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mini+mighty

MULTI MICRO HORNET
ORG1510-MK04/MK05

GPS / GNSS MODULE WITH INTEGRATED ANTENNA

Datasheet

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1. SCOPE

This document describes the features and specifications of Multi Micro Hornet ORG1510-MK04 GNSS receiver module with integrated antenna.

2. DISCLAIMER

All trademarks are properties of their respective owners.
Performance characteristics listed in this document do not constitute a warranty or guarantee of product performance. OriginGPS assumes no liability or responsibility for any claims or damages arising out of the use of this document, or from the use of integrated circuits based on this document.
OriginGPS assumes no liability or responsibility for unintentional inaccuracies or omissions in this document.
OriginGPS reserves the right to make changes in its products, specifications and other information at any time without notice.
OriginGPS reserves the right to conduct, from time to time, and at its sole discretion, firmware upgrades. As long as those FW improvements have no material change on end customers, PCN may not be issued.
OriginGPS navigation products are not recommended to use in life saving or life sustaining applications.

3. SAFETY INFORMATION

Improper handling and use can cause permanent damage to the product.

4. ESD SENSITIVITY

This product is ESD sensitive device and must be handled with care.

5. CONTACT INFORMATION

Support - support@origingps.com or Online Form
Marketing and sales - marketing@origingps.com
Web – www.origingps.com

6. RELATED DOCUMENTATION

№	DOCUMENT NAME
1	Multi Micro Hornet – ORG1510 Evaluation Kit Datasheet
2	MTK NMEA Manual Packet 3.5
3	MTK FAQ
4	Feature List and Command Usage- ORG4033 and ORG1510MK-04

TABLE 1 – RELATED DOCUMENTATION

7. REVISION HISTORY

REVISION	DATE	CHANGE DESCRIPTION	Author
1.0	October 15, 2015	First release	Ori Adas
1.1	October 28, 2015	Orderable devices table	Ori Adas
1.2	November 2, 2015	Configuration update- default: GPS and GLONASS. GPS and BEIDOU- optional.	Ori Adas
1.3	January 12, 2016	Update of Related Documentation, Glossary, Power Consumption, Periodic Mode	Mark Kriger
1.4	January 19, 2016	1PPS options update	Ori Adas
1.5	January 31, 2016	Configuration settings remark	Ori Adas
1.6	July 19, 2016	Backup mode update	Ori Adas
1.7	August 17, 2016	RESET, WAKEUP updates	Ori Adas
1.8	August 28, 2016	Typo corrections	Mark Kriger
1.9	November 16, 16	Figure15 – Typical PCB stack-up update	Mark Kriger
2.0	November 24, 16	Table 8 - Sensitivity test remark	Mark Kriger
2.1	February 12, 2017	Periodic backup/standby mode update	Mark Kriger
2.2	March 14, 2017	MK05 update Mechanical Specification – dimension tolerances update	Mark Kriger
2.3	June 12, 2017	Pin out - I2C update	Mark Kriger
2.4	June 14, 2017	Galileo constellation support – starting from May 28, 2017	Mark Kriger
2.5	August 15, 2017	Pin Assignment for ORG1510-mk05 update Soldering Profile update Vbackup input range update Standby mode exit via I2C update Backup mode exit via SW command update	Mark Kriger
2.6	October 10, 2017	I2C specifications update Table 7 – Acquisition time update ,Hotstill-Easy update. Backup battery implementation for mk05 update	Mark Kriger
2.7	December 11, 17	Wakeup update, Backup mode update	Mark Kriger
2.8	March 14,2018	Chapter 16.2.2 update -	Mark Kriger
2.9	June 3, 2018	Update force on	Gil M
3.0	July 1, 2018	Update TYPICAL APPLICATION CIRCUIT	Gil M
3.1	July 11, 2018	Update GPS + BeiDou option ordering p/n	Gil M
3.2	July 12, 2018	Update pinout table and typical application circuit	Gil M
3.3	July 22, 2018	Update section 12.3.9.1	Gil M
3.4	5-Aug-18	Update backup mode	Gil M
3.5	27-Aug-18	Update dynamic constrains table	Gil M
3.6	12/30/18	Update layout recommendation	Gil
3.7	5/30/19	Hotstill update	Gil
3.8	Jun. 17, 19	Update on Standby mode	Gil

