# MN5010HS
# GPS Receiver Module

## 1 Description

The Micro Modular Technologies MN5010HS Global Positioning System (GPS) Receiver Module is a complete 20-channel receiver with high sensitivity that measures only 10 x 10 x 2 mm. It features fast-acquisition hardware, integrated RF filtering, TCXO, reset circuit, real-time clock with on-board crystal, and an integrated LNA that allows operation with either active or passive antennas. The user needs only provide DC power and a GPS signal; the MN5010HS will output the navigation solution in the widely-used NMEA-0183 protocol or in SiRF binary protocol.

The 20-channel receiver allows all satellites in view to be tracked, providing an over-determined solution to minimize position jumps caused by individual satellite blockage. The fast-acquisition hardware design greatly reduces the time for signal acquisition when the receiver is initially powered up. The MN5010HS operates from a single battery supply between 3.25 and 5.5 VDC. For even further power reductions, the OEM design may use a power-saving mode via binary commands.

The MN5010HS is supported by an evaluation kit, including software, along with reference designs to speed OEM development. The MN5010HS is machine placeable by standard surface mount equipment and is available in tube or tape and reel. A metal shield is provided for RF protection and for automated nozzle pickup.

### 1.1 Features

- Complete SiRFstarIII-based 20-channel GPS receiver
- Highly integrated design includes on-board LNA, TCXO, RF filtering, Reset circuit, and a Real Time Clock circuit with crystal
- Ultra-small 10 x 10 x 2 mm 36-pin LGA package
- Less than 80 mW typical power consumption
- Fast-acquisition design for rapid position determination under all startup and operating conditions.
- Extended commercial temperature operation (-20℃ to +85℃)
- Supports active or passive antennas
- Supports SBAS (WAAS, EGNOS, MSAS,GAGAN)
- Standard serial protocols: NMEA-0183 or SiRF binary
- Extended Ephemeris upload capability
- Evaluation kit available
- Pb free RoHS compliant


### 1.2 Block Diagram

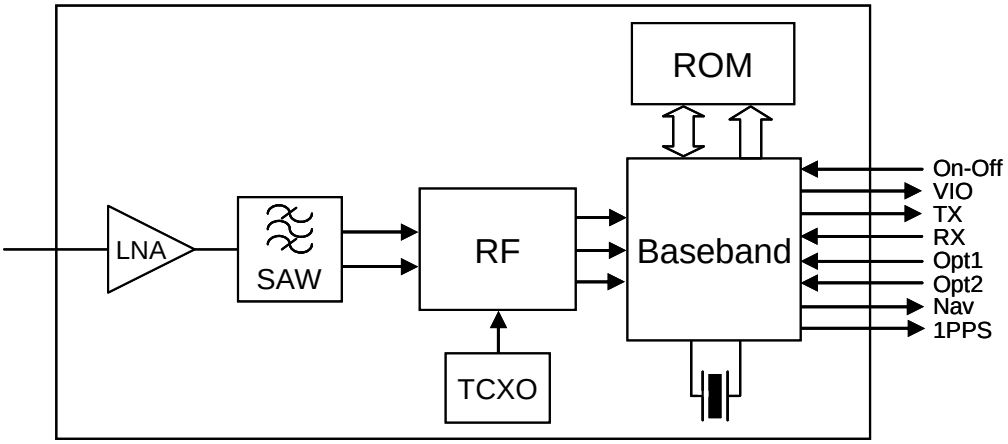



Figure 1 - MN5010HS Block Diagram

### 1.3 GPS Performance

| Acquisition Time | Specification |
|---|---|
| Cold start TTFF (no time, no position, no ephemeris) | <35 seconds |
| Warm start TTFF (approximate time and position, no ephemeris) | <35 seconds |
| Hot Start TTFF (time, position and ephemeris) | <1 second |

Table 1 – Acquisition Performance

| Horizontal Position Error | Accuracy |
|---|---|
| CEP | <2.5 meters |

Table 2 – Horizontal Position Accuracy

| Sensitivity | Typical |
|---|---|
| Tracking | -159 dBm |
| Acquisition (Cold Start) | -145 dBm |

Table 3 – Sensitivity

## 2 Environmental Limits

### 2.1 Operating

| | |
|---|---|
| Temperature | -20℃ to +85℃ |
| Humidity | Up to 95% non-condensing or a wet bulb temperature of +35℃, whichever is less |
| Altitude | -1000 feet to 60,000 feet |

Table 4 – Operating Limits

### 2.2 Storage

| | |
|---|---|
| Temperature | -40℃ to +85℃ |
| Humidity | Up to 95% non-condensing or a wet bulb temperature of +35℃, whichever is less |
| Altitude | -1000 feet to 60,000 feet |
| Shock | 18G peak, 5 millisecond duration |
| Shock (in shipping container) | 10 drops from 75 cm onto concrete floor |

