GlobalTop Tech Inc.
宇誠科技股份有限公司

Document	Global Top GPS NMEA over SPI Software Guide				
Author	Steve Chen	**Date**	2015/07/23	**Ver.**	1.0

Global GPS NMEA over SPI Software Guide V 1.0

Steve Chen

GlobalTop Tech Inc.
No.16 Nan-ke 9th Rd., Science-based Ind. Park, Tainan 741-47, Taiwan R.O.C
Tel:+886-6-5051268 Fax:+886-6-5053381 http://www.gtop.info email: sales@gtop-tech.com

GlobalTop Tech Inc.
宇誠科技股份有限公司

Document	Global Top GPS NMEA over SPI Software Guide				
Author	Steve Chen	Date	2015/07/23	Ver.	1.0

Version History

History			
Date	Rev.	Author	Description
2015/07/23	1.0	Steve Chen	First Release

GlobalTop Tech Inc.
No.16 Nan-ke 9th Rd., Science-based Ind. Park, Tainan 741-47, Taiwan R.O.C
Tel:+886-6-5051268 Fax:+886-6-5053381 http://www.gtop.info email: sales@gtop-tech.com

Document	Global Top GPS NMEA over SPI Software Guide				
Author	Steve Chen	Date	2015/07/23	Ver.	1.0

1. Description

Global Top MT3339 & MT3333 GPS modules support UART, I^2C and SPI communication peripherals. This software guide illustrates how to set up the GlobalTop GPS module with SPI four-wire peripheral.

2. GlobalTop GPS module SPI specification

MT3339 & MT3333 support Baud rate up to 700kbit/s.

MT3339 & MT3333 work in slave mode.

Default SPI Clock Polarity Bit: 1(Active-low clocks selected. In idle state SCK is high)

Default SPI Clock Phase Bit: 1(Sampling of data occurs at even edges of the SCK clock)

SPI Interface	Description
MISO pin	outputs GPS information for application
MOSI pin	It is used to receive commands from system
CLK pin	It is used to receive clock from system
CS pin	It is used to select chip for system
INT pin	It is used to determine whether NMEA has outputted from SPI buffer of the module

3. The Flow of Host Processor(I^2C-master) Receiving NMEA

In SPI's transmission method, data is transmitted (shifted out serially) and received (shifted in serially) simultaneously. This means master will send padding bytes and receive NMEA data from slave during the same moment, even though PMTK command is not transmitted from the master. In factory's default, padding byte is set as "0xFF"so that the MT3339/MT3333 can ignore it ("0xFF") during the reading process.

GlobalTop Tech Inc.
No.16 Nan-ke 9th Rd., Science-based Ind. Park, Tainan 741-47, Taiwan R.O.C
Tel:+886-6-5051268 Fax:+886-6-5053381 http://www.gtop.info email: sales@gtop-tech.com

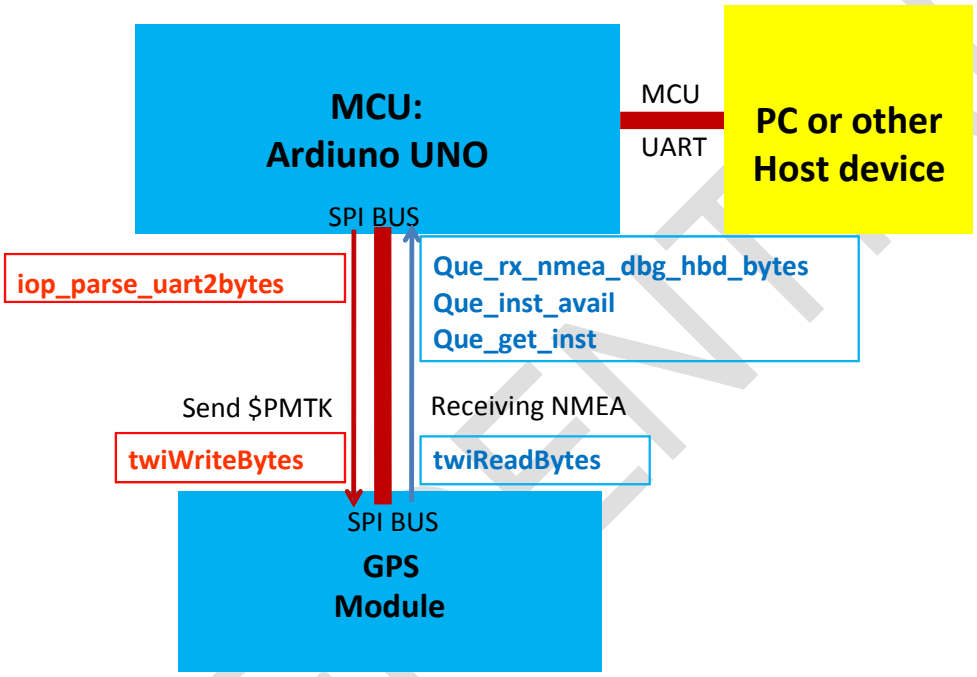
(1) The capacity of buffer for MT3339 & MT3333 SPI TX is 255 bytes, and the master reads one SPI data packet for maximum 255 bytes at a time. The master will read several SPI data packets in order to get complete NMEA packet of one second.

