

# MN5020HS

## Smart GPS Antenna Module



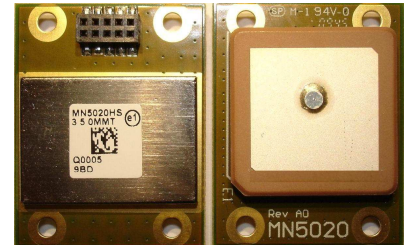
### 1 Description

The Micro Modular Technologies MN5020HS Smart Global Positioning System (GPS) Antenna Module is a complete 20-channel receiver with an integrated 18 x 18 mm patch antenna. With this highly integrated solution, the user needs only provide DC power and ground connections; the MN5020HS will output the navigation solution in the widely-used NMEA-0183 protocol or in SiRF binary protocol. It measures only 21 x 27 x 6 mm, and includes a convenient connector for electrical interface and four holes for easy mounting. The MN5020HS features fast-acquisition hardware, integrated RF filtering, TCXO, reset circuit, and a real-time clock with on-board crystal. It also has improved cold-start acquisition sensitivity of -145dBm.

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 MN5020HS operates from a single battery supply between 3.0 and 3.6 VDC. For even further power reductions, the OEM design may use a power-saving mode via binary commands. An evaluation kit with test software is available to speed development.

### 1.1 Features

- Complete SiRFstarIII-based 20-channel Smart Antenna including integrated 18 x 18 mm patch antenna
- Highly integrated design includes on-board TCXO, RF filtering, Reset circuit, and a Real Time Clock circuit with crystal
- Ultra-small 21 x 27 x 6 mm package
- Cold-start acquisition sensitivity of -145dBm, tracking -159dBm
- Less than 80 mW typical power consumption
- Full industrial temperature operation (-40°C to +85°C)
- Supports SBAS (WAAS, EGNOS, MSAS, GAGAN)
- Standard serial protocols: NMEA-0183 or SiRF binary
- Extended Ephemeris upload capable
- Evaluation Kit available
- Pb free RoHS compliant



### 1.2 Block Diagram

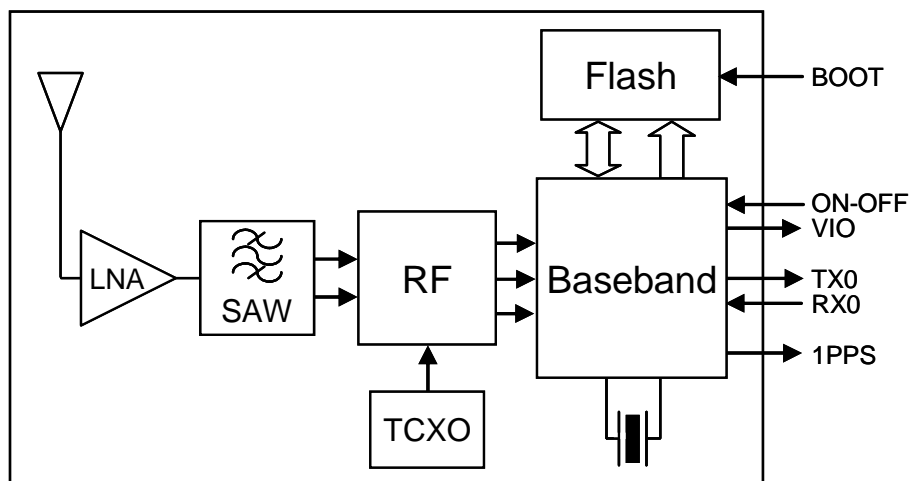


Figure 1 - MN5020HS Block Diagram

# MN5020HS

## Smart GPS Antenna Module



### 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	-40°C to +85°C
Humidity	Up to 95% non-condensing or a wet bulb temperature of +35°C, whichever is less
Altitude	-1000 feet to 60,000 feet

Table 4 – Operating Limits

### 2.2 Storage

Temperature	-40°C to +85°C
Humidity	Up to 95% non-condensing or a wet bulb temperature of +35°C, 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