Table 5 – Storage Limits

# 3 Electrical

## 3.1 Module Pin Descriptions

| Pin | Name | Pin Definition |
|---|---|---|
| 2 | GND | Ground |
| 4 | RESERVED | This pin must be grounded, preferably through a zero Ω resistor. |
| 7 | RX0 | The MN5010HS GPS Receiver Module implements a single full-duplex asynchronous serial UART port. This signal is used to input commands or other information to the receiver in either NMEA or SiRF binary protocol, depending upon the current configuration of the receiver. In the idle condition, this pin should be driven at logic 1. If the driving circuitry is powered independently of the MN5010HS, ensure that this pin is not driven to logic 1 when primary power to the MN5010HS is removed or when the MN5010HS is in the Hibernate state. |
| 8 | TX0 | The MN5010HS GPS Receiver Module implements a single full-duplex asynchronous serial UART port. This signal is used to output position, time and velocity information from the receiver. The protocol may be either NMEA or SiRF binary, depending upon the current configuration of the receiver. In the idle condition, this pin is at logic 1. In the Hibernate state, this pin will be at logic 0. |
| 9 | 1PPS | One-pulse-per-second (1PPS) output, synchronized when the fix is valid. The pulse duration is 1 µs, and its rate is 1 Hz. See section 3.4.5, 1PPS Signal. |
| 11 | GND | Ground |
| 12 | VIO | I/O voltage (output). This pin may be used to determine the current state of the module (Off or Hibernate). VIO can supply a maximum of 5 mA. |
| 13 | OPT1 | This input signal is used (with OPT2) to configure the operation of the MN5010HS. Please refer to the MN5010HS Design Guidelines document for more information regarding use of this pin. |
| 14 | OPT2 | This input signal is used (with OPT1) to configure the operation of the MN5010HS. Please refer to the MN5010HS Design Guidelines document for more information regarding use of this pin. |
| 20 | NAV | This output signal indicates navigation status. It pulses high for 100 ms each second when the receiver is in navigation (i.e., the fix is valid), and steady low when the receiver is not in navigation. |
| 22 | ON-OFF | An input pulse toggles the state of the module between On and Hibernate. To toggle the state, pulse this pin high for a minimum of 1 ms. Maximum pulse rate is one per second. |
| 23 | nMR | This input signal is pulled low for at least 30 ms to reset the MN5010HS. If the user does not need this signal, it may be left unconnected. This signal will also wake up an MN5010HS receiver that is in the HIBERNATE state. Internally, this pin is a 1.2V logic level. It may not be driven by any source; it may only be pulled to ground. Please refer to the MN5010HS Design Guidelines document for more information regarding use of this pin. |
| 24 | GND | Ground |
| 27 | GND | Ground |
| 29 | GND | Ground |

| Pin | Name | Pin Definition |
|---|---|---|
| 30 | ANT | RF input: Connect to external antenna. See Section 3.3, RF Interface. |
| 31 | GND | Ground |
| 33 | BATTERY | Power supply to module (+3.25 to +5.5 VDC) |

Table 6 – MN5010HS Pin-out

Note: The following pins have no internal connection: 1, 3, 5, 6, 10, 15-19, 21, 25, 26, 28, 32, 34-36.

Caution: The input pins are not 3V tolerant. See Table 9 – Digital I/O Interface Levels and Table 10 – ON-OFF Signal Digital I/O Interface Levels.

## 3.2 Power Supply

The MN5010HS GPS Receiver Module is designed to operate from a single supply, typically from a Lithium Ion battery.

| | |
|---|---|
| Voltage | 3.25 to 5.5 VDC |
| Current (typical) | 26.5 mA |
| Current (maximum) | 37 mA |
| Current - hibernate state – (maximum) | 25 µA |

Table 7 – Main Power Supply

## 3.3 RF Interface

### 3.3.1 RF Input

The MN5010HS GPS Receiver Module accepts a GPS L1 C/A signal from an industry-standard GPS antenna (which may be passive or active). If a passive antenna is used, no other circuitry is required. However, if an active antenna is required, then suitable means for powering the active antenna must be provided external to the MN5010HS GPS Receiver Module. The RF input is isolated from DC levels to a maximum of ±15 VDC.