(2) After reading one SPI data packet, the master will then sleep for 8ms before it starts to receive next SPI data packet. The 8ms-sleep is a rule for MT3339 & MT3333 to upload new NMEA data into slave SPI buffer. After a complete NMEA packet of one second is read, the master is set to sleep longer to wait next NMEA packet of one second being ready.

Note: If **valid PMTK command** is included in the SPI packet to be transmitted, then set **30ms** for the master to wait for next coming SPI data packet. if PMTK is not included (All data is padding bytes), keep it at 8ms.

GlobalTop Tech Inc.
No.16 Nan-ke 9th Rd., Science-based Ind. Park, Tainan 741-47, Taiwan R.O.C
Tel:+886-6-5051268 Fax:+886-6-5053381 http://www.gtop.info email: sales@gtop-tech.com

In this SW guide, the Ardiuno UNO EV-board is used as the platform(MCU). The hardware connection and software architecture are simply shown in the following chart:

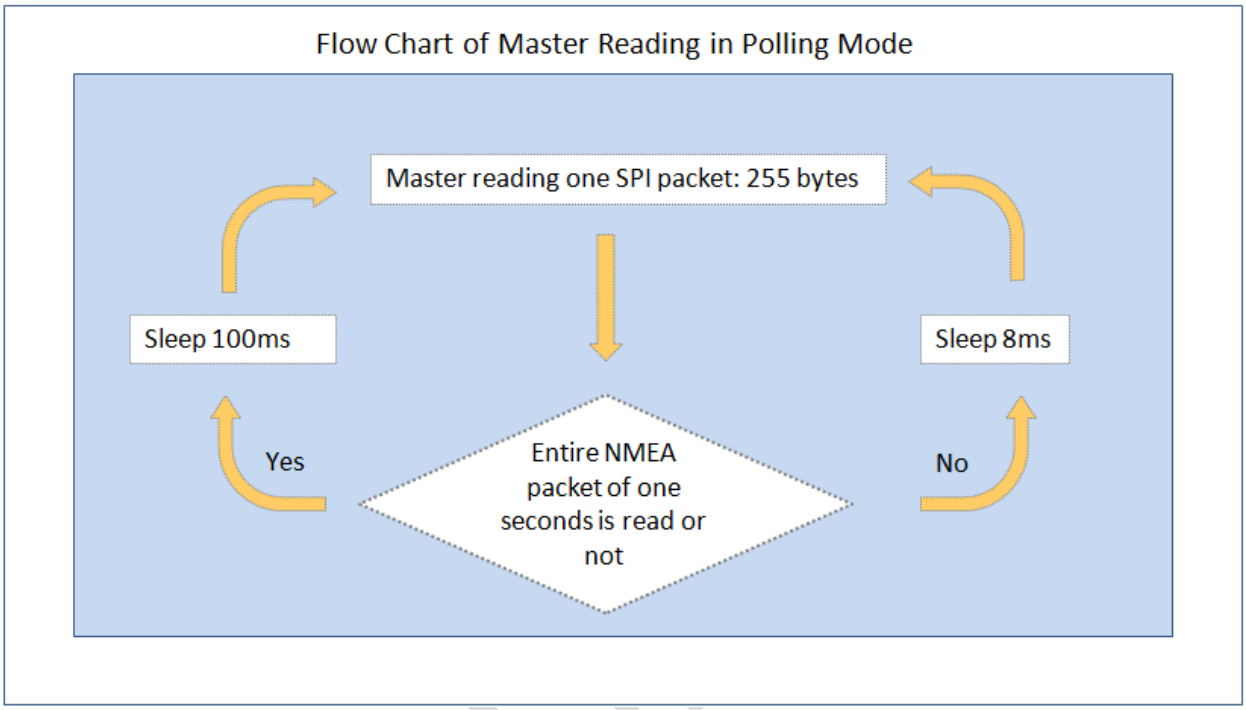


MediaTek supports two modes for reading NMEA via SPI: **Polling mode** and **Interrupt mode**. The SPI read NMEA flow of each mode are as follows:

1. Polling mode

In polling mode, master will read entire NMEA packet of one second repeatedly in each polling time interval. The time interval can be configured according to GPS fix interval. Normally time interval must be less than GPS fix interval.