TABLE 2 – REVISION HISTORY

8. GLOSSARY

A-GPS **A**ssisted **GPS**
AC **A**lternating **C**urrent
ADC **A**nalog to **D**igital **C**onverter
AGC **A**utomatic **G**ain **C**ontrol
BPF **B**and **P**ass **F**ilter
C/N_0 **C**arrier to **N**oise density ratio [dB-Hz]
CDM **C**harged **D**evice **M**odel
CE European Community conformity mark
CEP **C**ircular **E**rror **P**robability
CMOS **C**omplementary **M**etal-**O**xide **S**emiconductor
CPU **C**entral **P**rocessing **U**nit
CTS **C**lear-**T**o-**S**end
CW **C**ontinuous **W**ave
DC **D**irect **C**urrent
DOP **D**ilution **O**f **P**recision
DR **D**ead **R**eckoning
DSP **D**igital **S**ignal **P**rocessor
ECEF **E**arth **C**entred **E**arth **F**ixed
ECHA **E**uropean **Ch**emical **A**gency
EGNOS **E**uropean **G**eostationary **N**avigation **O**verlay **S**ervice
EIA **E**lectronic **I**ndustries **A**lliance
EMC **E**lectro-**M**agnetic **C**ompatibility
EMI **E**lectro-**M**agnetic **I**nterference
ENIG **E**lectroless **N**ickel **I**mmersion **G**old
ESD **E**lectro-**S**tatic **D**ischarge
ESR **E**quivalent **S**eries **R**esistance
EU **E**uropean **U**nion
EVB **E**valuation **B**oard
EVK **E**valuation **K**it
FCC **F**ederal **C**ommunications **C**ommission
FSM **F**inite **S**tate **M**achine
GAGAN **G**PS **A**ided **G**eo-**A**ugmented **N**avigation
GNSS **G**lobal **N**avigation **S**atellite **S**ystem
GPIO **G**eneral **P**urpose **I**nput or **O**utput
GPS **G**lobal **P**ositioning **S**ystem
HBM **H**uman **B**ody **M**odel
HDOP **H**orizontal **D**ilution **O**f **P**recision
I^2C **I**nter-**I**ntegrated **C**ircuit
I/O **I**nput or **O**utput
IC **I**ntegrated **C**ircuit
ICD **I**nterface **C**ontrol **D**ocument
IF **I**ntermediate **F**requency
ISO **I**nternational **O**rganization for **S**tandardization
JEDEC **J**oint **E**lectron **D**evice **E**ngineering **C**ouncil
KA **K**eep **A**live
KF **K**alman **F**ilter
LDO **L**ow **Dropo**ut regulator
LGA **L**and **G**rid **A**rray
LNA **L**ow **N**oise **A**mplifier
LP **L**ow **P**ower

LS **L**east **S**quares
LSB **L**east **S**ignificant **B**it
MID **M**essage **Id**entifier
MM **M**achine **M**odel
MSAS **M**ulti-functional **S**atellite **A**ugmentation **S**ystem
MSB **M**ost **S**ignificant **B**it
MSL **M**oisture **S**ensitivity **L**evel
NFZ™ **N**oise-**F**ree **Z**ones **S**ystem
NMEA **N**ational **M**arine **E**lectronics **A**ssociation
NVM **N**on-**V**olatile **M**emory
PCB **P**rinted **C**ircuit **B**oard
PLL **P**hase **L**ock **L**oop
PMU **P**ower **M**anagement **U**nit
POR **P**ower-**O**n **R**eset
PPS **P**ulse **P**er **S**econd
PRN **P**seudo-**R**andom **N**oise
PSRR **P**ower **S**upply **R**ejection **R**atio
PTF™ **P**ush-**T**o-**F**ix
QZSS **Q**uasi-**Z**enith **S**atellite **S**ystem
RAM **R**andom **A**ccess **M**emory
REACH **R**egistration, **E**valuation, **A**uthorisation and Restriction of **Ch**emical substances
RF **R**adio **F**requency
RHCP **R**ight-**H**and **C**ircular **P**olarized
RMS **R**oot **M**ean **S**quare
RoHS **R**estriction of **H**azardous **S**ubstances directive
ROM **R**ead-**O**nly **M**emory
RTC **R**eal-**T**ime **C**lock
RTS **R**eady-**T**o-**S**end
SAW **S**urface **A**coustic **W**ave
SBAS **S**atellite-**B**ased **A**ugmentation **S**ystems
SID **S**ub-**Id**entifier
SIP **S**ystem **I**n **P**ackage
SMD **S**urface **M**ounted **D**evice
SMPS **S**witched **M**ode **P**ower **S**upply
SMT **S**urface-**M**ount **T**echnology
SOC **S**ystem **O**n **C**hip
SPI **S**erial **P**eripheral **I**nterface
SV **S**atellite **V**ehicle
TCXO **T**emperature-**C**ompensated Crystal **O**scillator
TTFF **T**ime **T**o **F**irst **F**ix
TTL **T**ransistor**-T**ransistor **L**ogic
UART **U**niversal **A**synchronous **R**eceiver/**T**ransmitter
VCCI **V**oluntary **C**ontrol **C**ouncil for **I**nterference by information technology equipment
VEP **V**ertical **E**rror **P**robability
VGA **V**ariable-**G**ain **A**mplifier
WAAS **W**ide **A**rea **A**ugmentation **S**ystem

9. ABOUT HORNET FAMILY

OriginGPS GNSS receiver modules have been designed to address markets where size, weight, stand-alone operation, highest level of integration, power consumption and design flexibility - all are very important.

OriginGPS' Hornet family breaks size barrier, offering the industry's smallest fully-integrated, highly-sensitive GPS and GNSS modules with integrated antennas or on-board RF connectors.

Hornet family features OriginGPS' proprietary NFZ™ technology for high sensitivity and noise immunity even under marginal signal condition, commonly found in urban canyons, under dense foliage or when the receiver's position in space rapidly changes.

Hornet family enables the shortest TTM (Time-To-Market) with minimal design risks.

Just connect power supply on a single layer PCB.

10. ABOUT MULTI MICRO HORNET MODULE

Micro Hornet is a complete SiP featuring miniature LGA SMT footprint designed to commit unique integration features for high volume cost sensitive applications.

Designed to support compact and traditional applications such as smart watches, wearable devices, asset trackers, Multi Micro Hornet ORG1510MK-04 module is a miniature multi-channel GPS and GLONASS/BEIDOU, Galileo, SBAS, QZSS overlay systems receiver that continuously tracks all satellites in view, providing real-time positioning data in industry's standard NMEA format.

Multi Micro Hornet ORG1510 module offers superior sensitivity and outstanding performance, achieving rapid TTFF in less than one second, accuracy of approximately two meters, and tracking sensitivity of -165dBm.

Sized only 10mm x 10mm Multi Micro Hornet ORG1510 module is industry's small sized, record breaking solution.