If the design is required to supply power for an active antenna, MMT recommends that a quarter wave stub be used to prevent disturbing the matching of the antenna and MN5010HS module. The other end of the quarter wave stub should be AC grounded with a suitable microwave quality capacitor. Please refer to the MN5010HS Design Guidelines for more information.

| | |
|---|---|
| Signal Level | -160 to -125 dBm (typical) |
| Frequency | L1 (1575.42 MHz) |
| Return Loss | Better than -10 dB |
| Noise Figure | 1.5 dB (typical) |
| Impedance | 50 ohms nominal |

Table 8 – RF Signal Characteristics

### 3.3.2 Burnout Protection

The MN5010HS GPS Receiver Module can accept signal levels up to +10 dBm with a DC voltage of ±15 V on the RF input pin without permanent damage to the module.

3.3.3 Jamming Performance

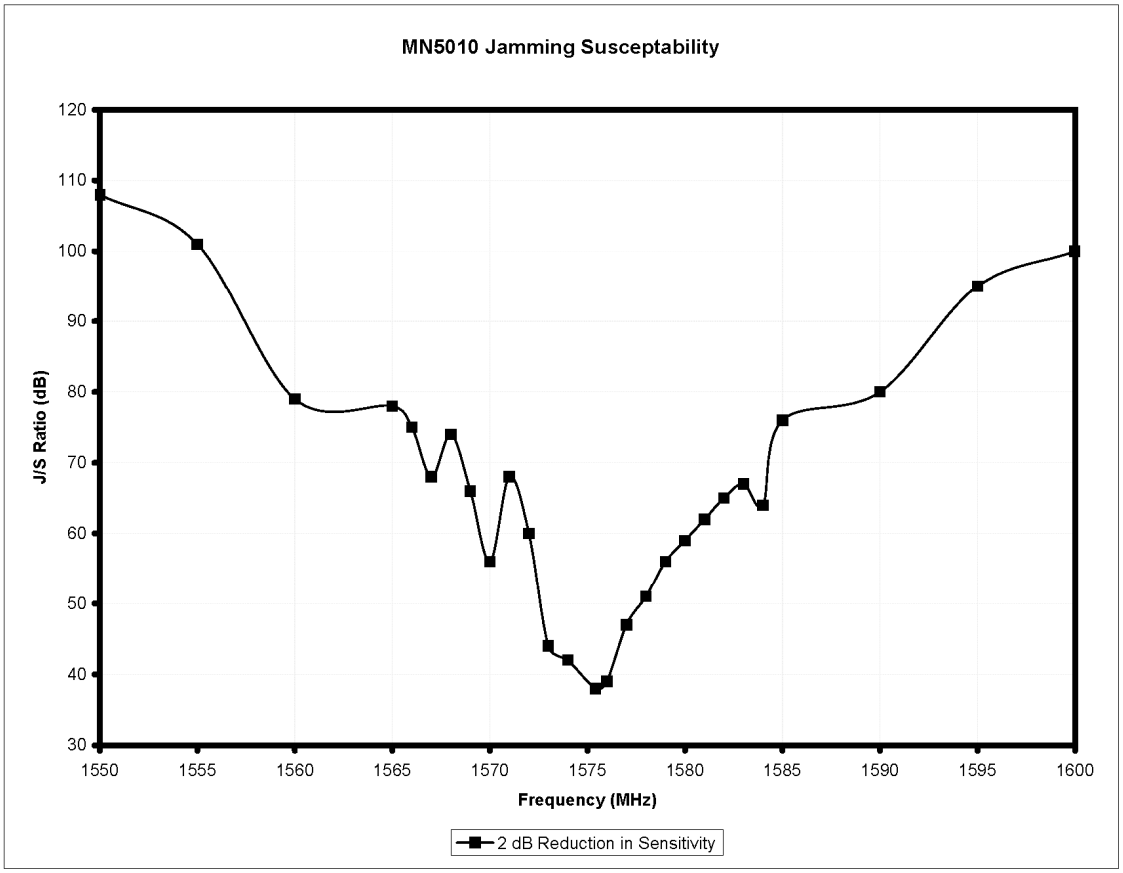



Figure 2 – Jamming Performance

### 3.4 Signal Interface

3.4.1 Digital Interface Levels excluding ON-OFF (pin 22) and nMR (pin 23)

$V_{DD}$ is nominally 1.8 VDC.

| Parameter | Symbol | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| High Level Input Voltage | $V_{IH}$ | 0.75*$V_{DD}$ | | $V_{DD}$ | V |
| Low Level Input Voltage | $V_{IL}$ | 0 | | 0.25* $V_{DD}$ | V |
| Switching Threshold | $V_T$ | | 0.5* $V_{DD}$ | | V |
| High Level Input Current | $I_{IH}$ | -10 | | 10 | uA |
| Low Level Input Current | $I_{IL}$ | -10 | | 10 | uA |
| High Level Output Voltage | $V_{OH}$ | $V_{DD}$-0.2 | | | V |
| Low Level Output Voltage | $V_{OL}$ | | | 0.2 | V |