GlobalTop Tech Inc.
No.16 Nan-ke 9th Rd., Science-based Ind. Park, Tainan 741-47, Taiwan R.O.C
Tel:+886-6-5051268 Fax:+886-6-5053381 http://www.gtop.info email: sales@gtop-tech.com



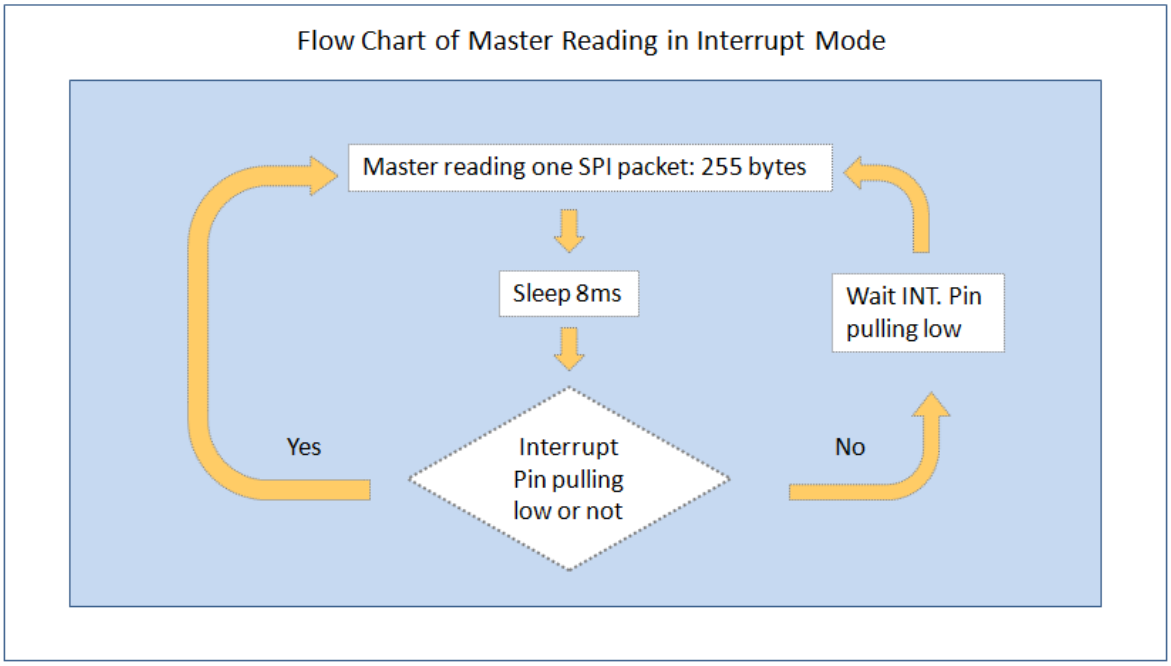
Note: The figure above assumes that GPS fix interval is 1 second; therefore the polling time interval is set to 100ms.

2. Interrupt Mode

The mode is used when the module provides Interrupt Pin. When NMEA data is uploaded to the SPI buffer, the interrupt Pin will pull low. After a complete NMEA packet of one second is transmitted, the SPI buffer will become empty and the interrupt Pin will pull high.

Note: Interrupt Pin can also be used in Polling mode to determine whether the slave stores NMEA or not.

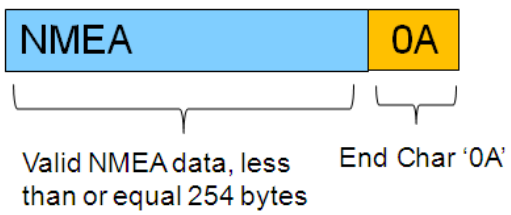
GlobalTop Tech Inc.
No.16 Nan-ke 9th Rd., Science-based Ind. Park, Tainan 741-47, Taiwan R.O.C
Tel:+886-6-5051268 Fax:+886-6-5053381 http://www.gtop.info email: sales@gtop-tech.com



3.1 SPI data packet format in the slave buffer

An SPI data packet has 254 valid NMEA bytes at most and one end char <LF> in slave buffer. The master can read up to 255-byte SPI data packet at one time. When the slave buffer is empty, the slave will keep providing SPI data packet(255 byte) for the master to read; however the content in the packet could be garbage bytes because information in the data is nothing new. The garbage bytes will be explained in the later section.