# MN5020HS

## Smart GPS Antenna Module



### 3 Electrical

#### 3.1 Module Pin Descriptions

Pin	Name	Description
1	TX0	The MN5020HS implements a 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-0183 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.
2	VBACKUP	Backup power supply to the internal RTC and SRAM (+3.0 to +3.6 VDC). VBACKUP must be applied whenever BATT is applied. This pin should be powered continuously to minimize the time required for restarts. If BATT and VBACKUP are both removed, a Factory Start will be performed upon power up.
3	1PPS	One-pulse-per-second (1PPS) output, synchronized when the fix is valid. The pulse duration is 1 $\mu$ s, and its rate is 1 Hz. See section 3.4.3, 1PPS Signal.
4	GND	Ground.
5	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.
6	BOOT	Boot select. If this pin is at logic 0 upon startup or reset, the MN5020HS will begin normal operation. If it is at logic 1, the module will enter the flash reprogramming mode. This pin must be grounded, preferably through a 0 $\Omega$ resistor.
7	GND	Ground.
8	RX0	The MN5020HS implements a full-duplex asynchronous serial UART port. This signal is used to input commands or other information to the receiver in either NMEA-0183 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 MN5020HS, ensure that this pin is not driven to logic 1 when primary power to the MN5020HS is removed or when the MN5020HS is in the Hibernate state.
9	VIO	2.85 V I/O voltage (output). This pin may be used to determine the current state of the module (Off vs. Hibernate). VIO can supply a maximum of 5 mA.
10	BATT	Primary power supply to the module (+3.0 to +3.6 VDC).

Table 6 – MN5020HS Pin-out

# MN5020HS

## Smart GPS Antenna Module



### 3.2 Power Supply

The BATT supply can be switched on and off, but VBCKUP should always be present in order to keep the internal RTC and SRAM alive, even when the receiver is in Hibernate mode. Please refer to the MN5020HS Design Guidelines for more information.

Voltage	3.0 to 3.6 VDC
Current (typical)	26 mA
Current (maximum)	30 mA

Table 7 – Main (BATT) Power Supply

Voltage	3.0 to 3.6 VDC
Current (operating)	1.5 mA
Current (hibernating)	15 uA

Table 8 – Backup (VBCKUP) Power Supply

### 3.3 RF Interface

#### 3.3.1 RF Input

The MN5020HS Smart GPS Antenna Receiver Module accepts a standard GPS L1 C/A signal through the integrated GPS patch antenna. The antenna is connected to an LNA and capable of receiving a signal from up to 20 GPS satellites and converting the satellite data into position and time information that can be read over a serial port. Small size and high-end GPS functionality are combined with low power consumption.

Signal Level	-151 dBm to -125 dBm typical
Frequency	L1 (1575.42 MHz)
Return Loss	Better than -10 dB
Noise Figure	2 dB typical
Impedance	50 Ohms nominal

Table 9 – RF Signal Characteristics

The MN5020HS Smart GPS Antenna Module has a typical noise figure of 2 dB.

#### 3.3.2 Burnout Protection

The internal RF circuit of the MN5020HS Smart GPS Antenna Module can accept signal levels up to -20dBm with a DC voltage of  $\pm 15$ VDC on the RF input pin (LNA) without permanent damage to the module.

# MN5020HS

## Smart GPS Antenna Module



### 3.4 Signal Interface

#### 3.4.1 Digital Interface Levels

$V_{DD}$  is nominally 2.85 VDC.

