SOC Robotics, Inc.

IMU8420 V1.02 Release Notes
September 28, 2013

MediaTek MT3329 GPS Receiver

Support for the GP1 GPS daughter card is now implemented. The GP1 uses the Mediatek MT3329 GPS receiver. The MT3329 outputs one or more NEMA compatible records 1, 5 or 10 times per second. One of several different NEMA records is captured, parsed and appended to the MEMs sensor log. A record type character ('m' 'g' or 'a') is inserted at the beginning of each record to identify if GPS sensor data or other optional data has been appended to the MEMs sensor log. Analysis software uses the record type to determine how to parse the record. Several NEMA records include GMT time. Once the GPS receiver sync's to a sufficient number of satellites precise time is available. Several IMU8420's with GP1's can be precisely time sync'd using the GMT signal.

The following NEMA MediaTek specific records are available. Some records have more information than others. For example, it is possible to log latitude, longitude, altitude, heading and direction tracked by the GPS receiver. The default record that is logged is GPGGA. See the Mediatek MT3329 Technical Manual (included with IMU8420 project folder) for more information.

- GPGGA - Time, position and fix type data (default record).
- GPGLL - Position and time.
- GPVTG - Course and speed information relative to the ground.
- GPGSA - GPS receiver operating mode, active satellites used in the position solution and DOP values.
- GPRMC - Time, date, position, course and speed data. Recommended Minimum Navigation Information.
- GPGSV - The number of GPS satellites in view satellite ID numbers, elevation, azimuth, and SNR values.

The GPS has a top level command menu is entered using the 'g' command. GPS logging can be enabled or disable, baud rate set to 9600, 19200 or 38400, GPS to be recorded set, GMT hour/minute offset and recorded format selected.

Data logging records now have the first character set to either m, g or a indicating a MEMs sensor record, MEMs plus GPS or MEMS plus other data respectively. Parsing software can use the first character to determine how to parse the record. A sample record is appended to the end of document.

uSD Data Logging Configuration Commands

Data logging configuration settings can now be loaded from the uSD using either a default file called "logconfg.txt" or a user defined file. If file logconfg.txt is on the uSD its contents are loaded at power up and acted on. These settings are not loaded automatically into Flash. If the file logconfg.txt is not on the uSD then the contents of Flash are acted on. Most of the data logging menu commands can be placed in the configuration file. Several new commands have been added to support the GPS receiver.

A new top level command 'c' allows the user to load/save/list logging configuration parameters. It is now possible to save several configuration files and load them individually. Six commands are supported:

ad	- save logging parameters to logconfg.txt
sn filename	- save logging parameters to file filename
ld	- load contents of logconfg.txt
ln filename	- save contents of file filename
dd	- list contents of logconfg.txt
dn filename	- list contents of file filename

The Logging configuration file contains parameters followed by a value. Only parameters to be changed need be in the file and can be entered in any order. The following parameters are supported with example entries:

```
data2log agmbks
poweruplogmode n
terminatemode h
timeoutperiod 140
timedstartmode y
delaystarttimesec 0
thresholdmode i
thresholds yyyyyyyyy
logrestart n
lograte 5
logrestartmax 32000
storeminmax d
usdfilenamemode u
logfilename
usdfilenamenumber 1
printoutput y
armswitch n
logekf i
loggpsmode a
loggpstype n
loggpsrecord GPGGA
gpsbaudrate 38400
gpsupdaterate 10
gmthouroffset -7
gmtminuteoffset 0
```

Extended Kalman Filter (EKF)

The output of the Extended Kalman Filter (EKF) can be added as a logged parameter. The EKF outputs roll, pitch and yaw in real time. Enabling EKF logging adds approximately 1.5msec to the data acquisition/processing loop. EKF information is added after the accelerometer, gyrocompass and magnetometer output but before the temperature and barometer.

IMU8420 Data Logger V1.02 Source Code

The latest application was developed using AVR Studio 6.1. The complete source code and project file is available by request.

The project hex file is available at:

http://www.soc-robotics.com/downloads/IMU8420_Controller%20V1.02.hex

Version 1.03 Features

The next version will support a tighter integration of GPS data with MEMs sensor data. GPS GMT time will be used to synchronize the IMU8420 clock and GPS heading and height information will be used to adjust the barometer height readings and EKF data.