The format of Packet in the slave SPI buffer:



GlobalTop Tech Inc.
No.16 Nan-ke 9th Rd., Science-based Ind. Park, Tainan 741-47, Taiwan R.O.C
Tel:+886-6-5051268 Fax:+886-6-5053381 http://www.gtop.info email: sales@gtop-tech.com

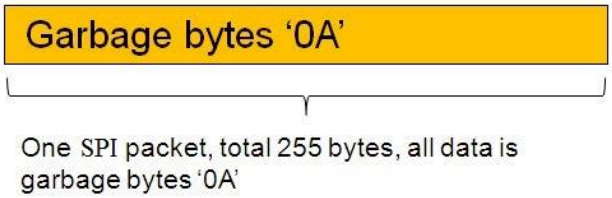
3.2 Three types of SPI packet that master reads from slave

1. NMEA + Garbage bytes---When the slave (MT3339/MT3333) buffer has already had some data stored, the master will read one 255-byte SPI packet from the slave, including valid data in the header and garbage bytes in the end of a packet.

SPI packet format:

2. Garbage bytes--- When the slave buffer is empty, the slave will keep providing data (255-byte SPI packet) for the master to read. Since there is no new or useful data contained in the packet, all data will be garbage bytes.

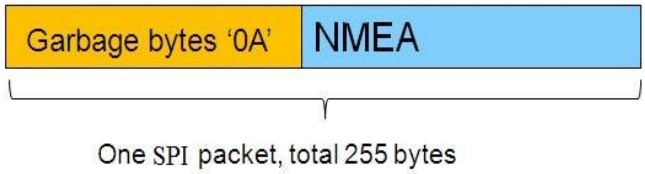
SPI packet format:



3. Garbage bytes + NMEA--- The master will first receive garbage bytes and then NMEA data. If this reading process is not completed before MT3339/MT3333 uploading next new data into SPI buffer, the master will accept new/valid NMEA data bytes and overlaps the previous unfinished data.

GlobalTop Tech Inc.
No.16 Nan-ke 9th Rd., Science-based Ind. Park, Tainan 741-47, Taiwan R.O.C
Tel:+886-6-5051268 Fax:+886-6-5053381 http://www.gtop.info email: sales@gtop-tech.com

SPI packet format:



3.3 How to extract valid NMEA data from many SPI packets

As described in section above, valid NMEA data are to be extracted from SPI packets, and sample code will be provided for valid NMEA data extraction. Please refer to next section for detail.

Note: According to the factory default setting, all "0A" Characters are to be discarded when NMEA data is extracted from SPI packets. An SPI packet comes in 3 formats: (1) "0A" is allocated in the end char in an SPI packet; (2) Garbage bytes ('0A' under normal circumstances); (3)The <LF> char '0A' in NMEA sentence. Discarding "0A" doesn't affect parsing NMEA sentence.

4 Inserting PMTK Command via SPI bus (MT3339/MT3333)

User can insert PMTK command via SPI bus since the capacity of MT3339/MT3333 SPI RX buffer is 255 bytes. For one SPI packet that the slave & master transmits, the size must be less than 255 bytes, and the time interval of two SPI packet inputs cannot be less than 30 milliseconds because the slave needs 30milli seconds to process input data.

5 Sample Code to Receive NMEA and Send PMTK

MediaTek(MTK) provides API and sample code for the devices to receive NMEA data and send PMTK.

5.1 Provided API for Receiving Queue

After queue is received, it will extract NMEA and MTK Debug data from the incoming SPI packets. It will also discard garbage bytes and will valid data automatically.