Multi Micro Hornet ORG1510 module is introducing industry's lowest energy per fix ratio, unparalleled accuracy and extremely fast fixes even under challenging signal conditions, such as in built-up urban areas, dense foliage or even indoor.

Integrated GPS SoC incorporating high-performance microprocessor and sophisticated firmware keeps positioning payload off the host, allowing integration in embedded solutions with low computing resources.

Innovative architecture can detect changes in context, temperature, and satellite signals to achieve a state of near continuous availability by maintaining and opportunistically updating its internal fine time, frequency, and satellite ephemeris data while consuming mere microwatts of battery power.

11. ABOUT ORIGINGPS

OriginGPS is a world leading designer, manufacturer and supplier of miniature positioning modules, antenna modules and antenna solutions.

System (NFZ™) proprietary technology for faster position fix and navigation stability even under challenging satellite signal conditions.

Founded in 2006, OriginGPS is specializing in development of unique technologies that miniaturize RF modules, thereby addressing the market need for smaller wireless solutions.

12. DESCRIPTION

12.1. FEATURES

- Autonomous operation
- Active antenna on-board
- Pin to pin compatible with all ORG1410/ORG1411 GPS and ORG1510-R01 GNSS modules
- OriginGPS Noise Free Zone System (NFZ™) technology
- Fully integrating:
  Antenna element, Dual-stage LNA, SAW filter, TCXO, RTC crystal, GNSS SoC, LDO regulator, RF shield
- Concurrent tracking of multiple constellations
- Uses GPS , GLONASS and GALILEO /BEIDOU, QZSS constellations.
- GPS L1 1575.42 frequency, C/A code
- GLONASS L1 FDMA 1598-1606MHz frequency band, SP signal.
- GALILEO E1 1575.42MHz frequency
- BEIDOU B1 1561.098MHz frequency band.
- SBAS (WAAS, EGNOS, MSAS and GAGAN)
- DGPS capability
- 99 search channels and 33 simultaneous tracking channels
- Ultra-high Sensitivity down to -165dBm enabling Indoor Tracking
- TTFF of < 1s in 50% of trials under Hot Start conditions
- Low Power Consumption of ≤ 15mW
- High Accuracy of < 2.5m in 50% of trials
- AGPS support: Embedded Assist System (EASY) and Extended Prediction Orbit (EPO)
- Indoor and outdoor Multipath and cross-correlation mitigation
- Jamming Rejection – 12 multi-tone Active Interference Cancellation (AIC)
- 8 Megabit built in flash
- Power management modes: Full Power Continuous, Standby, Periodic and AlwaysLocate™
- NMEA commands and data output over UART serial interface or I2C
- High update messages rate of 1,2,5,10Hz
- 1PPS Output
- Static Navigation
- Single voltage supply 3.3V
- Ultra-small LGA footprint of 10mm x 10mm
- Ultra-low weight of 2.4g
- Surface Mount Device (SMD)
- Optimized for automatic assembly and reflow equipment
- Operating from -40°C to +85°C
- FCC, CE, VCCI compliant

