Functional Specification

MN1010 – 10mm by 10mm GPS Receiver Module

90-00010 Rev. A1

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1 Scope

The specification defines the requirements for the MN1010 GPS Receiver Module from Micro Modular Technologies PTE LTD. This module is a 12 channel continuous tracking receiver optimized for small size, high sensitivity and low cost applications. The GPS signal is applied to the antenna input of the module, and a complete serial data message with position, velocity and time information is presented at the serial interface.

1.1 Referenced Documents

MMT NMEA User Manual for Orion	
MMT NMEA User Manual for ISuite03	
MN1010 reference design with patch antenna	

1.2 General Requirements

The MN1010 GPS Receiver Module shall have the following generic requirements (which are defined in greater detail in the following sections):

- 12-channel GPS receiver with fast acquisition
- 10 by 10 mm LGA package
- Complete GPS receiver including flash memory and TCXO
- Less than 75 mW total power consumption
- Supports active or passive antenna
- Power management for extended battery life
- -40°C to +85°C industrial temperature range
- Surface mountable by standard SMT placement equipment
- ROHS design
- Integral shield for high RF environments
- NMEA and binary serial output
- 8 Megabit of built in flash
- Supported by hardware and software development kits.
- Reference designs available to speed product development.

1.3 Defined Configurations

The MN1010 can be configured with or without an integral TCXO. If the integral TCXO is omitted, then the MN1010 can support four different frequency plans:

- 16.3676 MHz (standard)
- 19.2 MHz (CDMA)
- 13 MHz (GSM)
- 26 MHz (GSM)

When other than the standard reference frequency is used, then the TPI and TPQ lines need to be properly strapped, and suitable software needs to be loaded into flash to allow proper operation.

2 Environmental

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
Vibration	Full performance (see Figure 1)
Maximum Vehicle Dynamics (see note)	500 m/sec (acquisition and navigation)

Table 1 – Operating Requirements

Note: While maximum vehicle dynamics for the receiver is 500 m/sec, the user may wish to optimize the receiver performance by selecting a platform type appropriate to the application. See the section on GPS performance for more details.

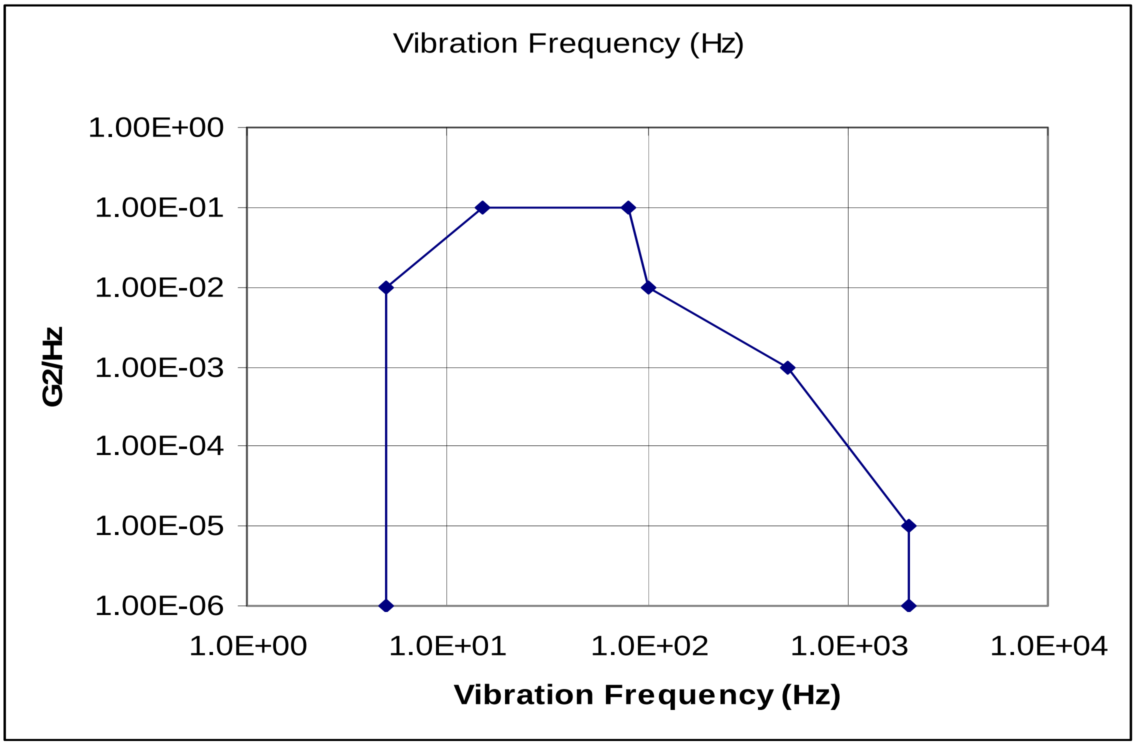

Figure 1 – SAE Composite Vibration Curve

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 2 – Storage Requirements

3 Electrical

3.1 Module Pin-out

Pin Number	Signal Name	Type
1	FREF	Analog [see text]
2	GND	GND
3	+1.8V	Power
4	SERBOOT/SPI2_CS3/GPIO_B22	Digital
5	RX1/GPIO_A2	Digital
6	TX1/GPIO_A3	Digital
7	RX0/GPIO_A0	Digital
8	TX0/GPIO_A1	Digital
9	1PPS	Digital
10	+1.8V	Power
11	GND	GND
12	GPIO_A11/TCAP1	Digital
13	GPIO_A5/PM0	Digital
14	GPIO_A6/PMI	Digital
15	GPIO_A9/TCAP0	Digital
16	GPIO_A4/FCLK	Digital
17	RTC_XIN	Digital
18	RTC_XOUT	Digital
19	GPIO_B19/SPI2_XCS0	Digital
20	SPI2_SD [see text]	Digital [See text]
21	+1.8V	Power
22	GPIO_B16/SPI2_CK	Digital
23	RESET	Digital
24	GND	GND
25	+1.8VVCO	Power
26	+1.8VIF	Power
27	GND	GND
28	+1.8VLNA	Power
29	GND	GND
30	ANT	RF input
31	GND	GND
32	RFEN~/GPIO_B26	Digital
33	+3V	Power
34	+1.8VRF	Power
35	TPI	Analog [see text]
36	TPQ	Analog [see text]

Table 3 – MN1010 Pin-out

3.2 Power Supply

The MN1010 GPS Receiver Module is designed to operate from two supply voltages, the main voltage being 1.8 volts, and a secondary low current supply voltage of 3.0 volts.

The main 1.8 volts supply is fed into several voltage pins of the MN1010 GPS Receiver Module. Suitable decoupling and isolating of the individual power supply pins must be provided by external decoupling circuitry. In addition, optional power control may be added to select power supply pins to further reduce power consumption in standby and/or sleep modes. See the reference design (as indicated in the reference document table) for suggested decoupling values.

Voltage	1.8 VDC ± 0.15 VDC
Current (typical)	35 mA
Current (maximum)	40 mA

Table 4 – Main Power Supply

Voltage	3.0 VDC ± 0.15 VDC
Current (typical)	2 mA
Current (maximum)	3 mA

Table 5 – TCXO Power Supply

3.3 RF Interface

3.3.1 RF Input

The MN1010 GPS Receiver Module accepts a standard L1 signal (as from a passive antenna) on the RF Input pad of the module. 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 MN1010 GPS Receiver Module. The RF input is isolated from DC levels to a maximum of ±15 VDC.