Parameter	Symbol	Min	Typ	Max	Units
High Level Input Voltage	$V_{IH}$	$0.7 \cdot V_{DD}$		$V_{DD} + 0.3$	V
Low Level Input Voltage	$V_{IL}$	-0.3		$0.3 \cdot V_{DD}$	V
Switching Threshold	$V_T$		$0.5 \cdot V_{DD}$		V
High Level Input Current	$I_{IH}$	-10		10	$\mu A$
Low Level Input Current	$I_{IL}$	-10		10	$\mu A$
High Level Output Voltage	$V_{OH}$	$V_{DD} - 0.2$			V
Low Level Output Voltage	$V_{OL}$			0.2	V

Table 10 – Digital I/O Interface Levels

#### 3.4.2 Serial Interface

A single full-duplex asynchronous serial data port provides data communications to and from the MN5020HS Smart GPS Antenna Module. Please refer to the MN5020HS Design Guidelines for more information.

#### 3.4.3 1PPS Signal

The 1PPS signal output is valid only 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

#### 3.4.4 BOOT Signal

The BOOT pin must be tied to ground for normal operation. It is recommended to go through a zero  $\Omega$  resistor to permit re-programming the flash memory if that should be required in the future.

# MN5020HS

## Smart GPS Antenna Module



### 4 Software Interface

#### 4.1 NMEA Data Messages

The MN5020HS supports the following NMEA-0183 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
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 MN5020HS 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 commands, 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
MN5020HS Design Guidelines