- RoHS II/REACH compliant

12.2. ARCHITECTURE

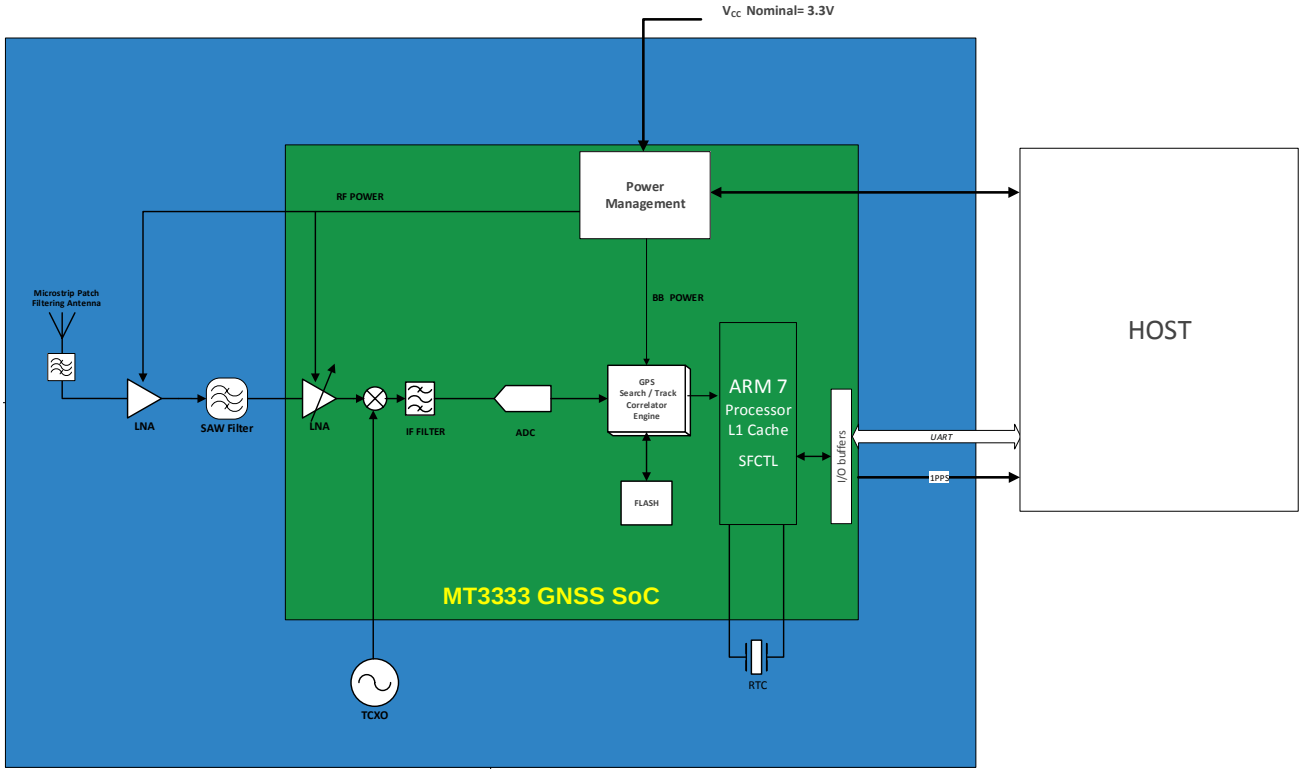


FIGURE 1 – ORG1510-MK04 ARCHITECTURE

- **Antenna**

  OriginGPS proprietary Microstrip Patch Antenna collects GNSS signals from the medium. Antenna is built from hi-K ceramic element mounted on top of RF shield, providing stable resonance.

- **GNSS SAW Filter**

  Band-Pass SAW filter eliminates out-of-band signals that may interfere to GNSS reception.

  GNSS SAW filter is optimized for low Insertion Loss in GNSS band and low Return Loss outside it.

- **GNSS LNA**

  Dual-stage cascaded LNAs amplify GNSS signals to meet RF down converter input threshold. Noise Figure optimized design was implemented to provide maximum sensitivity.

- **TCXO**

  Highly stable 26MHz oscillator controls down conversion process in RF block of the GNSS SoC. Characteristics of this component are important factors for higher sensitivity, shorter TTFF and better navigation stability.

- **RTC crystal**

  RTC 32.768 KHz quartz crystal with very tight specifications is necessary for maintaining Hot Start and Warm Start capabilities of the module.

- **RF Shield**

  RF enclosure avoids external interference from compromising sensitive circuitry inside the module.

  RF shield also blocks module's internal high frequency emissions from being radiated.

MT3333 GNSS SoC

The MT3333, multi-GNSS System on Chip designed by MediaTek, which is the world's leading digital media solution provider and largest fab-less IC Company in Taiwan.
It is a hybrid positioning processor that combines GPS, GLONASS, GALILEO, BEIDOU, SBAS, QZSS, DGPS and AGPS to provide a high-performance navigation solution.
MT3333 is a full SoC built on a low-power RF CMOS, incorporating GNSS RF, GNSS baseband, integrated navigation solution software, ARM® processor and serial flash.

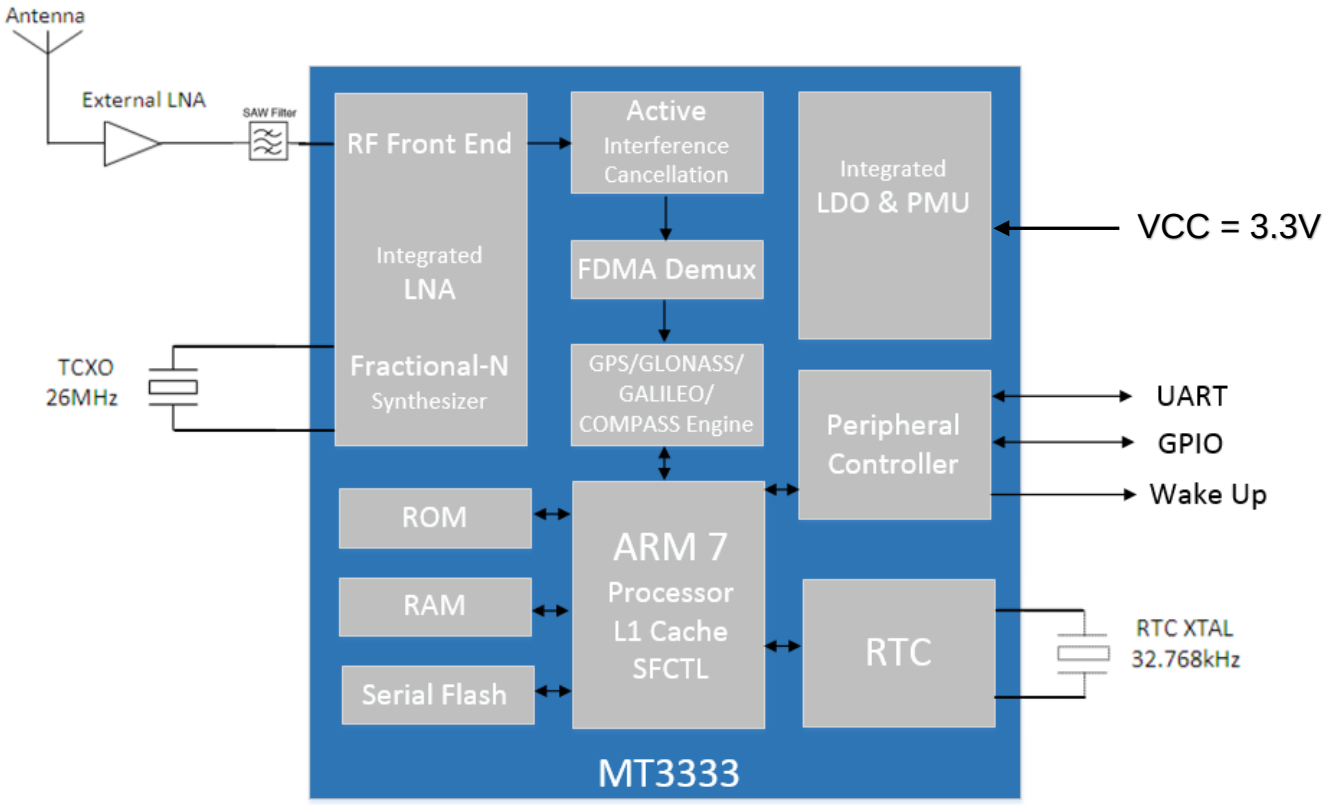


FIGURE 2 – MT3333 SYSTEM BLOCK DIAGRAM AND PERIPHERAL

MT3333 SoC includes the following units:

- GNSS radio subsystem containing single input dual receive paths for concurrent GPS, GLONASS and Galileo or GPS and BEIDO, mixer with current mode interface between the mixer and multi-modes low pass filter, fractional-N synthesizer, integrated self-calibrating filters, IF VGA with AGC, high-sample rate ADCs with adaptive dynamic range.
- Measurement subsystem including DSP core for GNSS signals acquisition and tracking, interference scanner and detector, interference removers, multipath and cross-correlation detectors, dedicated DSP code ROM and DSP cache RAM.
- Measurement subsystem interfaces GNSS radio subsystem.
- Navigation subsystem comprising ARM7® microprocessor system for position, velocity and time solution, program ROM, data RAM, cache and patch RAM and SPI flash.
- Peripheral Controller subsystem containing UART Host interface, RTC block, wake up signal option, and GPIO.
- Peripheral Controller subsystem interfaces navigation subsystem, PLL and PMU subsystems.
- Navigation subsystem interfaces measurement subsystem.
- PMU subsystem containing voltage regulators for RF and baseband domains.

12.3. ORG1510-MK04 FEATURES DESCRIPTION:

12.3.1 CONSTELLATION CONFIGURATION

- GPS, GLONASS and GALILEO – default since 28.5.2017.
- GPS and GLONASS- default (prior to 28.5.2017).
- GPS and BEIDOU- available (Use P/N ORG1510 MK14 for this option).
  For ordering this option contact marketing@origingps.com

12.3.2 1PPS

1PPS (Pulse Per Second) signal output available on configuration:

- At 2D Fix only.
- At 3D Fix only.
- After the first Fix
- **Always- default configuration.**

For ordering other 1PPS options contact marketing@origingps.com

The pulse is configurable for required duration, frequency and active high/low via command.

The pulse may vary 30nS (1 σ). The relationship between the PPS signal and UTC is unspecified.

12.3.3 Static Navigation

Static Navigation is an operational mode in which the receiver will freeze the position fix when the speed falls below a threshold (indicating that the receiver is stationary). The course is also frozen, and the speed is reported as 0. The navigation solution is then unfrozen when the speed increases above a threshold or when the computed position exceeds a set distance from the frozen position (indicating that the receiver is again in motion. The speed threshold can be set via a command. Static Navigation is disabled by default, but can be enabled by command. This feature is useful for applications in which very low dynamics are not expected, the classic example being an automotive application.

12.3.4 Assisted GPS (AGPS)

Assisted GPS (or Aided GPS) is a method by which TTFF is reduced using information from a source other than broadcast GPS signals. The necessary ephemeris data is calculated either by the receiver itself (locally-generated ephemeris) or a server (server-generated ephemeris) and stored in the module.

ORG1510-MK04 has EASY, EPO and HotStill technology to allow for Hot Starts even in weak signal conditions and moving start-ups. EPO (Extended Prediction Orbit) is one of MediaTek's innovative proprietary off-line server based AGPS solution. Host could use an application to store and load the EPO files into device. With multi-constellation EPO, the user experience will be enhanced by the improved Time To First Fix (TTFF) and better first fix accuracy.

12.3.4.1 Locally-generated AGPS (Embedded Assist System – EASY)

The EASY™ is embedded assist system for quick positioning, the GPS engine will calculate and predict automatically the single emperies (Max. up to 3 days) when power on, and save the predict information into the memory, GPS engine will use these information for positioning if no enough information from satellites, so the function will be helpful for positioning and TTFF improvement under indoor or urban condition**.**

<u>Up to 3 days</u> extension for single received ephemeris:

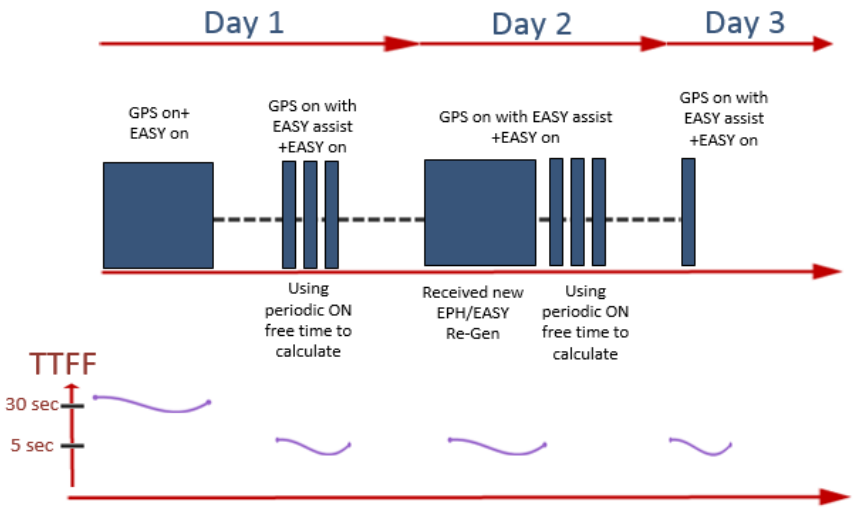


FIGURE 3 – EASY™ TTFF TIMING

12.3.4.2 Server-generated AGPS (Extended Prediction Orbit – EPO)

The AGPS (EPO™) supply the predicated Extended Prediction Orbit data to speed TTFF ,users can download the EPO data to GNSS engine from the FTP server by internet or wireless network ,the GNSS engine will use the EPO data to assist position calculation when the navigation information of satellites are not enough or weak signal zone . Host could use an application to store and load the EPO files into device. With multi- Constellation EPO, the user experience will be enhanced by the improved Time To First Fix (TTFF) and better first fix accuracy. The predicted ephemeris file is obtained from the AGPS server and is injected into the module over serial port 1 (RX1). These predictions do not require local broadcast ephemeris collection, and they are valid for up to 14 days.