If power is required for an active antenna, MMT recommends that a quarter wave stub be used to prevent disturbing the matching of the antenna and MN1010 module. The other end of the quarter wave stub should be AC grounded with a suitable microwave quality capacitor.

Signal Level	-151 dBm to –125 dBm typical
Frequency	L1 (1575.42 MHz)
Return Loss	Better than –5.5 dB
Noise Figure	7 dB typical
Impedance	50 ohms nominal

Table 6 – RF Signal Characteristics

The MN1010 GPS Receiver Module has a noise figure of 7 dB typically. With high quality high gain passive antennas this will provide adequate performance in low cost environments. Using an external LNA of 2 dB NF and approximately 15 dB of gain will improve the performance of the receiver to work with a wider range of passive antennas.

3.3.2 Burnout Protection

The MN1010 GPS Receiver Module can accept signal levels up to –20dBm with a DC voltage of ±15VDC on the RF input pin without permanent damage to the module.

3.3.3 Jamming Performance

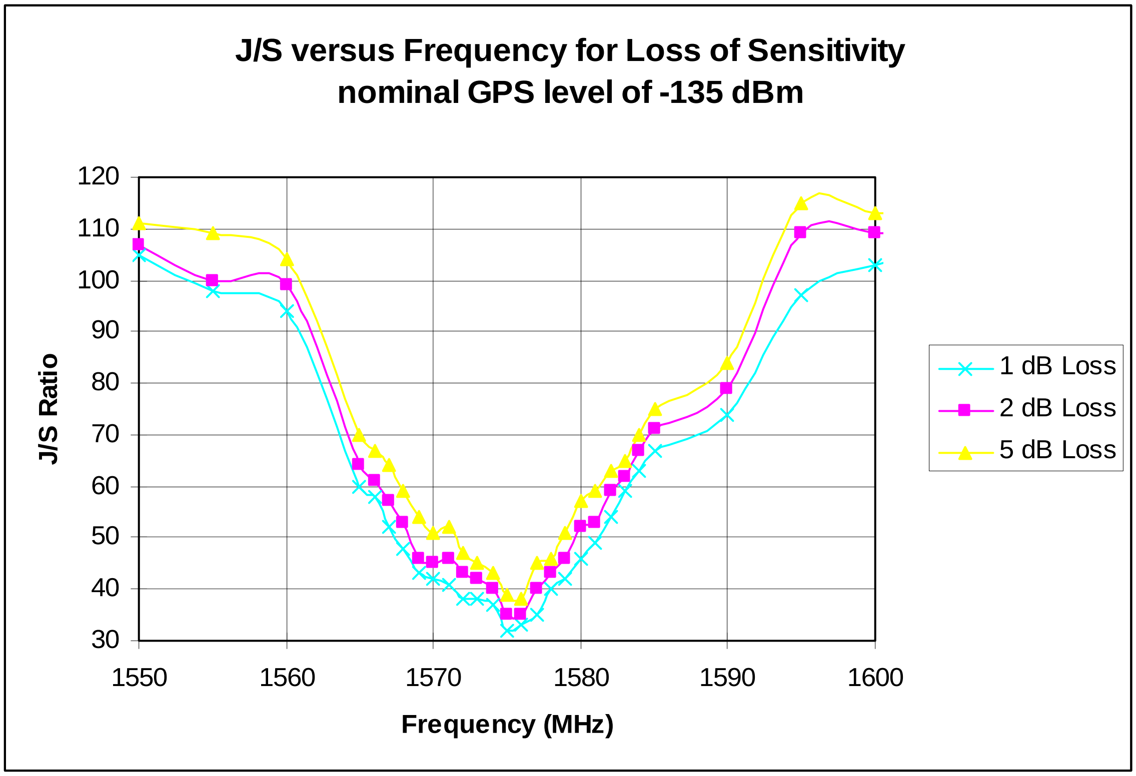

Figure 2 – Jamming Performance

3.4 Signal Interface

3.4.1 Digital Signal Interface Levels

Vdd is nominally 1.8 Vdc.

VIH(min)	0.7 x Vdd
VIH(max)	Vdd + 0.3 Vdc
VIL(min)	-0.3 Vdc
VIL(max)	0.3 x Vdd
VOH(min)	0.8 * Vdd
VOH(max)	Vdd
VOL(min)	0 Vdc
VOL(max)	0.22 * Vdd

Table 7 – Digital I/O Interface Levels

3.4.2 Serial Interface

Two serial data ports carry out main data communications into and out of the MN1010 GPS Receiver Module.

3.4.2.1 Supported bit rates

The MN1010 default bit rate depends upon the software loaded into flash. However, the user can change the default bit rate to any value from 4800 bps to 115kbps. During firmware reprogramming, the serial port defaults to 9600 bps upon reset if SERBOOT is pulled to logic zero.

3.4.2.2 Supported data formats

The MN1010 operates at 8 data bits only with a single stop bit.

3.4.3 Digital Signal Pin-out

The standard software loads only make use of the following digital signal lines.

Pin	Signal	MN1010
4	SERBOOT/SPI2_CS3/GPIO_B22	SERBOOT
7	RX0/GPIO_A0	RX0
8	TX0/GPIO_A1	TX0
5	RX1/GPIO_A2	RX1
6	TX1/GPIO_A3	TX1
9	1PPS/GPIO_A7	–
12	GPIO_A11/TCAP1/RTC_INT2	RTC_INT2
13	GPIO_A5/PM0/RTC_SCL	RTC_SCL
14	GPIO_A6/PM1	–
15	GPIO_A9/TCAP0	–
16	GPIO_A4/FCLK/RTC_SDA	RTC_SDA
17	RTC_XIN	XTAL/RTC_INT1
18	RTC_XOUT	XTAL/NC
19	GPIO_B19/SPI2_XCS0	–
20	SPI2_SD/VALID_FIX	VALID_FIX
22	GPIO_B16/SPI2_CK	–
23	RESET	RESET
32	RFEN~	RFEN~

Table 8 – Standard Digital Signal Assignments

3.4.3.1 Pin 4: SERBOOT/SPI2_CS3/GPIO_B22

SERBOOT is a digital input. If SERBOOT is logic 1, then the MN1010 will start executing code from on board flash upon system reset. If SERBOOT is logic 0, then the MN1010 will enter boot mode upon system reset to receive programming information in LOD format. This feature can be used to download a flash re-programmer into on board RAM to update or change flash code. The sense of the SERBOOT line is only read upon power up or system reset. Refer to section 5.1 for further information.

If SPI port 2 is used, this pin also functions as an additional chip select. However, this pin must be maintained in the proper state (high to execute code from flash, low to enter serial boot mode) during power up.

This pin is available for general purpose input or output when using customized firmware. However, this pin must be maintained in the proper state (high to execute code from flash, low to enter serial boot mode) during power up.

3.4.3.2 Pin 7: RX0/GPIO_A0

The MN1010 GPS Receiver Module implements two full duplex asynchronous serial UART ports. This signal is the input for the first UART and is normally used to input commands to the receiver in either binary or NMEA format depending upon the configuration of the receiver.

