4D SYSTEMS

Modules On The Go Series

MOTG-GPS

Pluggable µSD GPS Module

Data Sheet

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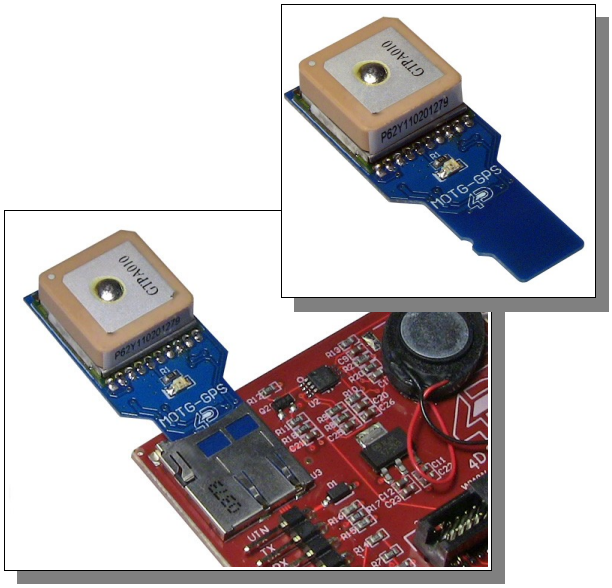
Description



MOTG-GPS is a small pluggable GPS module ideally suited for embedded systems. It incorporates a complete solution GPS engine module with an integrated finely tuned highly sensitive Patch-On-Top (POT) ceramic antenna and has a wide range of uses in educational, experimental as well as during any development phase where a quick GPS solution is required. It comes in a micro-SD memory card format which is designed to interface to any embedded platform that has an on board micro-SD (or SD) card adaptor.

Complete NMEA messages as well as specific information such as Longitude, Latitude, Heading, Time, Date, Speed and many more features are built inside the MOTG-GPS. The module utilises the standard SPI signals and acts as a slave device to the host micro. It offers a simple yet effective command set to any host platform that can communicate via a SPI port and all GPS related commands are sent using a simple protocol.

MOTG-GPS device simply plugs into a standard µSD/SD socket for quick assembly and maintenance, no need to solder and end up with a wiring nest. Don't need the device permanently, or want to make it optional? Simple, just unplug.

The MOTG-GPS is a novel concept from 4D Systems that belong to a broader range of **Modules-On-The-Go** series. Some of the other modules on offer are:

- **MOTG-96:** Pluggable 0.96" 96x64 OLED display module in a micro-SD card format.
- **MOTG-128:** Pluggable 1.5" 128x128 display module in a micro-SD card format.

Features

- Low-cost pluggable GPS module.
- Easy micro-SD card form factor that will plug into any embedded host platform that has a micro-SD or SD card adaptor.
- SPI interface to the host via the micro-SD or SD adaptor.
- Comprehensive set of built in high level GPS commands.
- Based on MediaTek Single Chip Architecture, MT3329.
- Patch Antenna Dimensions : 15mm x 15mm x 4mm.
- L1 Frequency, C/A code, 66 channels.
- High Sensitivity : Up to -165dBm tracking, superior urban performance.
- Position Accuracy : < 3m CEP (50%) without SA (horizontal).
- Supports up to 210 PRN channels.
- Jammer detection and reduction.
- Multi-path detection and compensation.
- Cold Start : under 35 seconds (Typical).
- Warm Start : under 34 seconds (Typical).
- Hot Start : under 1 second (Typical).
- Supports NMEA0183 V3.01 data protocol.
- RoHS Compliant.