12.3.4.3 HotStill – EASY (Extended Prediction Orbit)

HotStill (EASY) is one of MTK's innovative proprietary Off-line client based A-GPS solution which could greatly accelerate GPS TTFF (Time to First Fix) in urban canyon or weak signal environment from several minutes to only few seconds. It works as a background software running on the host processor to predicate satellite orbit navigation data and generate Broadcast Ephemeris Extension (BEE) from received broadcast ephemeris as well as no network connection requirements. Hotstill feature is designed for use on smartphones and it's not suitable for standalone designs.

12.3.5 Quasi-Zenith Satellite System (QZSS)

The three satellites of the Japanese SBAS are in a highly-inclined elliptical orbit which is geosynchronous (not geostationary) and has analemma-like ground tracks. This orbit allows continuous coverage over Japan using only three satellites. Their primary purpose is to provide augmentation to the GPS system, but the signals may also be used for ranging. NMEA reporting for QZSS may be enabled/disabled by the user.

12.3.6 Satellite-Based Augmentation System (SBAS)

The ORG1510-MK04 receiver is capable of using Satellite-Based Augmentation System (SBAS) satellites as a source of both differential corrections and satellite range measurements. These systems (WAAS, EGNOS, MSAS, and GAGAN) use geostationary satellites to transmit regional differential corrections via a GNSS-compatible signal. The use of SBAS corrections can significantly improve position accuracy, and is enabled by default.

12.3.7 Differential GPS (DGPS)

DGPS is a Ground-Based Augmentation System (GBAS) for reducing position errors by applying corrections from a set of accurately-surveyed ground stations located over a wide area. These reference stations measure the range to each satellite and compare it to the known-good range. The differences can then be used to compute a set of corrections which are transmitted to a DGPS receiver, either by radio or over the internet. The DGPS receiver can then send them to the serial port 1 (RX1) using the RTCM SC-104 message protocol. The corrections can significantly improve the accuracy of the position reported to the user. The receiver can accept and apply either the RTCM SC-104 messages or SBAS differential data.

12.3.8 Jamming Rejection – Active Interference Cancellation (AIC)

The ORG1510-MK04 detect, track and removes narrow-band interfering signals (jamming signals) without the need for external components or tuning. It tracks and removes up to 12 CW (Continuous Wave) type signals up to –80 dBm (total power signal levels). By default, the jamming detection is enabled but can be disabled by command. This feature is useful both in the design stage and during the production stage for uncovering issues related to unexpected jamming. When enabled, AIC will increase current consumption by about 1 mA. Impact on GNSS performance is minimal at low jamming levels, however at high jamming levels (e.g. -90 to -80 dBm), the RF signal sampling ADC starts to become saturated after which the GNSS signal levels start to diminish.

12.3.9 Power Management Modes

The ORG1510-MK04 support operational modes that allow them to provide positioning information at reduced overall current consumption. Availability of GNSS signals in the operating environment will also be a factor in choice of power management modes. The designer can choose a mode that provides the best trade-off of performance versus power consumption.

The power management modes are described below, and can be enabled via command:

- **Full Power Continuous- for best GNSS performance**
- **Power save mode to optimize power consumption:**
  - **Standby**
  - **Periodic**
  - **AlwaysLocate™**
- **Backup mode**

12.3.9.1 Full Power Continuous Mode

The modules start up in full power continuous mode. This mode uses the acquisition engine at full performance resulting in the shortest possible TTFF and the highest sensitivity. It searches for all possible satellites. The receiver then switches to the tracking engine to lower the power consumption when:

- A valid GPS/GNSS position is obtained
- The ephemeris for each satellite in view is valid

To return to Full Power mode (from a low power mode, excluding Backup mode), send the following command: **PMTK225,0** [Just after the module wakes up from its previous sleep cycle].

12.3.9.2 Standby Mode

In this mode, the receiver stops navigation, the internal processor enters standby state, and the current drain at main supply (VCC) is reduced. Standby mode is entered by sending only one of following command:

PMTK161,0 – Standby stop mode = Turn off VTCXO, RF and baseband.

PMTK161,1– Standby sleep mode = Turn off RF and baseband.

The host can then wake up the module from Standby mode to Full Power mode by sending any byte to the serial port.

Please notice: it is not possible to wake up the module from Standby Mode via **I2C** interface.
In case you are using **I2C** interface – please use Backup mode (see page 19 – section 12.3.9.5).
It is possible to exit from backup mode to active mode only by hardware- by applying high signal on Force_On pad.

12.3.9.3 Periodic Mode

This mode allows autonomous power on/off with reduced fix rate to reduce average power consumption. In periodic mode, the main power supply VCC is still powered, but power distribution to internal circuits is controlled by the receiver.