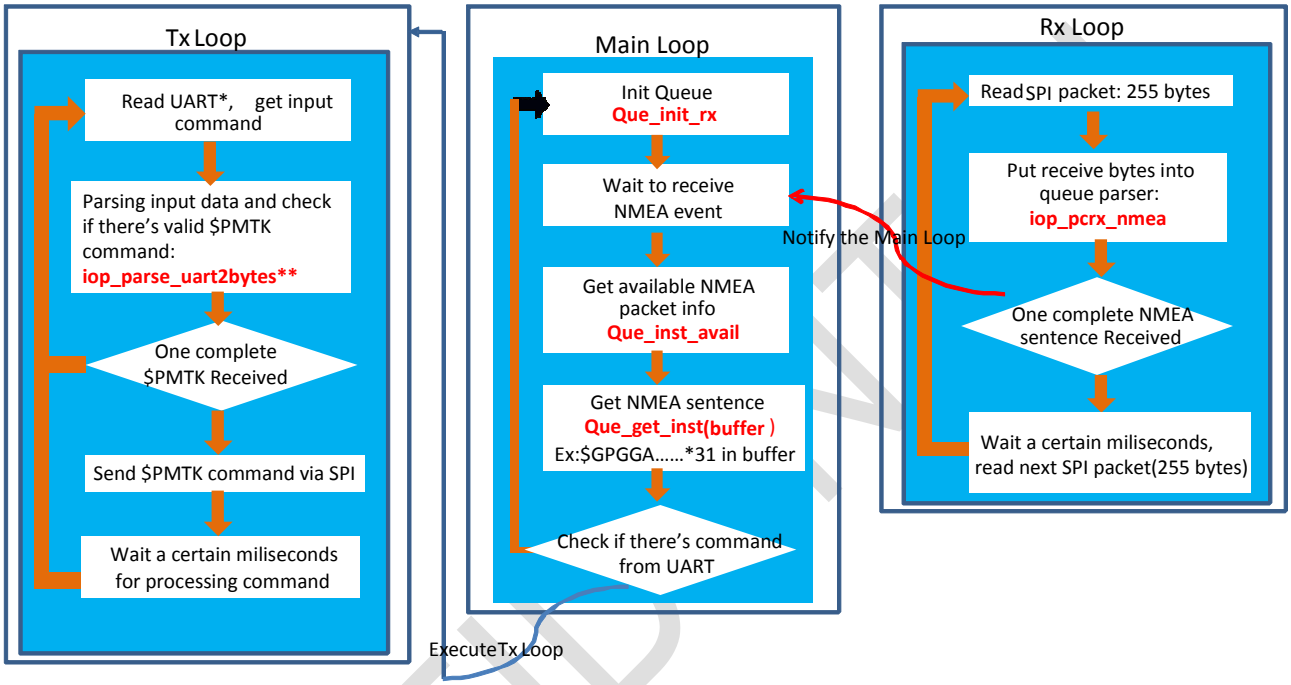
GlobalTop Tech Inc.
No.16 Nan-ke 9th Rd., Science-based Ind. Park, Tainan 741-47, Taiwan R.O.C
Tel:+886-6-5051268 Fax:+886-6-5053381 http://www.gtop.info email: sales@gtop-tech.com

Function Name	Description	Prototype and Parameter
Que_init_rx	Initialize receive queue	
Que_inst_avail	Get available NMEA sentence information	BOOL Que_inst_avail(short *inst_id, short *dat_idx, short *dat_siz) inst_id - NMEA sentence type dat_idx - start data index in queue dat_siz - NMEA sentence size
Que_get_inst	Get NMEA sentence data from queue buffer	void Que_get_inst(short idx, short size, void *data) idx - start data index in queue size - NMEA sentence size data - data buffer used to save NMEA sentence
Que_rx_nmea	Process SPI packets, get valid NMEA data and discard garbage bytes	void Que_rx_nmea(unsigned char data)
Que_rx_nmea_dbg_hbd_bytes	Process SPI packets, get valid NMEA data and debug log code.	void Que_rx_nmea_dbg_hbd_bytes(unsigned char aData[], int i4NumByte) aData[] - the array keeps all data read form I2C packets. i4NumByte - size of the array keeps all data read form I2C packets

GlobalTop Tech Inc.
No.16 Nan-ke 9th Rd., Science-based Ind. Park, Tainan 741-47, Taiwan R.O.C
Tel:+886-6-5051268 Fax:+886-6-5053381 http://www.gtop.info email: sales@gtop-tech.com

5.2 Firmware Flow Chart After Receiving Queue

The flow chart is shown below:



Note:

*The item "UART" here means the MCU Serial Port connecting to PC or other host. User can get NMEA and input $PMTK commands through this interface.

**This function is platform dependent. It is used for MCU to receive UART input data. For different platform, users must implement this function by themselves. The $PMTK command is ranging from 8 to 64bytes in length. It is required to have enough buffer size in firmware to keep these data bytes.

GlobalTop Tech Inc.
No.16 Nan-ke 9th Rd., Science-based Ind. Park, Tainan 741-47, Taiwan R.O.C
Tel:+886-6-5051268 Fax:+886-6-5053381 http://www.gtop.info email: sales@gtop-tech.com