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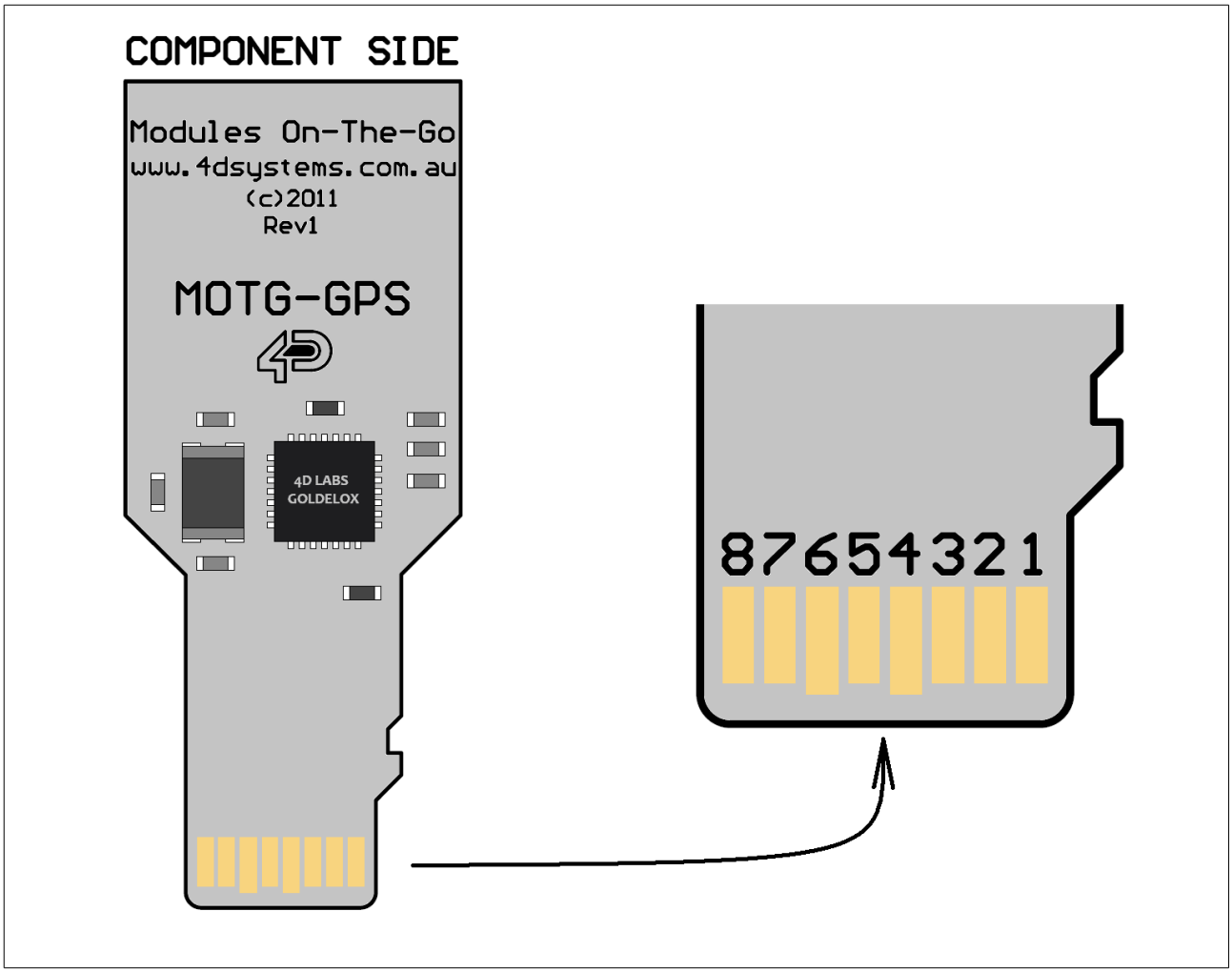
1. Pin Configuration and Description



Pin	Symbol	I/O	Description
1	N.C.	--	Not Connected.
2	CS	I	MOTG SPI Chip Select. The host asserts this signal LOW when accessing the display module.
3	SDI	I	MOTG SPI Data In. This pin connects to the Data Out of the host SPI.
4	3.3V	P	Voltage supply input. Range is 3.0V to 3.6V, nominal 3.3V.
5	SCK	I	MOTG SPI Clock In. This pin connects to the host SPI Clock output.
6	GND	P	Ground.
7	SDO	O	MOTG SPI Data Out. This pin connects to the host SPI Data input.
8	RESET	I	MOTG Reset Input (active LOW). This pin is only used by the Programming module for updating the MOTG with PmmC files. Not used during normal operation.

Legend: I = Input, O = Output, P = Power

2. micro-SD SPI Hardware Interface

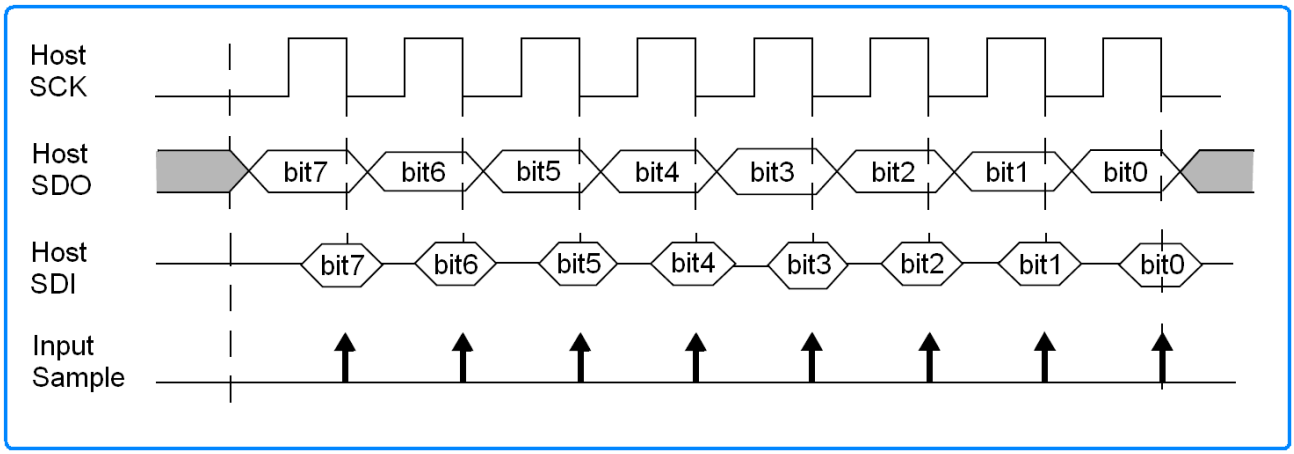
The MOTG-GPS is designed to plug into standard micro-SD card sockets employed in most embedded platforms. It can also plug into standard SD slots with the aid of a micro-SD to SD adaptor. It is important to note that the communication interface is via standard SPI signalling and most embedded platforms employ the SPI mode for their on board memory card sockets. The following timing diagrams provide detailed information about the required SPI signalling.