Appendix 1 . Tables of Mediatek NEAM Records

Table-2 contains the values for the following example:
$GPGGA,064951.000,2307.1256,N,12016.4438,E,1,8,0.95,39.9,M,17.8,M,,*65

GGA Data Format — Table-2

Name	Example	Units	Description
Message ID	$GPGGA		GGA protocol header
UTC Time	064951.000		hhmmss.sss
Latitude	2307.1256		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12016.4438		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Position Fix Indicator	1		See Table-3
Satellites Used	8		Range 0 to 14
HDOP	0.95		Horizontal Dilution of Precision
MSL Altitude	39.9	meters	Antenna Altitude above/below mean-sae-level
Units	M	meters	Units of antenna altitude
Geoidal Separation	17.8	meters	
Units	M	meters	Units of geoidal separation
Age of Diff. Corr.		second	Null fields when DGPS is not used
Checksum	*65		
<CR> <LF>			End of message termination

Position Fix Indicator — Table-3

Value	Description
0	Fix not available
1	GPS fix
2	Differential GPS fix

Table-4 contains the values for the following example:
$GPGSA,A,3,29,21,26,15,18,09,06,10,,,,,2.32,0.95,2.11*00

GSA Data Format			Table-4
Name	**Example**	**Units**	**Description**
Message ID	$GPGSA		GSA protocol header
Mode 1	A		See Table-5
Mode 2	3		See Table-6
Satellite Used	29		SV on Channel 1
Satellite Used	21		SV on Channel 2
....	....	....	....
Satellite Used			SV on Channel 12
PDOP	2.32		Position Dilution of Precision
HDOP	0.95		Horizontal Dilution of Precision
VDOP	2.11		Vertical Dilution of Precision
Checksum	*00		
<CR> <LF>			End of message termination

Mode 1	Table-5
Value	**Description**
M	Manual—forced to operate in 2D or 3D mode
A	2D Automatic—allowed to automatically switch 2D/3D

Mode 2	Table-6
Value	**Description**
1	Fix not available
2	2D (<4 SVs used)
3	3D (≧4 SVs used)

Table-7 contains the values for the following example:
$GPGSV,3,1,09,29,36,029,42,21,46,314,43,26,44,020,43,15,21,321,39*7D
$GPGSV,3,2,09,18,26,314,40,09,57,170,44,06,20,229,37,10,26,084,37*77
$GPGSV,3,3,09,07,,,26*73

GSV Data Format			Table-7
Name	**Example**	**Units**	**Description**
Message ID	$GPGSV		GSV protocol header
Number of Messages	3		Range 1 to 3 *(Depending on the number of satellites tracked, multiple messages of GSV data may be required.)*
Message Number1	1		Range 1 to 3
Satellites in View	09		
Satellite ID	29		Channel 1 (Range 1 to 32)
Elevation	36	degrees	Channel 1 (Maximum 90)
Azimuth	029	degrees	Channel 1 (True, Range 0 to 359)
SNR (C/No)	42	dBHz	Range 0 to 99, (null when not tracking)
....	....	....	....
Satellite ID	15		Channel 4 (Range 1 to 32)
Elevation	21	degrees	Channel 4 (Maximum 90)
Azimuth	321	degrees	Channel 4 (True, Range 0 to 359)
SNR (C/No)	39	dBHz	Range 0 to 99, (null when not tracking)
Checksum	*7D		
<CR> <LF>			End of message termination

Table-8 contains the values for the following example:
$GPRMC,064951.000,A,2307.1256,N,12016.4438,E,0.03,165.48,260406,3.05,W,A*2C

RMC Data Format			Table-8
Name	**Example**	**Units**	**Description**
Message ID	$GPRMC		RMC protocol header
UTC Time	064951.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Latitude	2307.1256		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12016.4438		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Speed Over Ground	0.03	knots	
Course Over Ground	165.48	degrees	True
Date	260406		ddmmyy
Magnetic Variation	3.05, W	degrees	E=east or W=west **(Need customization service)**
Mode	A		A= Autonomous mode D= Differential mode E= Estimated mode
Checksum	*2C		
<CR> <LF>			End of message termination

Table-9 contains the values for the following example:
$GPVTG,165.48,T,,M,0.03,N,0.06,K,A*37