As a second function, if SERBOOT is held to logic 0, then RX0 receives LOD formatted programming information after power up.

In the idle condition, this pin is at logic 1.

This pin is available for general purpose input or output when using customized firmware.

3.4.3.3 Pin 8: TX0/GPIO_A1

The MN1010 GPS Receiver Module implements two full duplex asynchronous serial UART ports. This signal is the output for the first UART and is normally used to output position, time and velocity information from the receiver in either binary or NMEA format depending upon the configuration of the receiver.

In the idle condition, this pin is at logic 1.

This pin is available for general purpose input or output when using customized firmware.

3.4.3.4 Pin 5: RX1/GPIO_A2

The MN1010 GPS Receiver Module implements two full duplex asynchronous serial UART ports. This signal is the input for the second UART and is normally used to input additional information to the receiver, such as aiding data or DGPS data.

In the idle condition, this pin is at logic 1.

This pin is available for general purpose input or output when using customized firmware.

3.4.3.5 Pin 6: TX1/GPIO_A3

The MN1010 GPS Receiver Module implements two full duplex asynchronous serial UART ports. This signal is the output for the second UART.

In the idle condition, this pin is at logic 1.

This pin is available for general purpose input or output when using customized firmware.

3.4.3.6 Pin 9: 1PPS/GPIO_A7

The 1PPS signal is a one-pulse-per-second (1PPS) signal. Whenever the receiver provides a valid navigation solution, the rising edge of each 1PPS pulse is synchronized with the UTC one-second epochs to within 1000 nanoseconds.

The current Orion software loads do not support 1PPS, so this pin is not used.

This pin is available for general purpose input or output when using customized firmware.

3.4.3.7 Pin 12: GPIO_A11/TCAP1/RTC_INT2

This pin is available for general purpose input or output when using customized firmware. The standard firmware does not use this pin. In this condition it is programmed as an input with an internal pull-up resistor. If not used, this pin should be left open.

If an external RTC IC is used (Seiko S-35390A) this pin is connected to the INT2 line of the RTC IC.

3.4.3.8 Pin 13: GPIO_A5/PM0/RTC_SCL

This pin is available for general purpose input or output or as an input to the pulse measuring circuit 0 when using customized firmware. The standard firmware does not use this pin. In this condition it is programmed as an input with an internal pull-up resistor. If not used, this pin should be left open.

If an external RTC IC is used (Seiko S-35390A) this pin is connected to the SCL line of the RTC IC.

3.4.3.9 Pin 14: GPIO_A6/PM1

This pin is available for general purpose input or output or as an input to the pulse measuring circuit 1 when using customized firmware. The standard firmware does not use this pin. In this condition it is programmed as an input with an internal pull-up resistor. If not used, this pin should be left open.

3.4.3.10 Pin 15: GPIO_A9/TCAP0

This pin is available for general purpose input or output when using customized firmware. The standard firmware does not use this pin. In this condition it is programmed as an input with an internal pull-up resistor. If not used, this pin should be left open.

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3.4.3.11 Pin 16: GPIO_A4/FCLK/RTC_SDA

This pin is available for general purpose input or output when using customized firmware. The standard firmware does not use this pin. In this condition it is programmed as an input with an internal pull-up resistor. If not used, this pin should be left open.

If an external RTC IC is used (Seiko S-35390A) this pin is connected to the SDA line of the RTC IC.

3.4.3.12 Pin 17: RTC IN/RTC_INT1

The MN1010 provides for an optional RTC clock crystal to maintain time of day when the MN1010 is in a power sleep condition. If the hot start mode of operation is not required, then the real time clock may not be needed. If so, the crystal can be eliminated. See section 8 for additional information on the RTC crystal and recommended capacitors.

Connect this pin to one side of a 32.768 KHz clock crystal and a shunt capacitor returned to the 1.8 volt DC supply. See section 8 for additional information on the RTC crystal and recommended capacitors.

If an external clock signal is available, it may be presented at this pin. The logic levels must match the logic levels of the MN1010.

If an external RTC IC is used (Seiko S-35390A) this pin is connected to the INT1 line of the RTC IC.

3.4.3.13 Pin 18: RTC OUT

The MN1010 provides for an optional RTC clock crystal to maintain time of day when the MN1010 is in a power sleep condition. If the hot start mode of operation is not required, then the real time clock may not be needed. If so, the crystal can be eliminated. See section 8 for additional information on the RTC crystal and recommended capacitors.

Connect this pin to one side of a 32.768 KHz clock crystal and a shunt capacitor returned to the 1.8 volt DC supply. See section 8 for additional information on the RTC crystal and recommended capacitors.

If an external clock signal is applied to the RTC IN pin, then this pin should be left open.

3.4.3.14 Pin 19: GPIO_B19/SPI2_XCS0

This pin is available for general purpose input or output or as SPI port 2 chip select 0 when using customized firmware. The standard firmware does not use this pin. In this condition it is programmed as an input with an internal pull-up resistor. If not used, this pin should be left open.

3.4.3.15 Pin 20: SPI2_SD/VALID_FIX

This pin is used as for bi-directional data of the SPI 2 interface. Internally, this pin consists of both GPIO_B17 and GPIO_B18 signals tied together. If the SPI 2 port is not used, then this signal should be left open and both GPIO_B17 and GPIO_B18 programmed as inputs.

For current software loads, GPIO_B17 is used to indicate that the receiver has acquired a valid fix by asserting this pin.

3.4.3.16 Pin 22: GPIO_B16/SPI2_CK

This pin is available for general purpose input or output or as SPI port 2 clock when using customized firmware. The standard firmware does not use this pin. In this condition it is programmed as an input with an internal pull-up resistor. If not used, this pin should be left open.

3.4.3.17 Pin 23: Reset

To properly initialize the MN1010, a reset pulse must be supplied whenever the power supply is cycled. In addition, to prevent inadvertent damage to the on board flash, the reset line should be pulled low whenever the 1.8 volt power supply falls out of tolerance, such as during a powering up or powering down of the host platform.

The reset line should be held in the reset (logic low) state until 10 milliseconds after the 1.8 volt and 3.0 volt power supplies have stabilized within proper tolerance.

3.4.3.18 Pin 32: RFEN~

RFEN~ is a digital output providing optional power control to the on-board TCXO. This signal would be used to drive a FET or other suitable device to apply power to the +3V power pin. A logic zero would disable the +3V supply, whereas a logic one would enable the supply. If control of the power supply for the on-board TCXO is not required, this pin should be left unconnected. During power up or processor reset, this pin is actively driven low

3.4.4 Analog Signal Pinout

3.4.4.1 Pin 1: FREF

This signal is connected directly to the output of the internal TCXO through an internal DC blocking capacitor. During factory test, this pin can be monitored through a high impedance AC coupled probe to check the on board TCXO.

If the on board TCXO is deleted, then an external TCXO can be connected through a DC blocking capacitor to this pin. The frequency stability requirements of the external TCXO are going to be determined by the software chosen, but the signal amplitude should be around 1 volt peak to peak with either a sinewave or clipped sinewave format. The MN1010 will present a load of around 10Kohms on this pin.

3.4.4.2 Pin 35: TPI

This signal is used for factory test. This pin must be tied to ground through a 10Kohm resistor to support the internal TCXO. If an external TCXO is used, this pin must be strapped to either ground or +1.8V through a 10Kohm resistor based upon Table 9.