Note1: MOTG-128 supports a maximum clock rate of 12Mhz.

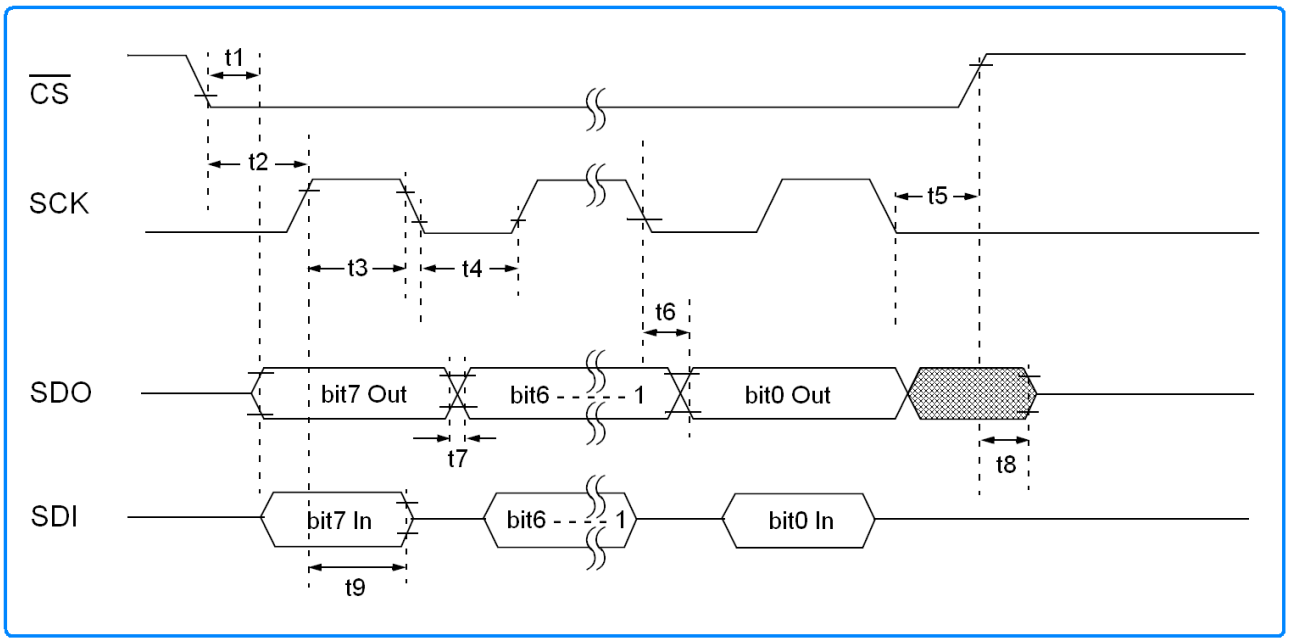
Note2: MOTG-128 will not work with external or built in PC card readers. These devices do not utilise the SPI signalling as required by the MOTG devices.

Note3: MOTG-GPS has a Red LED indicator at the front of the module. This LED will blink when the module is trying to lock and get a fix. Once it has established a successful lock the LED will turn off.

2.1 Generic Host Master SPI Timing



2.2 MOTG-GPS Slave SPI Timing Diagram



Item	Symbol	Min.	Typ.	Max.	Unit
SDO Data Output Valid after CS↓ Edge	t1	--	--	50	ns
CS↓ to SCK↑ Input	t2	100	--	--	ns
SCK Input High Period	t3	40	--	--	ns
SCK Input Low Period	t4	40	--	--	ns
CS↑ after SCK Edge	t5	190	--	--	ns
SDO Data Output Valid after SCK Edge	t6	--	--	50	ns
SDO Data Output Rise and Fall Period	t7	--	--	25	ns
CS↑ to SDO Output High-Impedance	t8	10	--	50	ns
Hold Time of SDI Data Input to SCK Edge	t9	100	--	--	ns

3. Software Interface

The MOTG-GPS module is a slave peripheral device and it provides bidirectional communications to a host controller via its SPI interface. All communications between the host and the device occur over this SPI interface. The protocol is simple and easy to implement.

Note: The host must initialise its SPI port as the master and must meet the MOTG SPI specifications outlined in the previous section.