Table 9 – Digital I/O Interface Levels
Excluding ON-OFF (pin 22) and nMR (pin 23)

3.4.2 Digital Interface Levels for ON-OFF signal (pin 22)

$V_{DD}$ is nominally 1.8 VDC.

| Parameter | Symbol | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| High Level Input Voltage | $V_{IH}$ | $0.8*V_{DD}$ | | $V_{DD}$ | V |
| Low Level Input Voltage | $V_{IL}$ | 0 | | $0.25* V_{DD}$ | V |
| Switching Threshold | $V_T$ | | $0.5* V_{DD}$ | | V |

Table 10 – ON-OFF Signal Digital I/O Interface Levels

3.4.3 Digital Input Signals

The input pins OPT1, OPT2, and RX0 may not be driven high when power is not present on the BATTERY pin, nor may they be driven high when the MN5010HS is in the hibernate state. One way to ensure this is to use the VIO voltage (through 47kΩ resistors) to supply these signals.

VIO cannot be used for power to drive the ON-OFF pin since it supplies no voltage when the MN5010 is in the hibernate state, therefore cannot turn it back on.

3.4.4 Serial Interface

A full-duplex asynchronous serial data port provides data communications to and from the MN5010HS GPS Receiver Module. Please refer to the MN5010HS Design Guidelines for more information.

3.4.5 1PPS Signal

The 1PPS signal is only valid when the receiver is in 3D navigation mode. The 1PPS signal pulses high for 1 microsecond at 1 Hz.

| | |
|---|---|
| 1PPS Signal Accuracy | 200 nanoseconds |
| 1PPS Signal Offset from UTC 1 Second Epoch | 450 nanoseconds, trailing |

Table 11 – 1PPS Signal Characteristics

3.4.6 RESERVED Signal

Pin 4 must be tied to ground. It is recommended to go through a zero Ω resistor.

# 4 Software Interface

## 4.1 NMEA Data Messages

The MN5010HS supports the NMEA-018 v3.0 messages:

| ID | Description | Default interval |
|---|---|---|
| GGA | GPS fix data | 1 sec |
| GLL | Latitude and longitude | N |
| GSA | DOP and active satellites | 1 sec |
| GSV | Satellites in view | 5 sec (Opt 00) |
| RMC | Recommended Minimum GNSS Data | 1 sec |
| VTG | Course over ground and ground speed | 1 sec |
| ZDA | Time and date | N |

Table 12 – NMEA Messages

For detailed information regarding these messages, please refer to the SiRF NMEA Reference Manual.

## 4.2 NMEA Proprietary Commands

The MN5010HS recognizes the following NMEA proprietary commands:

| ID | Description |
|---|---|
| $PSRF100 | Set Serial Port |
| $PSRF101 | XYZ Navigation Initialization |
| $PSRF103 | Query/Rate Control |
| $PSRF104 | LLA Navigation Initialization |
| $PSRF106 | Select Datum |

Table 13 – Proprietary NMEA Commands

For detailed information regarding these messages, please refer to the SiRF NMEA Reference Manual.

## 4.3 SiRF Binary Messages and Commands

For detailed information regarding the SiRF Binary protocol, please refer to the SiRF Binary Protocol Reference Manual.

# 5 Referenced Documents

| |
|---|
| SiRF NMEA Reference Manual |
| SiRF Binary Protocol Reference Manual |
| MN5010HS Design Guidelines |