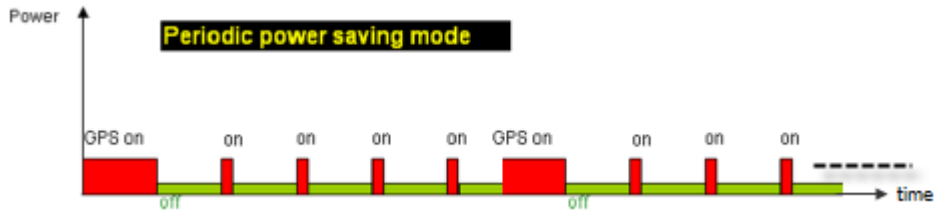


FIGURE 4 – PERIODIC POWER SAVING MODE

Enter periodic mode by sending the following command:

PMTK225,<Type>,<Run_time>,<Sleep_time>,<2nd_run_time>,<2nd_sleep_time>*<checksum>

Where:

- Type = 1 for Periodic backup mode,
  Type = 2 for Periodic standby mode
- Run_time = Full Power period (ms)
- Sleep_time = Standby period (ms)
- 2nd_run_time = Full Power period (ms) for extended acquisition if GNSS acquisition fails during Run_time.
- 2nd_sleep_time = Standby period (ms) for extended sleep if GNSS acquisition fails during Run_time

Example: **PMTK225,2,3000,12000,18000,72000**

for periodic mode with 3 s navigation and 12 s sleep. The acknowledgement response for this command is: **PMTK001,225,3**

Periodic mode is exited back to Full Power Continuous Mode by sending the command: **PMTK225,0** just after the module wakes up from a previous sleep cycle.

12.3.9.4 AlwaysLocate™ Mode

AlwaysLocate™ is an intelligent controller of the Periodic mode; the main power supply VCC is still powered up, but power distribution is internally controlled. Depending on the environment and motion conditions, the module can autonomously and adaptively adjust the parameters of the Periodic mode, e.g. ON/OFF ratio and fix rate to achieve a balance in positioning accuracy and power consumption. The average current can vary based on conditions.

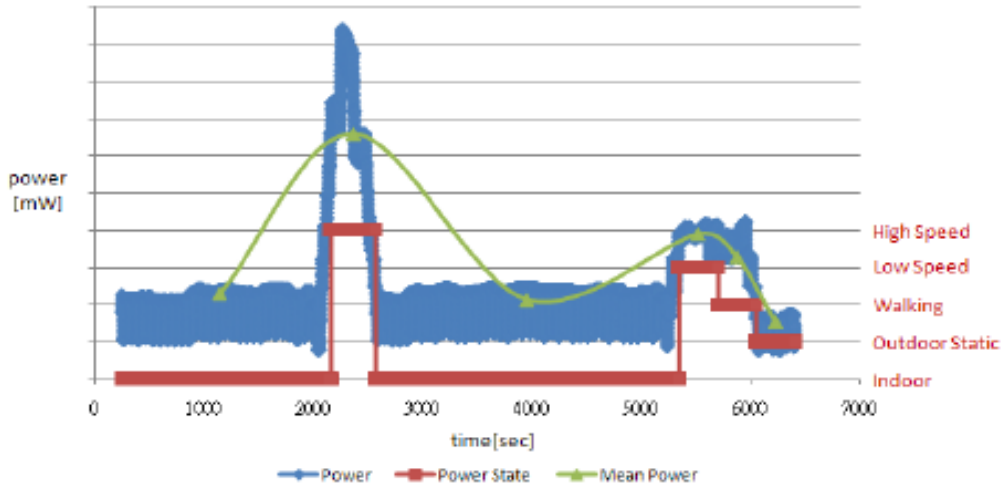


FIGURE 5 – AlwaysLocate™ MODE: POWER VS. TIME

Enter AlwaysLocate™ mode by sending the following NMEA command:

PMTK225,<mode>*<checksum><CR><LF>

Where: mode=9 for AlwaysLocate™

Example:

PMTK225,9

The acknowledgement response for the command is:

PMTK001,225,3

The user can exit low power modes to Full Power by sending NMEA command:

PMTK225,0

Just after the module wakes up from its previous sleep cycle.

12.3.9.5 Backup Mode

Backup Mode means a low quiescent power state where receiver operation is stopped.
The VCC (in ORG1510-mk04) / V_backup (in ORG1510-mk05) is powered on but the current consumption is minimal.
After waking up, the receiver uses all internal aiding, including GNSS time, Ephemeris, and Last Position, resulting in the fastest possible TTFF in either hot or warm start modes. During Backup State, the I/O block is powered off. The suggestion is that the host forces its outputs to a low state or to a high-Z state during the Backup State to minimize small leakage currents at receiver's input signals.

The Current consumption is ~7uA in BACKUP mode.

Entering Backup Mode:
Entering Backup Mode is done differently for ORG1510-mk04 and ORG1510-mk05.
For ORG1510-mk04 / MK05 entering to backup mode is done by a NMEA software command – PMTK225,4 (+checksum).
Important: Before sending the command the FORCE_ON pin [pin 1] must be tied to ground.
While in Backup mode, the module will consume ~7uA from VCC.
In case the command is sent while the FORCE_ON is not tied to the ground – the module would get into idle state, but not BACKUP mode, and the current consumption would be significantly higher.
The Current consumption is ~7uA in BACKUP mode while pin 1 of module is tied to ground with jumper. In real cases pin 1 is grounded by active device with residue resistance differ from zero so current consumption may be 2-3 times higher i.e. 20uA.

FORCE_ON must be tied to ground as long as you need to stay in BACKUP mode.

Example:
PMTK225,4 Enter backup mode

NMEA Return feedback:
PMTK001,225,3

Module will stay in BACKUP mode while FORCE ON is tied to ground.
To Exit from BACKUP mode, disconnect FORCE_ON from ground and pull the FORCE_On to high level, wait about 1 sec and then release it to logic low again.

Important: It is not possible to wake up the module from backup mode by software command.