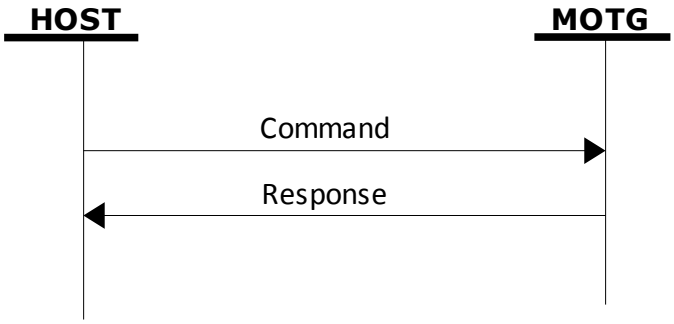
3.1 Command Protocol – Flow Control

The MOTG modules are slave devices and all communication and events must be initiated by the host. Each command is made up of a sequence of data bytes. When a command is sent to the device and the operation is completed, it will always return a response. For a command that has no specific response the device will send back a single acknowledge byte called the **ACK (06hex)**, in the case of success, or **NAK (15hex)**, in the case of failure.

Commands having specific responses may send back varying numbers of bytes, depending upon the command and response. It will take the device a certain amount of time to respond, depending on the command type and the operation that has to be performed. If the MOTG device receives a command that it does not understand it will reply back with a negative acknowledge called the NAK (15hex). Since a command is only identified by its position in the sequence of data bytes sending incorrect data can result in wildly incorrect operation.

4. Command Set

The command interface between the MOTG device and the host is via the SPI interface. A handful of easy to learn commands provide complete access to all the available functions. The simplified command set also means that very low overheads are imposed on the host controller. Commands and responses can be either single bytes or many bytes. All commands return a response, either an acknowledge or data.



Each Command set is described in detail in the following sections.

MOTG-GPS Command Summary Table				
Cmd	**Description**	**Sentence**	**Field Name**	**Returned Values**
1	Returns Latest $GPGGA sentence	$GPGGA		Sentence as per section 5.1
2	Returns Latest $GPGSA sentence	$GPGSA		Sentence as per section 5.2
3	Returns Latest $GPGSV sentence	$GPGSV		Sentence as per section 5.3
4	Returns Latest $GPRMC sentence	$GPRMC		Sentence as per section 5.4
5	Returns Latest $GPVTG sentence	$GPVTG		Sentence as per section 5.5
A	Altitude above MSL (in tenths of meters, 65535 maximum)	$GPGGA	MSL Altitude	nnn.n
L	Longitude	$GPGGA	Longitude, E/W	dddmm.mmmm,EW
P	Latitude and Longitude	$GPGGA	Latitude,N/S,Longitude,E/W	ddmm.mmmm,NS,dddmm.mmmm,EW
T	Latitude	$GPGGA	Latitude, N/S	ddmm.mmmm,NS
C	Satellites used	$GPGGA	Satellites Used	nn
F	Fix type	$GPGSA	Mode 2	n
I	Satellites in View	$GPGSV	Satellites in View	nn
M	Mode	$GPVTG	Mode	c
D	Date (UTC/Greenwich Mean Time)	$GPRMC	UTC Time	ddmmyy
E	Time (UTC/Greenwich Mean Time)	$GPRMC	UTC Date	hhmmss.sss
N	Date and Time	$GPRMC	UTC Date, UTC Time	ddmmyy, hhmmss.sss
H	Heading/Direction of travel (in tenths of degrees)	$GPVTG	Course (True)	nnn.nn
K	Speed (in tenths of knots)	$GPVTG	Speed (Knots)	n.nn
S	Speed (in tenths of km/hr)	$GPVTG	Speed (km/hr)	n.nn
V	MOTG Module version	N/A		Device, Hardware, Firmware
d	Disables MOTG and places in low power mode	N/A		ACK (06hex)
e	Enables MOTG	N/A		ACK (06hex)
Note1: All commands are in ASCII.				
Note2: All returned values are ASCII and NULL terminated (unless otherwise indicated).				

4.1.1 Return Latest $GPGGA Sentence – 1 (ascii)

Command	**cmd**	
	cmd	**1**(ascii) : Command byte
Response	**Returns the latest $GPGGA sentence as per section 5.1**	
Description	This command requests the latest $GPGGA NMEA sentence which includes GPS time, position and fix related data.	
Example	**Command Data:** 1 **MOTG Response:** $GPGGA,064951.000,2307.1256,N,12016.4438,E,1,8,0.95,39.9,M,17.8,M,,*65	

4.1.2 Return Latest $GPGSA Sentence – 2 (ascii)

Command	**cmd**	
	cmd	**2**(ascii) : Command byte
Response	**Returns the latest $GPGSA sentence as per section 5.2**	
Description	This command requests the latest $GPGSA NMEA sentence which includes GPS receiver operating mode, active satellites used in the position solution, and DOP values.	
Example	**Command Data:** 2 **MOTG Response:** $GPGSA,A,3,29,21,26,15,18,09,06,10,,,,,2.32,0.95,2.11*00	

4.1.3 Return Latest $GPGSV Sentence – 3 (ascii)

Command	**cmd**	
	cmd	**3**(ascii) : Command byte
Response	**Returns the latest $GPGSV sentence as per section 5.3**	
Description	This command requests the latest $GPGSV NMEA sentence which includes the number of GPS satellites in view, satellite ID numbers, elevation, azimuth, and SNR values. **Note:** The returned message may vary between 1 to 3 (depending on the number of satellites tracked, multiple messages of GSV data may be required.)	
Example	**Command Data:** 3 **MOTG Response:** $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	