Table 14 – Referenced Documents

# 6 Packaging and Marking Information

## 6.1 Package Dimensions and Component Marking

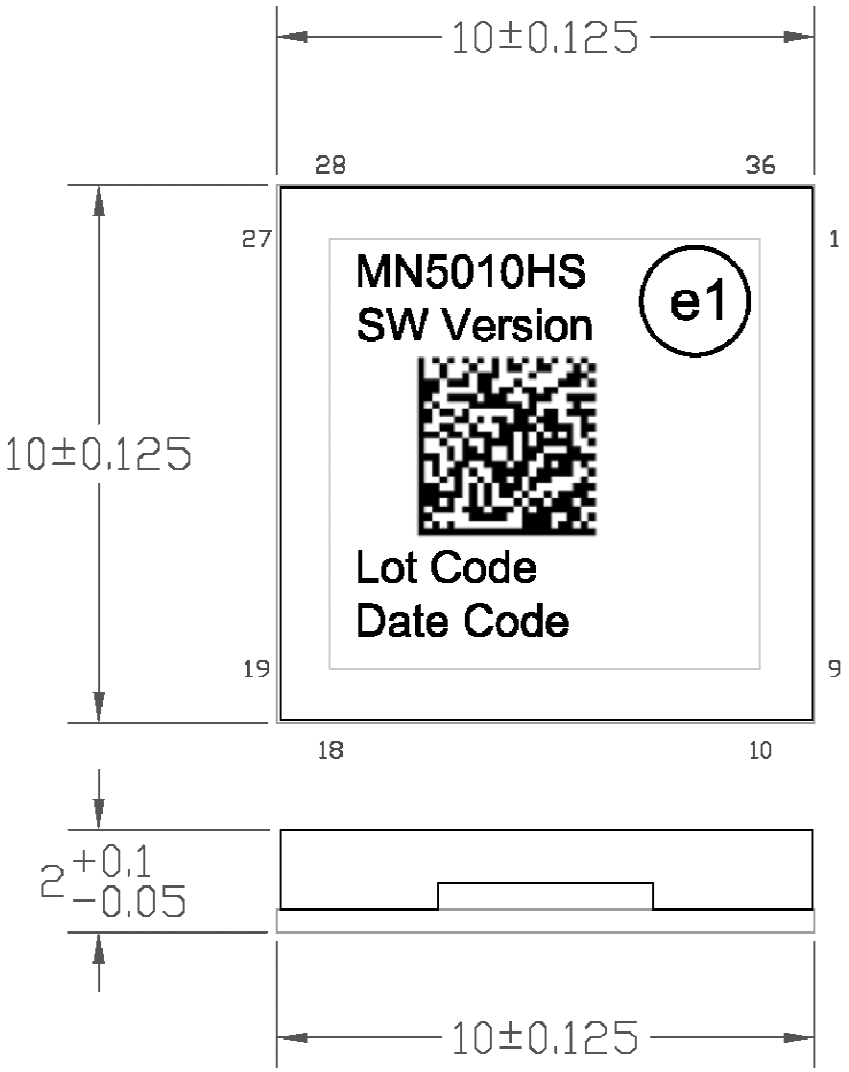



Figure 3 – Package Outline & Marking (in mm) : 36-pin LGA

Note the JEDEC Pb-free symbol is also used as the pin 1 identifier for the MN5010HS.

### 6.1.1 Date Code

The date code is contained in the fourth line of text. The first character shall be a number indicating the last digit of the year of manufacture, starting from 2005 to 2014. The second character shall be an alphanumeric character indicating the month of manufacture (see Table 15 – Date Code: Second Character (month indicator)). The third character shall be an alphanumeric character indicating the day of manufacture (see Table 16 – Date Code: Third Character (day indicator)).

| | | | |
|---|---|---|---|
| 1 = January | 4 = April | 7 = July | A = October |
| 2 = February | 5 = May | 8 = August | B = November |
| 3 = March | 6 = June | 9 = September | C = December |

Table 15 – Date Code: Second Character (month indicator)

| | | | | | |
|---|---|---|---|---|---|
| 1 = 01 | 6 = 06 | B = 11 | G = 16 | M = 21 | T = 26 |
| 2 = 02 | 7 = 07 | C = 12 | H = 17 | N = 22 | U = 27 |
| 3 = 03 | 8 = 08 | D = 13 | J = 18 | P = 23 | W = 28 |
| 4 = 04 | 9 = 09 | E = 14 | K = 19 | Q = 24 | X = 29 |
| 5 = 05 | A = 10 | F = 15 | L = 20 | R = 25 | Y = 30 |
| | | | | | Z = 31 |

Table 16 – Date Code: Third Character (day indicator)