Note the standard software loads available for the MN1010 all are designed to work with the 16.3676 MHz frequency plan only. To use any of the other frequency plans requires software customization

TPI	TPQ	Frequency Plan
0	0	16.3676 MHz (standard)
0	1	13 MHz (GSM)
1	0	26 MHz (GMS)
1	1	19.2 MHz (CDMA mode)

Table 9 – Frequency Plans

3.4.4.3 Pin 36: TPQ

This signal is used for factory test. This pin must be tied to ground through a 10Kohm resistor to support the TCXO. If an external TCXO is used, this pin must be strapped to either ground or +1.8V through a 10Kohm resistor based upon Table 9.

Note the standard software available for the MN1010 all are designed to work with the 16.3676 MHz frequency plan only. To use any of the other frequency plans requires software customization.

4 GPS Performance

4.1 General Information

The Micro Modular Technologies GPS Receiver Module is a complete 12-channel GPS receiver in a 10 by 10 mm LGA package. The receiver tracks GPS satellites at the L1 frequency (1.575GHz) and computes position, time and velocity.

The open architecture of the receiver allows for multiple software platforms: general navigation, assisted GPS, assisted GPS with push to fix. The OEM can select the software platform ideally suited for the intended application. The receiver incorporates the complexity of the RF and microwave signal chain into the module, so the user only need be concerned with routing the antenna signal into the module. All the other interfaces are ground, power or low speed digital signals.

The module is packaged as a land grid array (LGA) placeable onto a printed circuit board using standard surface mount manufacturing techniques. The module is manufacture using a ROHS process to meet stringent environmental requirements. The metal shield serves as both an RF shield for the receiver as well as a pickup surface for the SMT placement equipment.

The module contains a low noise amplifier for passive antenna operation, RF downconverter, baseband processor and all memory needed to compute the GPS solution. Three Mbits of space is available in the memory to allow OEM applications to share the processor.

4.2 Absolute Performance Limits

Acquisition Time	Specification
Cold start TTFF (no time, no position, no ephemeris)	42 seconds (95% confidence)
Hot start TTFF (time, position and ephemeris)	8 seconds (95% confidence)
Fast Start TTFF	<4 seconds
Reacquisition	2 seconds (95% confidence)

Table 10 – Acquisition Performance

Positional Error	Accuracy
CEP (50%)	<3.0 meters

Table 11 – Positional Accuracy

With 2 dB NF external LNA

Sensitivity	Typical
Tracking	-152 dBm
Acquisition (Cold Start)	-142 dBm

Table 12 – Sensitivity

5 Software Interface

5.1 Programming the on board flash

The on board flash device can be reprogrammed to update the firmware on the MN1010, or to replace the firmware with a customized version. The SERBOOT line, which is normally held in logic 1 state, is pulled to logic 0 and the power cycled or a reset issued.

The typical procedure for re-flashing the MN1010 is to use the MMT supplied utility to verify proper connection to the device, then download a RAM based flash utility, which upon startup will change the bit rate to a much higher speed, download the flash and then verify the flash.

Serial port 0 will issue a hexadecimal $55 (ASCII upper case U) at 9600 bps. MMT will supply a flash programming utility that runs on a standard PC compatible machine running the Windows operating system. The procedure for reprogramming the flash consists of the following steps:

1. Pull SERBOOT line low.
2. Reset the MN1010 by power cycling or sending a reset signal.
3. Detect the hexadecimal $55.
4. Using the MMT flash utility, download the flash loader program into on-board RAM.
5. Using the MMT flash utility, erase the on-board flash.
6. Using the MMT flash utility, download the new firmware image and program into the on board flash.
7. Pull SERBOOT line high.
8. Reset the MN1010 by power cycling or sending a reset signal.
9. If flash is programmed correctly, the MN1010 will respond as appropriate to the new software.

5.2 NMEA Data Messages

The MN1010 supports the NMEA 018 v3.0 standard message structure.

Message ID	**Description**
GGA	GPS fix data
GSA	DOP and active satellites
GSV	Satellites in view
RMC	Recommended Minimum specific GNSS Data
VTG	Course over ground and ground speed
ZDA	Time and date

Table 13 – NMEA Messages

5.2.1 GGA

This message contains the position, time and quality of position of the solution generated by the MN1010.

`$GPGGA,224710.32,3339.11238,N,11742.98771,W,1,10,1.0,104.3,M,-32.0,M,,*55`

Name	Description	Type	Example
Msg ID	GGA Header		$GPGGA
Time	UTC Time	hh.mmss.ss	224710
Lat	Latitude	ddmm.mmmm	3339.11238
N/S	Direction (North or South)		N
Lon	Longitude	dddmm.mmmm	11742.98771
E/W	Direction (East or West)		W
Fix Indicator	0 – no fix, 1 – fix valid		1
Sats used	Number of satellites in solution		10
HDOP	Horizontal Dilution of Precision		1.0
MSLAlt	Altitude of position with respect to Mean Sea Level		104.3
UnitsAlt	Units of altitude		M
GeoSep	Geoidal separation		-32.0
UnitsGeoSep	Units of geoidal separation		M
AgeDGPS	DGPS age (not supported)		<null>
StaId	DGPS reference station ID (not supported)		<null>
ChkSum	Checksum		*55
EOL	NMEA end of line <CR> <LF>		

Table 14 – GGA Message Fields

5.2.2 GSA

This message contains the mode of operation, type of fix, PRNs of the satellites used in the solution as well as PDOP, HDOP and VDOP.

`$GPGSA,A,3,15,22,18,21,03,14,09,19,16,26,,,1.5,1.0,1.2*3E`

Name	**Description**	**Type**	**Example**
Msg ID	GSA Header		$GPGSA
OpMode	A = Auto M = Forced into either 2D or 3D		A
FixType	1 = no fix 2 = 2D fix 3 = 3D fix		3
SatPrn	SV on channel 1		15
…	…		22
SatPrn	SV on channel 12		<null>
PDOP	Position Dilution of Precision		1.5
HDOP	Horizontal Dilution of Precision		1
VDOP	Vertical Dilution of Precision		1.2
ChkSum	Checksum		*3E
EOL	NMEA end of line <CR> <LF>		

Table 15 – GSA Message Fields

5.2.3 GSV

This message contains the PRNs, azimuth and elevation of all satellites in view by the MN1010.

```
$GPGSV,3,1,10,03,37,299,47,09,15,094,41,14,34,193,49,15,68,031,52*72
$GPGSV,3,2,10,16,07,242,42,18,58,025,50,19,08,322,40,21,53,086,52*76
$GPGSV,3,3,10,22,62,292,50,26,06,035,37*70
```

Name	Description	Type	Example
Msg ID	GSV Header		$GPGSV
NumMsgs	Number of message to report all satellites		3
MsgNum	Which message of the total		1
NumSatView	Number of satellites in view		10
SatPrn	SV on channel 1, 5 or 9		03
Elevation	Elevation		37
Azimuth	Azimuth		299
C/No	C/No of satellite		47
SatPrn	SV on channel 2, 6 or 10		09
Elevation	Elevation		15
Azimuth	Azimuth		094
C/No	C/No of satellite		41
SatPrn	SV on channel 3, 7 or 11		14
Elevation	Elevation		34
Azimuth	Azimuth		193
C/No	C/No of satellite		49
SatPrn	SV on channel 4, 8 or 12		15
Elevation	Elevation		68
Azimuth	Azimuth		031
C/No	C/No of satellite		52
ChkSum	Checksum		*72
EOL	NMEA end of line <CR> <LF>		

Table 16 – GSV Message Fields

5.2.4 RMC

This message contains the recommended minimum information provided by the MN1010.