4.1.4 Return Latest $GPRMC Sentence – 4 (ascii)

Command	**cmd**	
	cmd	**4**(ascii) : Command byte
Response	**Returns the latest $GPRMC sentence as per section 5.4**	
Description	This command requests the latest $GPRMC NMEA sentence which is the recommended minimum navigation information and includes : time, date, position, course and speed data.	
Example	**Command Data:** 4 **MOTG Response:** $GPRMC,064951.000,A,2307.1256,N,12016.4438,E,0.03,165.48,260406,,,A*55	

4.1.5 Return Latest $GPVTG Sentence – 5 (ascii)

Command	**cmd**	
	cmd	**5**(ascii) : Command byte
Response	**Returns the latest $GPVTG sentence as per section 5.5**	
Description	This command requests the latest $GPVTG NMEA sentence which includes course and speed information relative to ground.	
Example	**Command Data:** 5 **MOTG Response:** $GPVTG,165.48,T,,M,0.03,N,0.06,K,A*37	

4.1.6 MSL Altitude – A (ascii)

Command	**cmd**	
	cmd	**A**(ascii) : Command header byte
Response	**nnn.n <00hex>**	
	nnn	Altitude in meters
	.	Decimal point indicator
	n	Altitude in 1/10th meters
	<00hex>	1 byte NULL terminator
Description	This command returns the altitude above Mean Sea Level (in tenths of meters, 65535 maximum).	
Example	**Command Data:** A **MOTG Response:** 315.9<00hex>	

4.1.7 Longitude – L (ascii)

Command	**cmd**	
	cmd	**L**(ascii) : Command header byte
Response	**dddmm.mmmm,EW <00hex>**	
	dddmm	Longitude in degrees and minutes
	.	Decimal point indicator
	mmmm	Longitude decimal fraction of minutes
	,	Comma separator
	EW	East or West Indicator (1 character)
	<00hex>	1 byte NULL terminator
Description	This command returns the Longitude in degrees and minutes as well as the East or West indicator.	
Example	**Command Data:** L **MOTG Response:** 12016.4438,E<00hex>	

4.1.8 Latitude and Longitude – P (ascii)

Command	**cmd**	
	cmd	**P**(ascii) : Command header byte
Response	**ddmm.mmmm,NS,dddmm.mmmm,EW <00hex>**	
	ddmm	Latitude in degrees and minutes
	.	Decimal point indicator
	mmmm	Latitude decimal fraction of minutes
	,	Comma separator
	NS	North or South Indicator (1 character)
	,	Comma separator
	dddmm	Longitude in degrees and minutes
	.	Decimal point indicator
	mmmm	Longitude decimal fraction of minutes
	,	Comma separator
	EW	East or West Indicator (1 character)
	<00hex>	1 byte NULL terminator
Description	This command returns the Latitude, the North/South indicator, the Longitude and the East/West indicator.	
Example	**Command Data:** P **MOTG Response:** 2307.1256,N,12016.4438,E<00hex>	

4.1.9 Latitude – T (ascii)

Command	**cmd**	
	cmd	**T**(ascii) : Command header byte
Response	**ddmm.mmmm,NS <00hex>**	
	ddmm	Latitude in degrees and minutes
	.	Decimal point indicator
	mmmm	Latitude decimal fraction of minutes
	,	Comma separator
	NS	North or South Indicator (1 character)
	<00hex>	1 byte NULL terminator
Description	This command returns the Latitude in degrees and minutes as well as the North or South indicator.	
Example	**Command Data:** T **MOTG Response:** 2307.1256,N<00hex>	

4.1.10 Satellites Used – C (ascii)

Command	**cmd**	
	cmd	**C**(ascii) : Command header byte
Response	**nn <00hex>**	
	nn	Number of Satellites used (range is 0 to 14). **Note:** This field will vary between 1 and 2 characters.
	<00hex>	1 byte NULL terminator
Description	This command returns the number of satellites used.	
Example	**Command Data:** C **MOTG Response:** 8<00hex>	

4.1.11 Fix Type - F (ascii)

Command	**cmd**	
	cmd	**F**(ascii) : Command header byte
Response	**n <00hex>**	
	n	Mode 2 Fix Type. **n = 1:** Fix not available **n = 2:** 2D (**<** 4 SVs used) **n = 3:** 3D (≧4 SVs used)
	<00hex>	1 byte NULL terminator
Description	This command returns the Fix type.	
Example	**Command Data:** F **MOTG Response:** 3<00hex>	

4.1.12 Satellites In View – I (ascii)

Command	**cmd**	
	cmd	**I**(ascii) : Command header byte
Response	**nn <00hex>**	
	nn	Number of Satellites that are in view.
	<00hex>	1 byte NULL terminator
Description	This command returns the number of satellites that are in view to the MOTG-GPS.	
Example	**Command Data:** I **MOTG Response:** 09<00hex>	