### 6.2 Recommended PCB Footprint

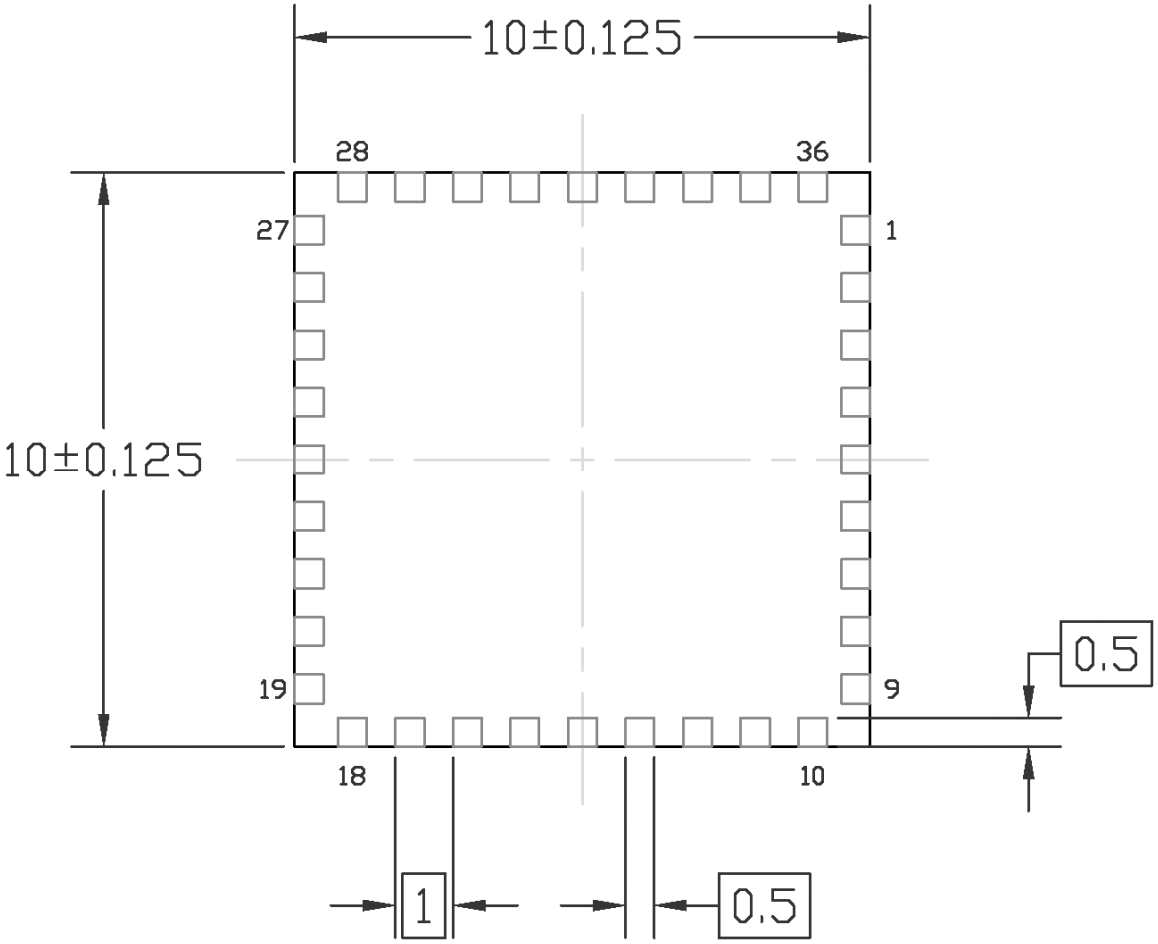
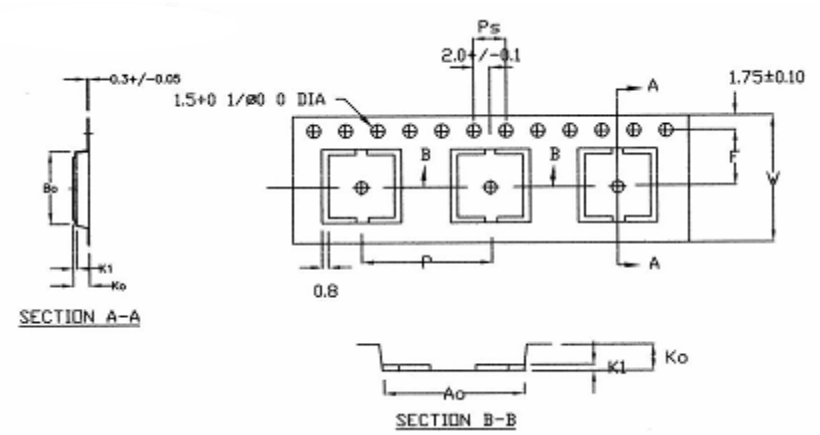



Figure 4 – Recommended PCB Footprint (in mm) – Top View

Figure 4 is a suggested PCB footprint for the MN5010HS. The user may need to adjust the pad dimensions based upon their manufacturing process. While solder mask covered traces are permissible underneath the MN5010HS, exposed vias or pads should be avoided.