VTG Data Format			Table-9
Name	**Example**	**Units**	**Description**
Message ID	$GPVTG		VTG protocol header
Course	165.48	degrees	Measured heading
Reference	T		True
Course		degrees	Measured heading
Reference	M		Magnetic *(Need customization service.)*
Speed	0.03	knots	Measured horizontal speed
Units	N		Knots
Speed	0.06	km/hr	Measured horizontal speed
Units	K		Kilometers per hour
Mode	A		A= Autonomous mode D= Differential mode E= Estimated mode
Checksum	*06		
<CR> <LF>			End of message termination

Appendix 2. Example MEMs Sensor Record

MEMs sensor data with record type, time, 3 axis accelerometer and GPS data. The GPS data is appended to the end of the record at a 10Hz rate. Note that the GPS record wraps to the next line in this document but does not in the recorded file. The first character of each record is either a m or g indicating record contents.

```
m 00:38:34.8879  0.105  0.016  0.948
m 00:38:34.8947  0.113  0.012  0.944
m 00:38:34.9013  0.113  0.012  0.944
m 00:38:34.9079  0.117  0.012  0.936
m 00:38:34.9144  0.117  0.012  0.940
m 00:38:34.9210  0.113  0.012  0.940
m 00:38:34.9279  0.113  0.008  0.952
m 00:38:34.9344  0.113  0.008  0.952
m 00:38:34.9410  0.113  0.016  0.944
g 00:38:34.9476  0.109  0.012  0.948 GPGGA 185228.300 4919.6334 N 12304.0940 W
1 5 1.48 152.1 M -16.8 M
m 00:38:34.9547  0.109  0.012  0.948
m 00:38:34.9623  0.113  0.008  0.944
m 00:38:34.9688  0.113  0.016  0.963
m 00:38:34.9754  0.117  0.016  0.940
m 00:38:34.9820  0.117  0.016  0.940
m 00:38:34.9885  0.113  0.008  0.952
m 00:38:34.9954  0.113  0.008  0.952
m 00:38:35.0019  0.113  0.012  0.944
m 00:38:35.0085  0.109  0.012  0.936
m 00:38:35.0151  0.109  0.012  0.936
m 00:38:35.0217  0.113  0.008  0.944
m 00:38:35.0284  0.109  0.012  0.948
m 00:38:35.0351  0.109  0.012  0.948
m 00:38:35.0417  0.117  0.012  0.944
g 00:38:35.0492  0.109  0.012  0.948 GPGGA 185228.400 4919.6316 N 12304.0920 W
1 5 1.48 152.1 M -16.8 M
m 00:38:35.0564  0.109  0.012  0.948
m 00:38:35.0629  0.117  0.008  0.952
m 00:38:35.0695  0.113  0.008  0.952
m 00:38:35.0761  0.113  0.008  0.952
m 00:38:35.0826  0.109  0.023  0.956
m 00:38:35.0895  0.109  0.016  0.944
m 00:38:35.0960  0.109  0.016  0.944
m 00:38:35.1026  0.109  0.020  0.936
m 00:38:35.1091  0.113  0.020  0.932
m 00:38:35.1157  0.113  0.020  0.932
m 00:38:35.1233  0.113  0.004  0.948
m 00:38:35.1298  0.117  0.016  0.948
m 00:38:35.1364  0.117  0.016  0.948
m 00:38:35.1430  0.109  0.008  0.952
g 00:38:35.1496  0.117  0.008  0.932 GPGGA 185228.500 4919.6291 N 12304.0887 W
1 5 1.48 152.2 M -16.8 M
m 00:38:35.1569  0.117  0.008  0.932
m 00:38:35.1634  0.117  0.012  0.928
m 00:38:35.1700  0.109  0.012  0.948
m 00:38:35.1766  0.109  0.012  0.948
m 00:38:35.1832  0.109  0.020  0.944
m 00:38:35.1900  0.109  0.012  0.944
m 00:38:35.1966  0.109  0.012  0.944
m 00:38:35.2039  0.117  0.016  0.948
m 00:38:35.2105  0.109  0.016  0.936
m 00:38:35.2171  0.109  0.016  0.936
m 00:38:35.2239  0.109  0.012  0.952
```