4.1.13 Mode - M (ascii)

Command	**cmd**	
	cmd	**M**(ascii) : Command header byte
Response	**c <00hex>**	
	c	Mode Type. **c = A:** Autonomous Mode **c = D:** Differential Mode **c = E:** Estimated Mode
	<00hex>	1 byte NULL terminator
Description	This command returns the Mode type used.	
Example	**Command Data:** M **MOTG Response:** A<00hex>	

4.1.14 Date (UTC/Greenwich Mean Time) – D (ascii)

Command	**cmd**	
	cmd	**D**(ascii) : Command header byte
Response	**ddmmyy <00hex>**	
	ddmmyy	days, months, years.
	<00hex>	1 byte NULL terminator
Description	This command returns the UTC date in days, months and years. 2 characters per each field.	
Example	**Command Data:** D **MOTG Response:** 220211<00hex>	

4.1.15 Time (UTC/Greenwich Mean Time) – E (ascii)

Command	**cmd**	
	cmd	**E**(ascii) : Command header byte
Response	**hhmmss.sss <00hex>**	
	hhmmss	hours, minutes, seconds.
	.	Decimal point indicator.
	sss	Decimal fraction of seconds.
	<00hex>	1 byte NULL terminator.
Description	This command returns the UTC time in hours, minutes, seconds and milliseconds.	
Example	**Command Data:** E **MOTG Response:** 064951.000<00hex>	

4.1.16 Date and Time (UTC/Greenwich Mean Time) – N (ascii)

Command	**cmd**	
	cmd	**N**(ascii) : Command header byte
Response	**ddmmyy,hhmmss.sss <00hex>**	
	ddmmyy	days, months, years.
	,	Comma separator
	hhmmss	hours, minutes, seconds.
	.	Decimal point indicator.
	sss	Decimal fraction of seconds.
	<00hex>	1 byte NULL terminator.
Description	This command returns the UTC date and time in days, months, years, hours, minutes, seconds and milliseconds.	
Example	**Command Data:** N **MOTG Response:** 220211,064951.000<00hex>	

4.1.17 Heading/Direction – H (ascii)

Command	**cmd**	
	cmd	**H**(ascii) : Command header byte
Response	**nnn.nn <00hex>**	
	nnn	Course in degrees
	.	Decimal point indicator
	nn	Fractions of degrees
	<00hex>	1 byte NULL terminator.
Description	This command returns the True Course of travel in degrees.	
Example	**Command Data:** H **MOTG Response:** 165.48<00hex>	

4.1.18 Speed in Knots – K (ascii)

Command	**cmd**	
	cmd	**K**(ascii) : Command header byte
Response	**n.nn <00hex>**	
	n	Speed in knots
	.	Decimal point indicator
	nn	Fractions of speed
	<00hex>	1 byte NULL terminator
Description	This command returns the measured horizontal speed in knots.	
Example	**Command Data:** K **MOTG Response:** 0.03<00hex>	

4.1.19 Speed in km/hr – S (ascii)

Command	**cmd**	
	cmd	**S**(ascii) : Command header byte
Response	**n.nn <00hex>**	
	n	Speed in km/hr
	.	Decimal point indicator
	nn	Fractions of speed
	<00hex>	1 byte NULL terminator
Description	This command returns the measured horizontal speed in km/hr.	
Example	**Command Data:** S **MOTG Response:** 0.06<00hex>	

4.1.20 Version-Device Info Request - V (ascii)

Command	**Cmd**	
	cmd	**V**(ascii) : Command header byte
Response	**device_type, hardware_rev, firmware_rev <00hex>**	
	device_type	This response indicates the device type. **G** = MOTG-GPS.
	,	Comma separator
	hardware_rev	This response indicates the device hardware version, current version = 0
	,	Comma separator
	firmware_rev	This response indicates the device firmware version, current version = 0
	<00hex>	1 byte NULL terminator
Description	This command requests all the necessary information from the device about its characteristics and capability.	

4.1.21 Disable MOTG – d (ascii)

Command	**cmd**	
	cmd	**d**(ascii) : Command header byte
Response	**acknowledge**	
	acknowledge	**06**(hex) : ACK byte if successful **15**(hex) : NAK byte if unsuccessful
Description	This command	disables the MOTG and puts it in low power mode.

4.1.22 Enable MOTG – e (ascii)

Command	**cmd**	
	cmd	**e**(ascii) : Command header byte
Response	**acknowledge**	
	acknowledge	**06**(hex) : ACK byte if successful **15**(hex) : NAK byte if unsuccessful
Description	This command	enables the MOTG and takes it out of low power mode.

5. NMEA Messages

The following table lists each of the NMEA output sentences and the following sections provide their relevant details. The individual command responses, in the previous section, are derived from these sentences.

NMEA OUTPUT SENTENCES	
Sentence	**Description**
GPGGA	Time, position and fix type data.
GPGSA	GPS receiver operating mode, active satellites used in the position solution, and DOP values.
GPGSV	The number of GPS satellites in view, satellite ID numbers, elevation, azimuth, and SNR values.
GPRMC	Time, date, position, course and speed data. Recommended Minimum Navigation Information.
GPVTG	Course and speed information relative to ground.