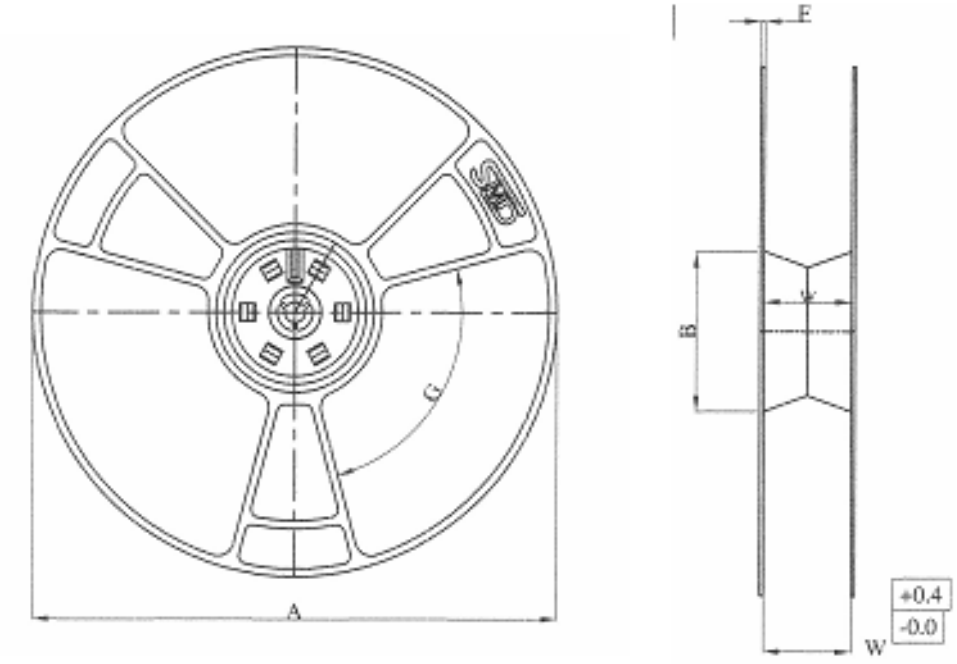
### 6.3 Tape and Reel Information

The MN5010HS is provided in standard tape and reel, with 2K devices per reel.




| Dimensions | W | P | Ao | Bo | Ko | K1 | Ps | F |
|---|---|---|---|---|---|---|---|---|
| Nominal | 24.00 | 16.00 | 10.40 | 10.40 | 1.50 | 0.40 | 4.00 | 11.50 |
| Tolerance | 0.3 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |

Figure 5 – Carrier tape dimensions (in mm)




| Reel Part No. | A | W | B | F | G |
|---|---|---|---|---|---|
| SMD/H4/W24 | 330 | 24.4 | 100 | 2.2 | 90° |

Figure 6 – Reel Dimensions (in mm)

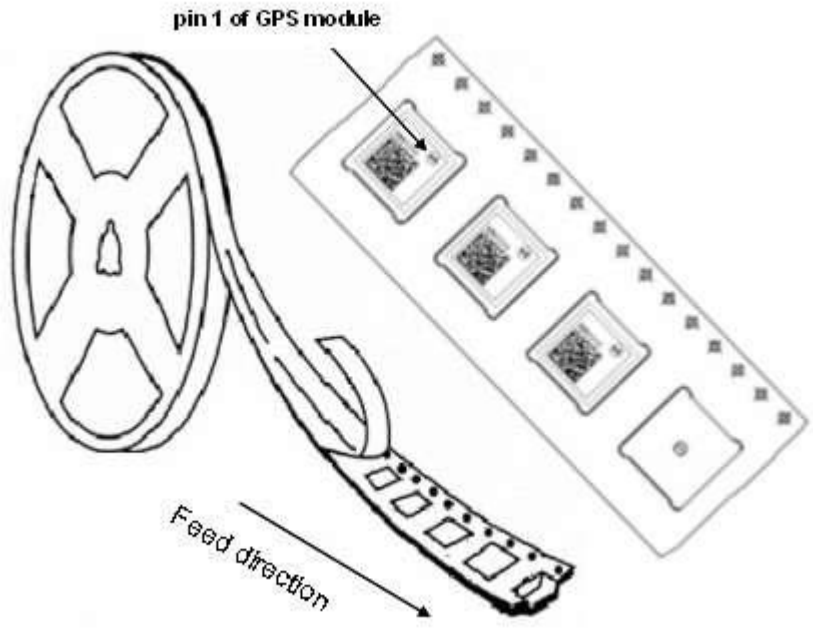



Figure 7 – Orientation in tape

### 6.4 Tube packaging

The MN5010HS is also available in tube form, with 48 devices per tube. The length of the tube is 501mm ± 0.1mm.