`$GPRMC,224710.32,A,3339.11238,N,11742.98771,W,00.1,000.0,070306,,,A*7E`

Name	**Description**	**Type**	**Example**
Msg ID	RMC Header		$GPRMC
Time	UTC Time	hh.mmss.ss	224710.32
Status	A = data valid, V = data not valid		A
Lat	Latitude	ddmm.mmmm	3339.11238
N/S	Direction (North or South)		N
Lon	Longitude	dddmm.mmmm	11742.98771
E/W	Direction (East or West)		W
Velocity			00.1
Heading			000.0
Date		Ddmmyy	070306
MagVar	Magnetic Variation		<null>
E/W	Magnetic Variation Direction		<null>
Mode	A = Autonomous		A
ChkSum	Checksum		*7E
EOL	NMEA end of line <CR> <LF>		

Table 17 – RMC Message Fields

5.2.5 VTG

This message contains the position, time and quality of position of the solution generated by the MN1010.

```
$GPVTG,000.0,T,,M,00.1,N,00.1,K,A*0D
```

Name	Description	Type	Example
Msg ID	VTG Header		$GPVTG
Course			000.0
Reference	T = True		T
Course			<null>
Reference	M = Magnetic		M
Speed			00.1
Units	N = Nautical Miles per Hour		N
Speed			00.1
Units	K = KPH		K
Mode	A = Automous		A
ChkSum	Checksum		*0D
EOL	NMEA end of line <CR> <LF>		

Table 18 – VTG Message Fields

5.2.6 ZDA

This message contains date and time information in the local time zone and is generated by the MN1010.

`$GPZDA,231725.05,07,03,2006,+00,00,,*48`

Name	Description	Type	Example
Msg ID	ZDA Header		$GPZDA
UTC Time			231725.05
Day			07
Month			03
Year			2006
Local Zone Hour			+00
Local Zone Minute			00
			<null>
ChkSum	Checksum		*48
EOL	NMEA end of line <CR> <LF>		

Table 19 – ZDA Message Fields

6 EMI/EMC

6.1 EMI Requirements

As the MN1010 is a component used on a circuit board assembly, it is not required nor is it specified to comply with EMI or EMC regulations.

6.2 Receiver Frequency Plan

The MN1010 implements a single down-conversion quadrature IF receiver which then is fed into the digital baseband processor.

6.2.1 The TCXO frequency is 16.3676 MHz.

6.2.2 The local oscillator frequency is 1573.874 MHz.

6.2.3 The IF frequency is 1.54604 MHz.

6.2.4 Baseband Processor Clock Frequency is 16.3676 MHz.

7 Power Supply Decoupling and Switching

Each power supply pin should by bypassed with a good quality RF ceramic capacitor resonant around 1.5 GHz. In addition, the RF and LNA supplies should use ferrite bead suppression of better than 100 ohms to the main 1.8 volts supply. In addition to the RF grounding, each supply pin should use a 0.01uF capacitor to handle lower frequency noise on the supply lines.

If a switching power supply is used, it is important that the peak to peak switching noise be kept below 50 mV peak to peak. As the switching frequency gets closer to the IF frequency, the switching noise will have to be further reduced to eliminate interference.

8 RTC Crystal Specification

8.1 Electrical

Frequency	32.768 KHz
Type	Tuning fork crystal
Load capacitance	Either 7 pf or 12 pf (see next section)
Shunt capacitors	The series combination of the input and output shunt capacitor must equal the load capacitance for the selected RTC crystal. When calculating the capacitor values, it is important to consider the 3 pf per pin capacitance of the MN1010 device. The other end of the shunt capacitors must be tied for the +1.8 volt power supply to ensure proper RTC startup.

Table 20 – RTC Crystal Specs

9 Packaging and Marking Information

9.1.1 Component Marking

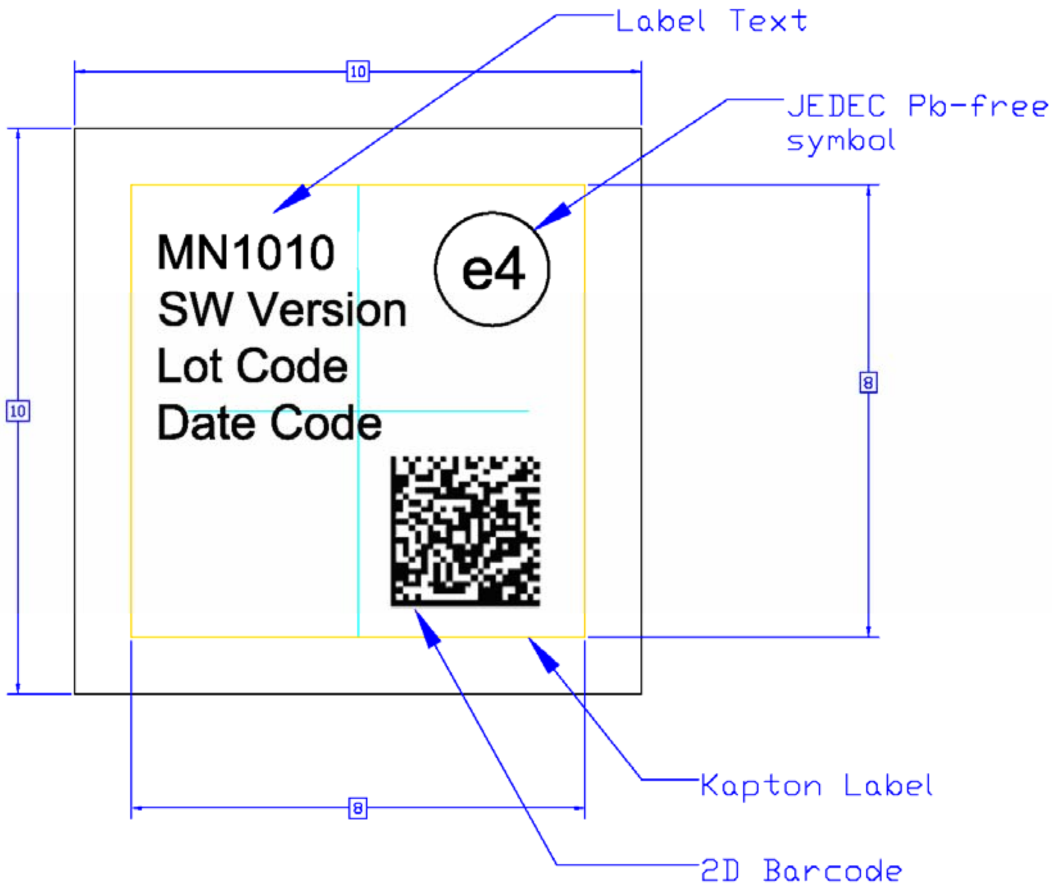

Figure 3 – Marking

Note the JEDEC Pb-free symbol is also used as the pin 1 identifier for the MN1010.