5.1 GPGGA – GPS Fixed Data. Time, Position and Fix Related Data.

This table 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

GPGGA Data Format			
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		**0:** Fix not available **1:** GPS Fix **2:** Differential GPS Fix
Satellites Used	8		Range 0 to 14
HDOP	0.95		Horizontal Dilution of Precision
MSL Altitude	39.9	meters	MOTG-GPS Altitude above/below mean-sea-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

5.2 GPGSA – GNSS DOP and Active Satellites.

This table 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

GPGSA Data Format			
Name	**Example**	**Units**	**Description**
Message ID	$GPGSA		GSA protocol header
Mode 1	A		**M:** Manual—forced to operate in 2D or 3D mode **A:** 2D Automatic—allowed to automatically switch 2D/3D.
Mode 2	3		**1:** Fix not available **2:** 2D (**<** 4 SVs used) **3:** 3D (≧4 SVs used)
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
HDOP	2.11		Vertical Dilution of Precision
Checksum	*00		
<CR> <LF>			End of message termination

5.3 GPGSV – GNSS Satellites in View.

This table 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

GPGSV Data Format			
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 1 (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

5.4 GPRMC – Recommended Minimum Navigation Information.

This table contains the values for the following example :
$GPRMC,064951.000,A,2307.1256,N,12016.4438,E,0.03,165.48,260406,,,A*55

GPRMC Data Format			
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		degrees	E = East or W = West **Note:** MOTG-GPS does not support magnetic declination.
Mode	A		**A:** Autonomous Mode **D:** Differential Mode **E:** Estimated Mode
Checksum	*55		
<CR> <LF>			End of message termination

5.5 GPVTG – Course and Speed Information Relative to Ground.

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

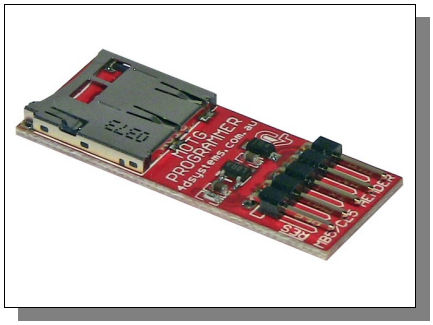
GPVTG Data Format			
Name	**Example**	**Units**	**Description**
Message ID	$GPVTG		VTG protocol header
Course	165.48	degrees	Measured Heading
Reference	T		True
Course		degrees	Measured Heading
Reference	M		Magnetic **Note:** MOTG-GPS does not support magnetic declination.
Speed	0.03	knots	Measured Horizontal 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	*37		
<CR> <LF>			End of message termination

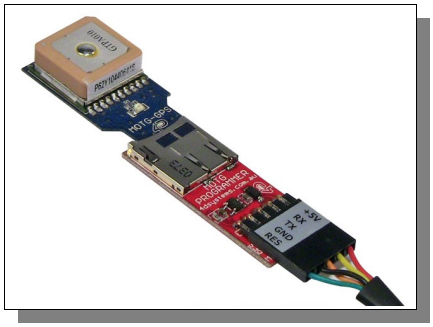
6. Development, Support and Test Tools

6.1 MOTG Programming Cable and Adaptor

The combination of the 4D-Programming-Cable and the MOTG-Program-Adaptor provides a convenient physical link between the PC and the MOTG module via the USB port. The MOTG module to PC link is required when:

- Testing the MOTG module with the 4D Embedded GPS Software Test Tool
- Programming the MOTG module with PmmC file

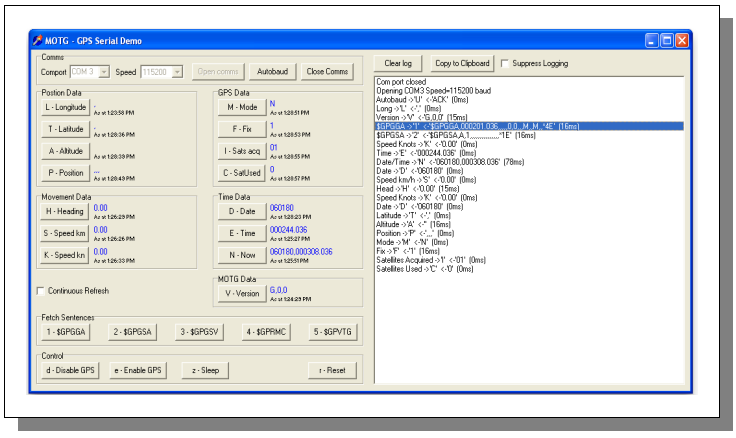




Note: The 4D-Programming-Cable and the MOTG-Program-Adaptor will need to be purchased separately.

6.2 4D Embedded GPS Software Test Tool

The 4D Embedded GPS Test tool is a free software tool to quickly test the functionality of the MOTG device using your PC, prior to writing any piece of embedded code for your platform to communicate with the MOTG-GPS module. The Test Software simulates the embedded host controller and provides an easy means of exercising the available commands.