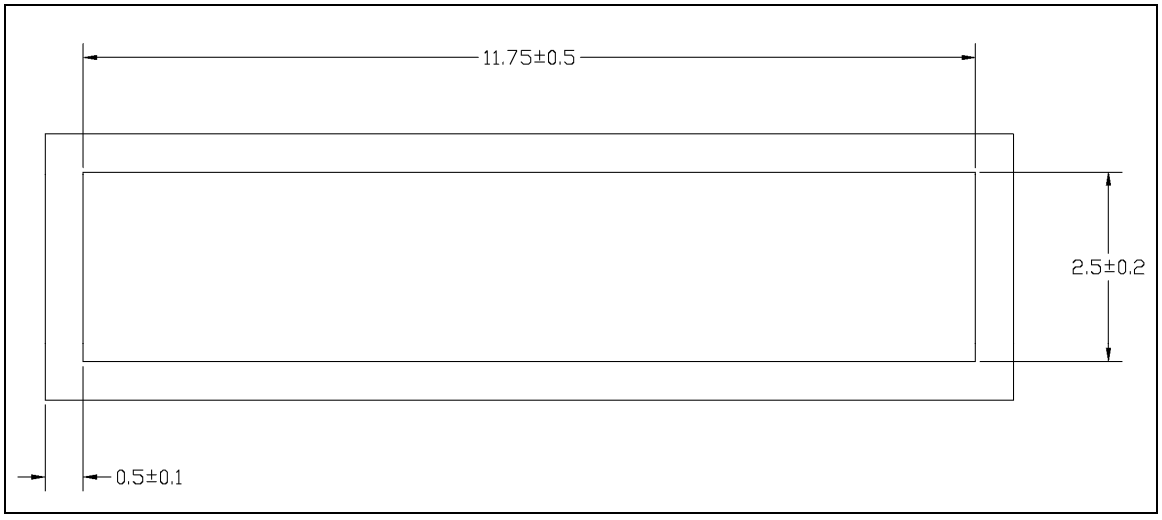



Figure 8 – Tube dimensions (in mm)

### 6.5 Recommended Reflow Profile

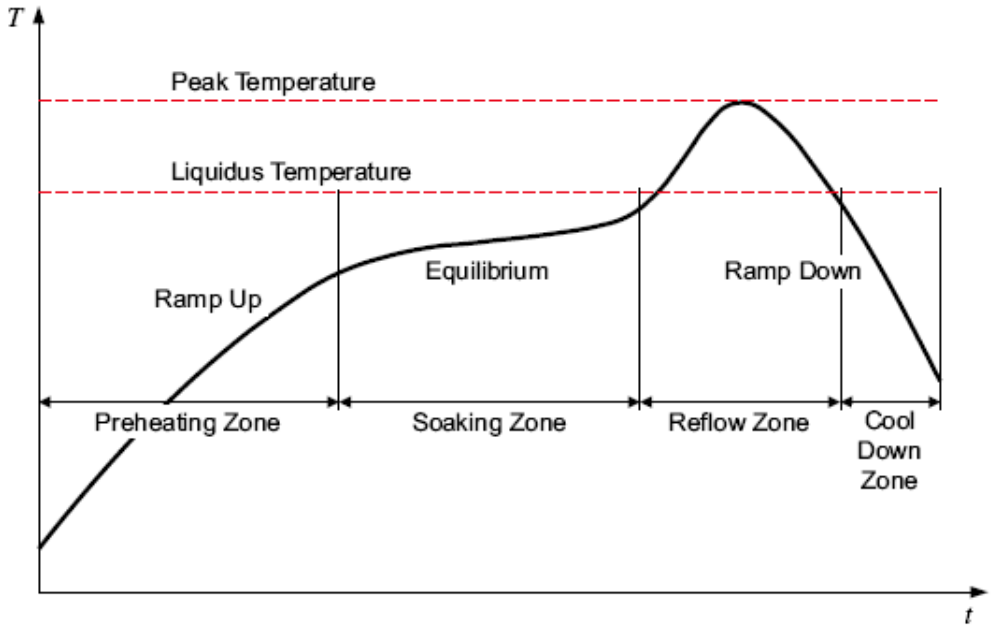



Figure 9 – Reflow Profile

| Reflow Parameter | Specification |
|---|---|
| Preheating Rate | 2.5℃/second |
| Soaking Temperature | 140℃ to 170℃ |
| Soaking Time | 80 seconds |
| Peak Temperature | 260℃ |
| Reflow Time over Liquidus | 60 seconds |
| Cool down Rate | 2.5℃/second |

Table 17 – Reflow Parameters

## 7 Ordering Information

The ordering part numbers are contained in the table below:

| Ordering Part Number | Description |
|---|---|
| MN5010HS-RS | MN5010HS in tape & reel |
| MN5010HS-TS | MN5010HS in tube |

Table 18 – Ordering Information

## 8 Notices

All reference and informational documents (including marketing information, specifications, reference designs, etc.) are provided for information only and are subject to change without notice. Reasonable efforts have been made in the preparation of these documents to assure their accuracy, however Micro Modular Technologies Pte. Ltd. assumes no liability resulting from errors or omissions in this, or any document, or from the use of the information contained herein. Micro Modular Technologies Pte. Ltd. reserves the right to make changes in the product design and specifications as needed and without notification to its users. Please check our website for the most current documentation. All information contained herein is the property of Micro Modular Technologies Pte. Ltd. and may not be copied or reproduced, other than for your information, without prior written consent.

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