9.1.2 Label is white with black printing.

9.1.3 Label is approximately centered on lid.

9.1.4 JEDEC symbol is used as the pin 1 locator.

9.1.5 The device part number is contained in the first line of text.

9.1.6 The software version is contained in the second line of text.

9.1.7 The lot code is contained in the third line of text.

9.1.8 The date code is contained in the fourth line of text.

9.1.8.1 The first character shall be a number indicating the last digit of the year of manufacture, starting from 2005 to 2014.

9.1.8.2 The second character shall be an alphanumeric character indicating the month of manufacture according to the table:

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

9.1.8.3 The third character shall be an alphanumeric character indicating the day of manufacture according to the table.

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

9.1.9 The lot code is contained in the fourth line of text.

9.1.10 Data Matrix bar code to consist of 9 alphanumeric characters.

9.1.10.1 The first character (left most) in the bar code shall be the letter Z.

9.1.10.2 The next three characters are the date code.

9.1.10.3 The next five characters are the lot code.

9.2 Packaging Drawing

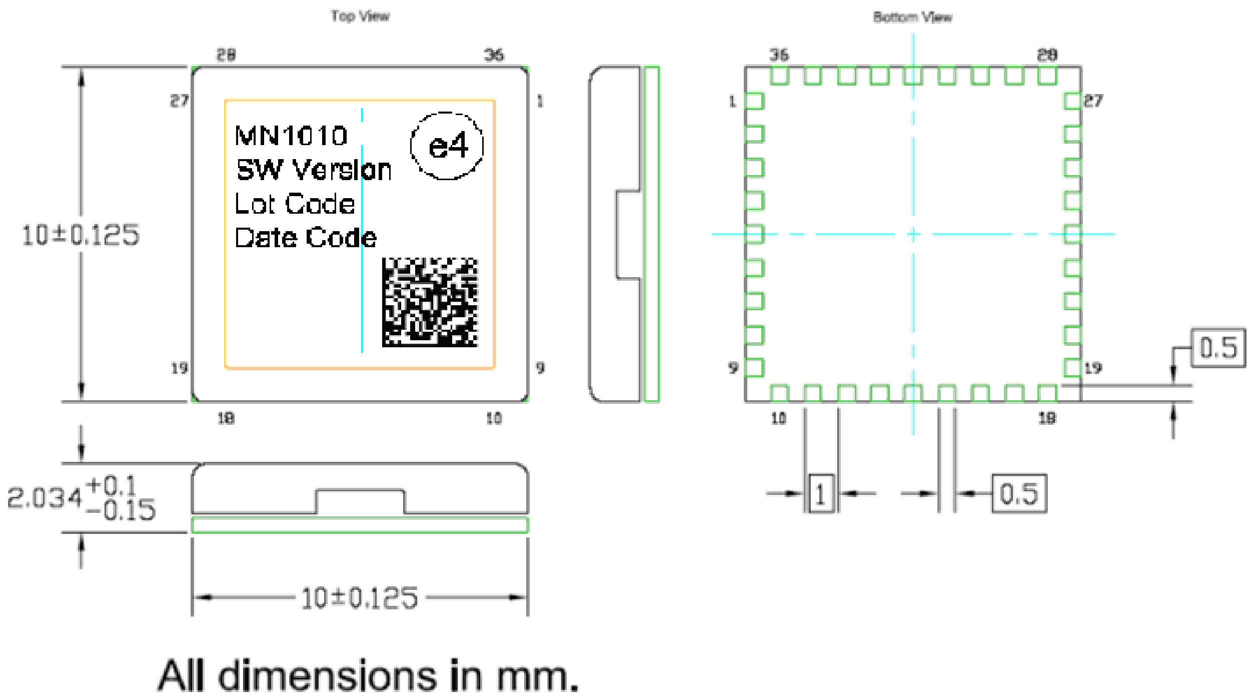

Figure 4 – Package Outline

Note the JEDEC Pb-free symbol is also used as the pin 1 identifier for the MN1010.

9.3 Recommended Footprint

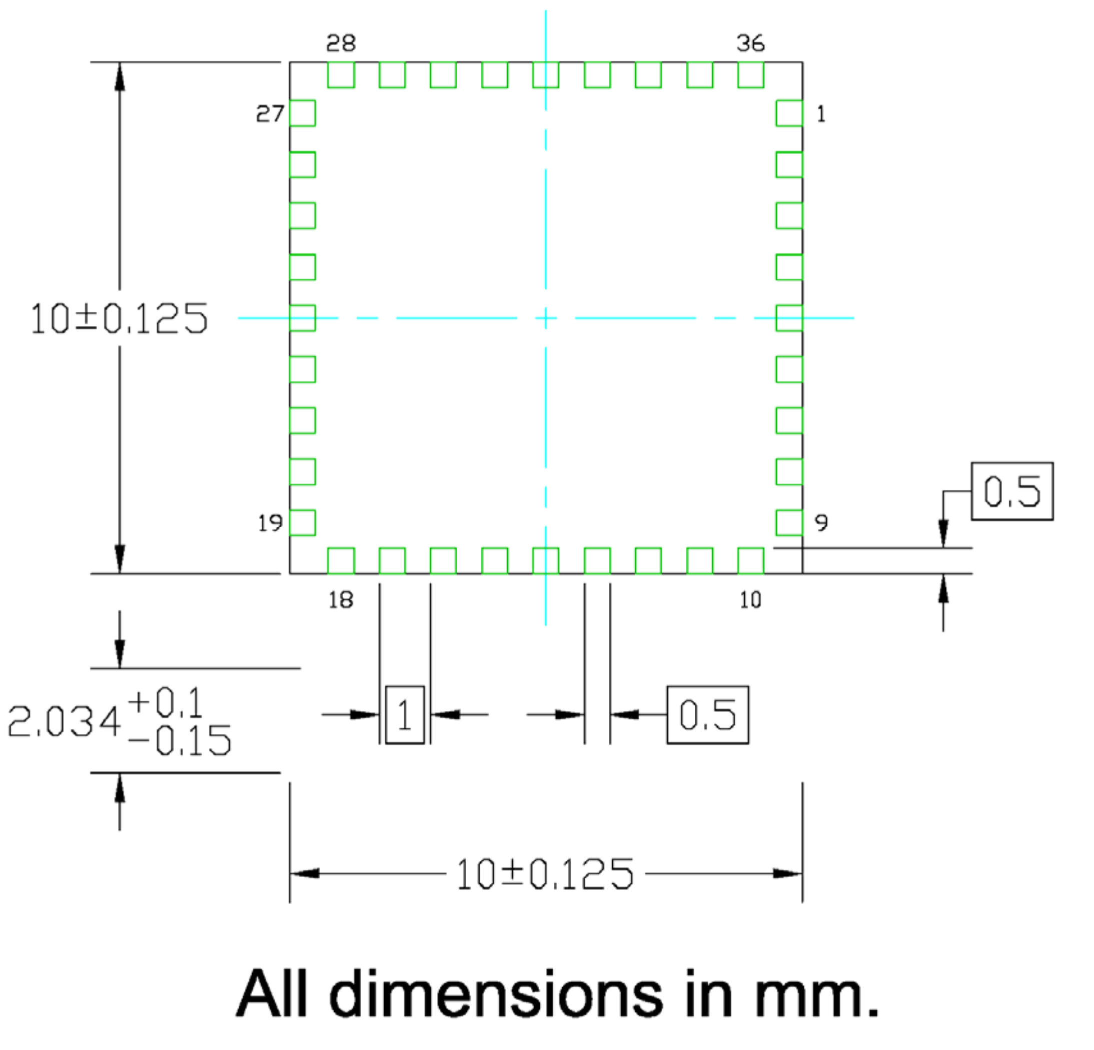

Figure 5 – Recommended PCB Footprint

Figure 5 is a suggested PCB footprint for the MN1010. The user may need to adjust the pad dimensions based upon their manufacturing process. While soldermask covered traces are permissible underneath the MN1010, exposed vias or pads should be avoided.