Note: To use the MOTG module with the Test Software, you'll need to program the module with a special test PmmC file. Refer to section 6.3 on how to program a PmmC file. Latest test PmmC can be found here: www.4dsystems.com.au/downloads/MOTG/MOTG-GPS/PmmC/Test/

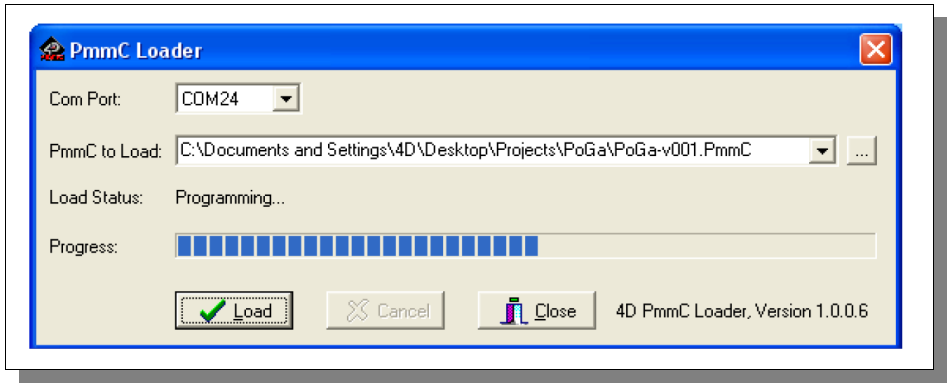
6.3 Programming the MOTG with a PmmC File

PmmC is an abbreviation of Personality-module-micro-Code. The GOLDLEOX chip used in the MOTG device is a custom controller and all functionality including the high level commands are built into the chip. This chip level configuration is available as a PmmC file and contains all of the low level micro-code information (analogy of that of a soft silicon) which define the characteristics and functionality of the MOTG device. The ability of programming the device with a PmmC file provides an extremely flexible method of customising as well as upgrading the MOTG with future enhancements.

As we make further improvements, we will release PmmC file updates and you should check regularly to benefit from these enhancements. You can download the latest version from here:
www.4dsystems.com.au/downloads/MOTG/MOTG-GPS/PmmC/Embedded/

To program the MOTG module with its PmmC file follow these steps:

- Download the PmmC-Loader Software tool.
- Run the PmmC Loader.
- Select the COM port your MOTG is attached to (using the Programming Cable & Adaptor).
- Select the MOTG PmmC file you've just downloaded. There's a small browser button on the right hand side to help you locate the file.
- Click the 'Load' button. The progress bar will inform you when the programming is done.

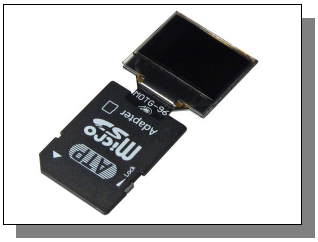


Note: The MOTG module is always shipped, factory programmed, with the latest PmmC file. It is advisable that you check regularly for the latest updates here:

www.4dsystems.com.au/downloads/MOTG/MOTG-GPS/PmmC/Embedded/

6.4 micro-SD to SD Adaptor

If your embedded hardware platform uses an SD connector, you'll need a micro-SD to SD adaptor. These should be readily available from most suppliers and are also available from 4D Systems online shopping cart.



7. Specifications and Ratings

Absolute Maximum Ratings	
Operating ambient temperature	-35°C to +75°C
Storage temperature	-40°C +80°C
Voltage on any digital input pin with respect to GND	-0.3V to 6.0V
Voltage on SWITCH pin with respect to GND	-0.3V to 6.0V
Voltage on VCC with respect to GND	-0.3V to 6.0V
Maximum current out of GND pin	300mA
Maximum current into VCC pin	250mA
Maximum output current sunk/sourced by any pin	4.0mA
Total power dissipation	1.0W

NOTE: Stresses above those listed here may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the recommended operation listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

Recommended Operating Conditions

Parameter	Conditions	Min	Typ	Max	Units
Supply Voltage (VCC)		3.0	3.3	3.6	V
Operating Temperature		-30	--	+70	°C
Input Low Voltage	SDI, CS pins	GND	--	0.8	V
Input High Voltage	SDI, CS pins	2.0	3.3	5.0	V
Reset Pulse	External Open Collector	2.0	--	--	µs
Operational Delay	Power-Up or External Reset	1000	--	--	ms

Global Characteristics based on Operating Conditions

Parameter	Conditions	Min	Typ	Max	Units
Supply Current (ICC)	VCC = 3.3V	60	65	75	mA
Output Low Voltage (VOL)	SDO pin, IOL = 3.4mA	--	--	0.4	V
Output High Voltage (VOH)	SDO pin, IOL = -2.0mA	2.4	--	3.3	V
Capacitive Loading	All pins	--	--	50	pF
Flash Memory Endurance	MOTG PmmC Programming	--	1000	--	E/W

Ordering Information

Order Code: MOTG-GPS
Package: 150mm x 95mm (ZIF Bag dimensions).
Packaging: Module sealed in antistatic padded ZIF bag.

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Contact Information

For Technical Support : support@4dsystems.com.au

For Sales Support : sales@4dsystems.com.au

Website : www.4dsystems.com.au