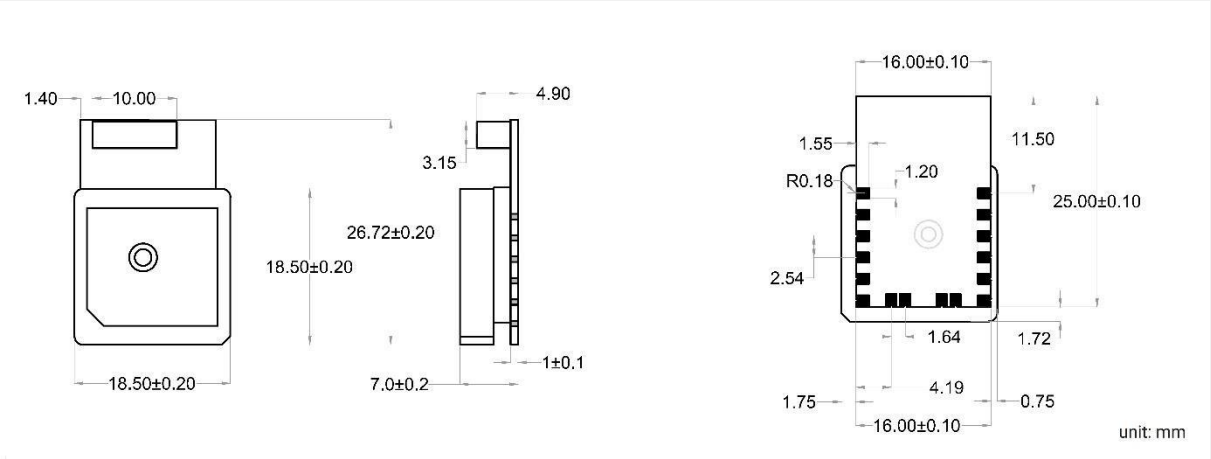

Figure 6 Mechanical dimensions

4.2 Recommended PCB

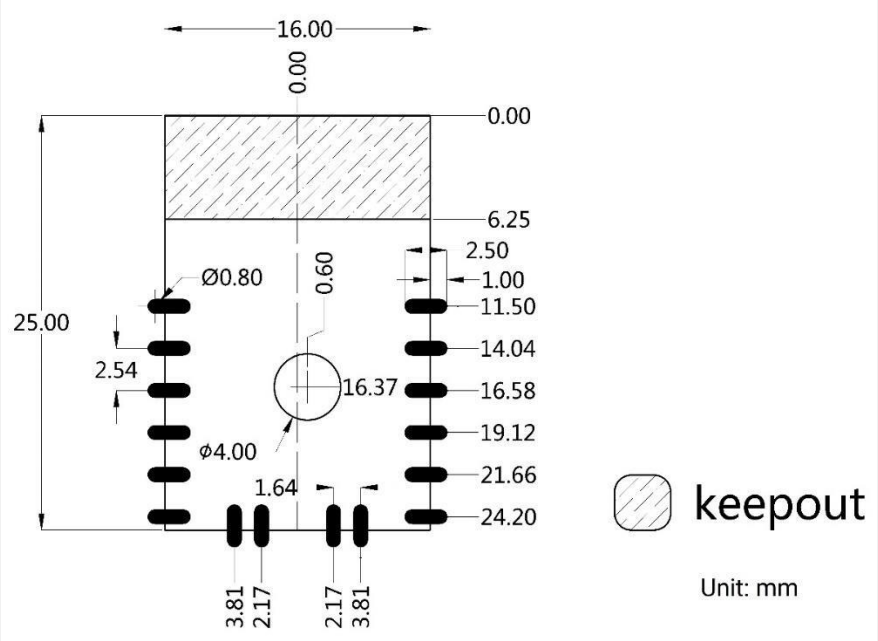

Figure 7 PCB footprints

4.3 Moisture sensitivity level

The Moisture Sensitivity Level (MSL) of the GNSS module is MSL3.

5 REVISION HISTORY

Revision	Date	Reviser	Status / Comments
V1.0	2023-06	Sanjeet	First released

Technoration India Pvt. Ltd.

www.technoration.in

support@technoration.in

F-25, 1st Floor, Block-4, Shankar Market,
Connaught Place, New Delhi – 110001, India