9.4 Tape and Reel Information

The MN1010 is provided in standard tape and reel, with 2K devices per reel.

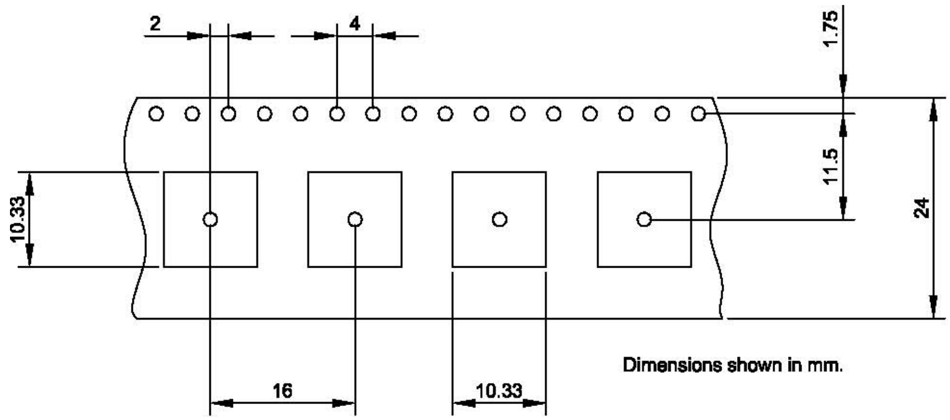

Figure 6 – Carrier tape dimensions

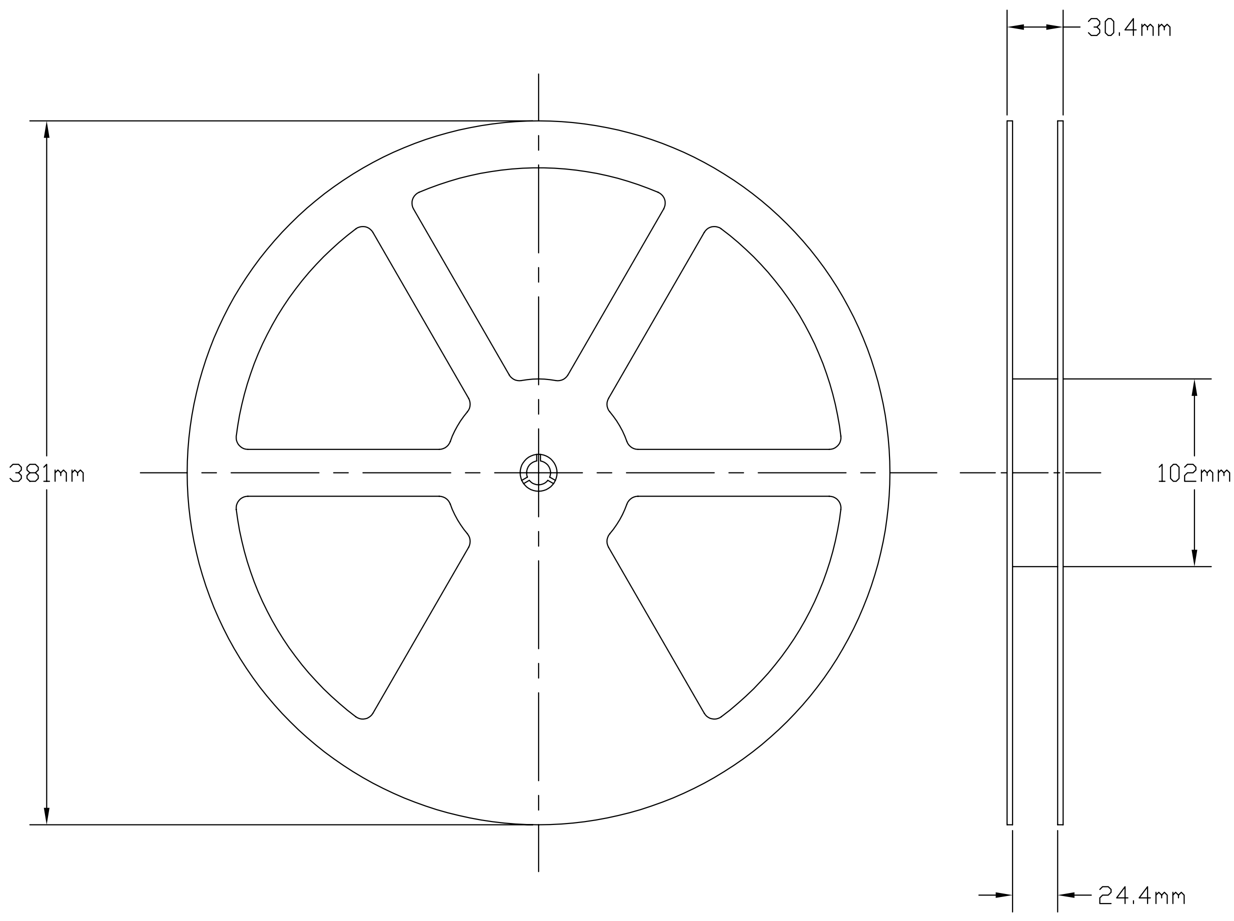

Figure 7 – Reel Dimensions

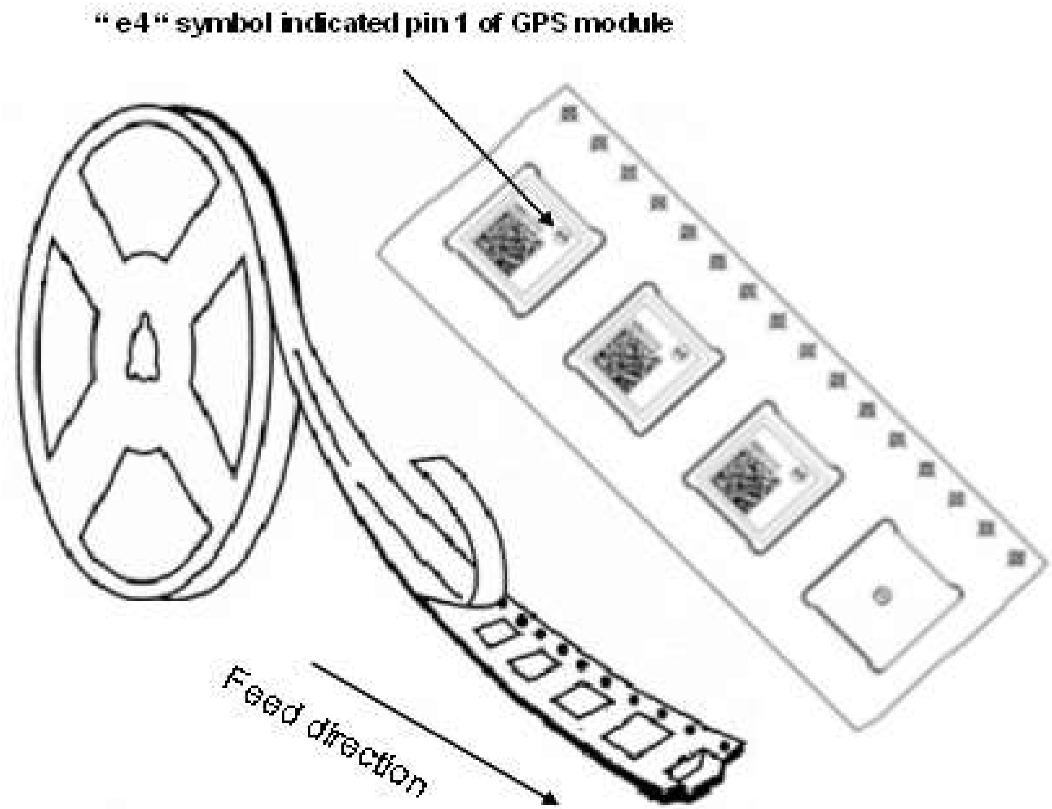

Figure 8 – Orientation in tape

9.5 Tube packaging

The MN1010 is also available in tube form, with 48 devices per tube.

The length of the stick is 501mm ± 0.1mm.

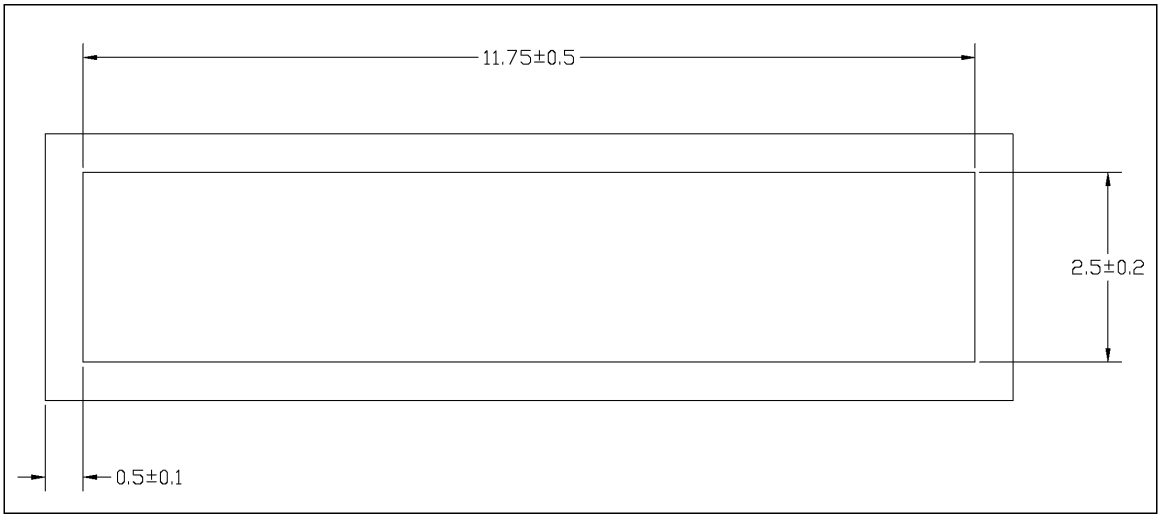

Figure 9 – Tube dimensions (in mm)

9.6 Recommended Reflow Profile

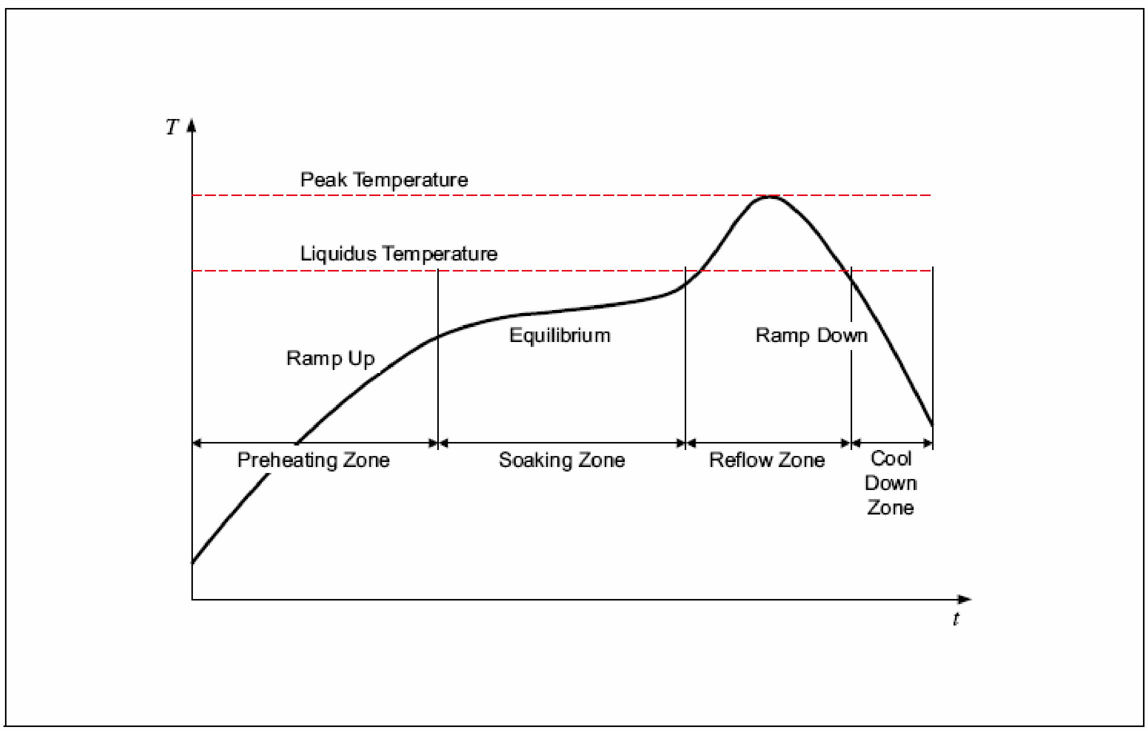

Figure 10 – Reflow Profile

9.6.1 Preheating Rate is 2.5°C/s.

9.6.2 Soaking Temperature is 140°C to 170°C.

9.6.3 Soaking Time 80 s

9.6.4 Peak Temperature is 260°C

9.6.5 Reflow time over Liquidus is 60 s.

9.6.6 Cool down rate is 2.5°C/s.

10 Ordering Information

The ordering part numbers are contained in the table below:

Part Number	Description
MN1010-RO	MN1010 in tape & reel with Orion Software
MN1010-TO	MN1010 in tube with Orion Software
MN1010-RI	MN1010 in tape & reel with iSuite03 Software
MN1010-TI	MN1010 in tube with iSuite03 Software

Table 21 – Ordering Information

Revision History		
Rev	**Description**	**Date**
A0	Initial Release of document	03 Mar 2006
A1	Revise label drawing plus other changes	02 Oct 2006

Table 22 – Revision History