Table 14 – Referenced Documents

# MN5020HS

## Smart GPS Antenna Module



### 6 Packaging and Marking Information

#### 6.1 Component Marking

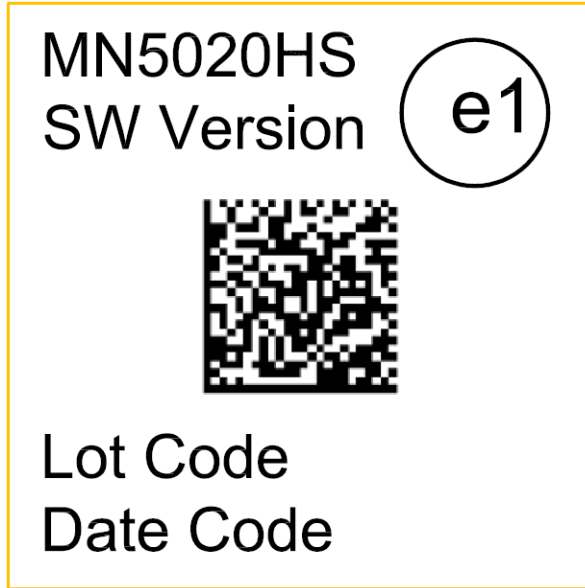


Figure 2 – Component Marking

##### 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)

# MN5020HS

## Smart GPS Antenna Module



### 6.2 Package Dimensions

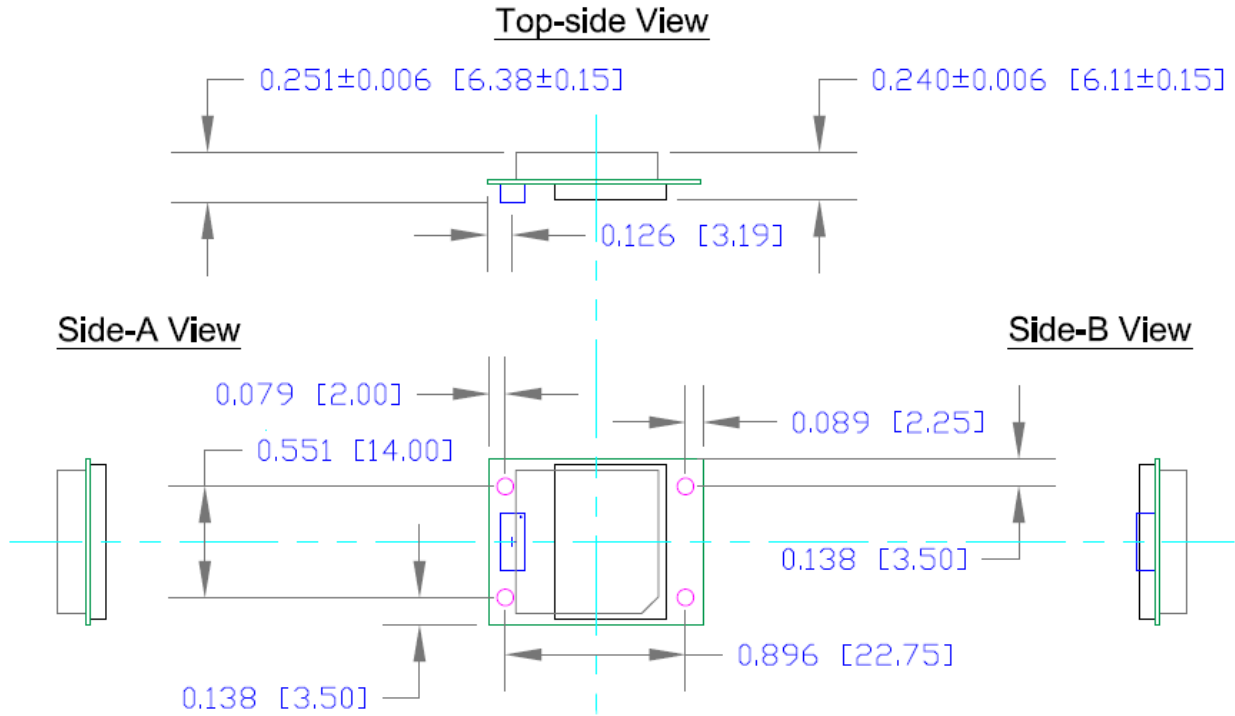


Figure 3 – Package Outline 1/2

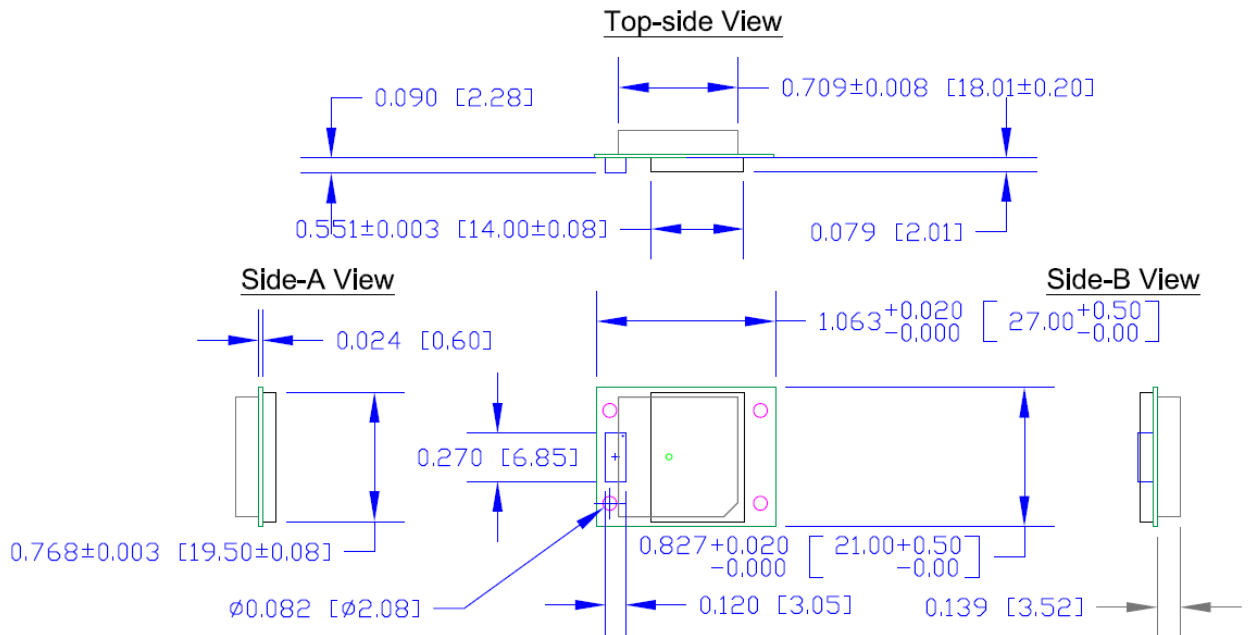


Figure 4 – Package Outline 2/2



# MN5020HS Smart GPS Antenna Module



## 6.3 Connector Pin Identification

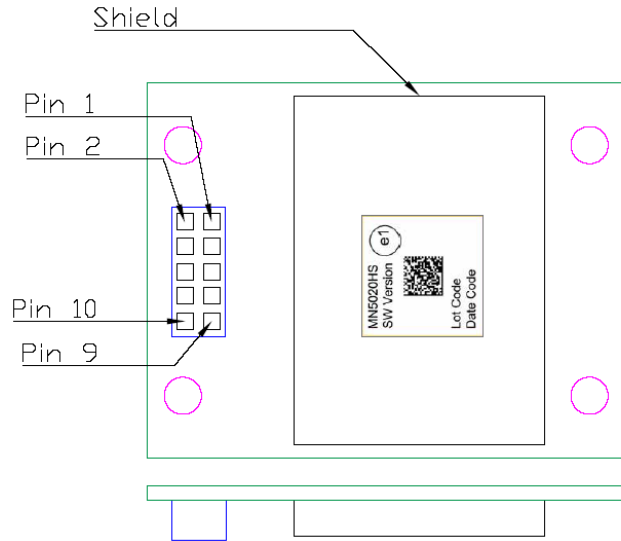


Figure 5 – Pin Identification for Connector – Bottom View

## 6.4 Recommended Connector

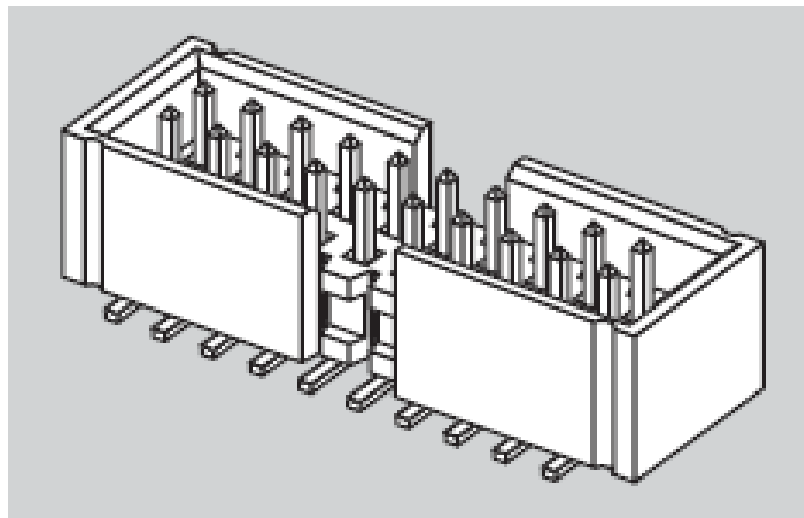


Figure 6 – Recommended Header Connector

Figure 6 shows a suggested header connector for the MN5020HS. The power and I/O connector used on MN5020HS is a 1.27mm(0.05") low profile, double row socket with a height of 2.29mm (0.09") and a total of 10 contacts. Potential counterparts on the motherboard are e.g. Samtec 1.27mm (0.05") micro strips of the FTSH(Figure 6) or FTS series (e.g. FTSH-105-02-F-DV-ES-A-TR or FTS-105-02-L-DV-TR).

# MN5020HS

## Smart GPS Antenna Module



### 7 Ordering Information

The ordering part numbers are contained in the table below:

Ordering Part Number	Description
MN5020HS-BS	MN5020HS in bulk

Table 17 – 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.

### 9 Contact Information

**Email:** [sales@micro-modular.com](mailto:sales@micro-modular.com)

[www.micro-modular.com](http://www.micro-modular.com)

**Asia & Corporate Headquarters**

Tel: (65) 6745 8832

**Americas and Europe**

Tel: (1) 303-482-2842