For ORG1510-mk05 Entering the BACKUP mode is done also by disconnecting VCC and keeping the V_backup connected . The module will consume 7uA from V_backup. Ones the VCC is connected again, the module would switch into active state and acquire a hot start. Force_on needs to remain low during the entire process.

12.3.10 Configuration settings

Currently, the configuration settings will be erased after turning down the power.

Be aware to this issue on power cycles while shutting down the module.

12.4. PADS ASSIGNMENT – ORG1510-MK04 / MK05

PAD	NAME	FUNCTION	DIRECTION	Logic level	ORG1510 MK05
1	FORCE ON	Forced full-power mode signal – Active Low	Input	2.8 V	Same
2	1PPS	UTC Time Mark	Output	2.8V	Same
3	TX	UART Transmit (Serial Output)	Output	2.8V	Same
4	V_{CC}	System Power	Power	3.3V	Same
5	GND	System Ground	Power		Same
6	WAKEUP	GPIO12/ WAKEUP/ EINT0	Output	2.8V	Same
7	CTS	UART Clear To Send/ I2C DATA	Input /Output	2.8V	Same
8	$\overline{\text{RESET}}$	System Reset– Active Low	Input	2.8V	Battery input**
9	RTS	UART Ready To Send/ I2C CLOCK	Input /Output	2.8V	Same
10	RX	UART Receive (Serial Input)	Input	2.8V	Same

TABLE 3 – ORG1510-MK04 PIN-OUT

** Battery range 2.8 – 4.3 Dc Volts

BOTTOM VIEW

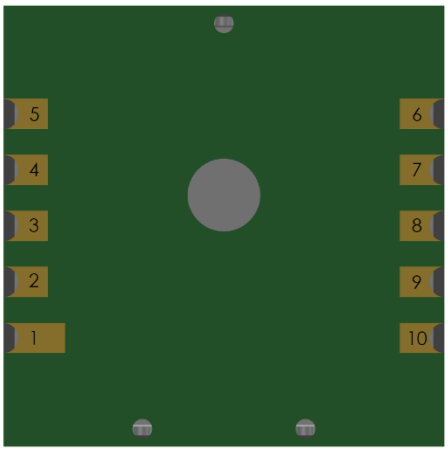


FIGURE 6 – PADS ASSIGNMENT

13. MECHANICAL SPECIFICATIONS

- ORG1510 module has advanced ultra-miniature LGA SMD packaging sized 10mm x 10mm.
- ORG1510 built on a PCB assembly enclosed with metallic RF shield box and antenna element on top of it.
- There are 10 castellated LGA SMT pads made Cu base and ENIG plating on bottom side.

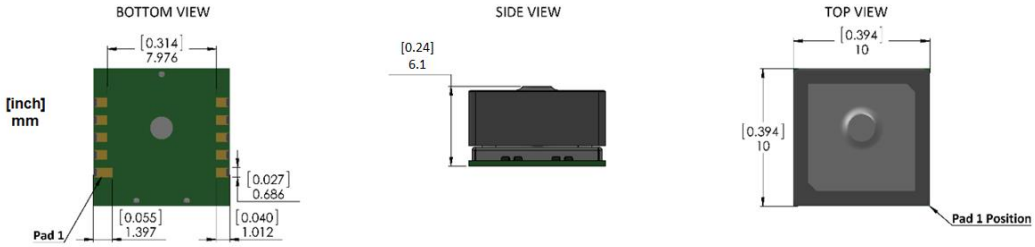


FIGURE 7 – MECHANICAL DRAWING

Dimensions	Length	Width	Height
mm	10.00 +0.20/ -0.05	10.00 +0.30/ -0.05	6.1 +0.20/ -0.05
inch	0.394 +0.008/ -0.002	0.394 +0.012/ -0.002	0.24 +0.008/ -0.002

***Weight**: 2.4 Gram, 0.08 Oz

TABLE 4 – MECHANICAL SUMMARY

14. ELECTRICAL SPECIFICATIONS

14.1. ABSOLUTE MAXIMUM RATINGS

Stresses exceeding Absolute Maximum Ratings may damage the device.

PARAMETER		SYMBOL	MIN	MAX	UNIT
Power Supply Voltage		V_{CC}	-0.30	+4.3	V
Backup Battery Supply Voltage		V_{backup}	-0.30	+4.3	V
Power Supply Current[1]		I_{CC}		100	mA
RF Input Voltage[2]		V_{RF}	-0.30	+3.6	V
I/O Voltage		V_{IO}	-0.30	+3.6	V
I/O Source/Sink Current		I_{IO}		+8	mA
ESD Voltage		$V_{IO/RF,\ HBM\ Model}$[3]	(-/+) 1000	(-/+) 3000	V
		$V_{IO/RF,\ MM\ Model}$[4]	(-/+) 100	(-/+) 300	V
RF Power[5]	f_{IN} = 1560MHz÷1630MHz	P_{RF}		+10	dBm
	f_{IN} <1560MHz, >1630MHz			+30	dBm
Operating Temperature		T_{AMB}	-45	+90	°C
Storage Temperature		T_{ST}	-50	+125	°C
Lead Temperature[6]		T_{LEAD}	-5	+260	°C

TABLE 5 – ABSOLUTE MAXIMUM RATINGS

Notes:

1. Inrush current of up to 100mA for about 20µs duration.
2. Voltage applied on antenna element.
3. Human Body Model (HBM) contact discharge per EIA/JEDEC JESD22-A114D. Step: 500V (+/-).
4. Machine Model (MM) contact discharge per EIA/JEDEC JESD22-A115C. Step: 50V (+/-).
5. Power delivered to antenna element.
6. Lead temperature at 1mm from case for 10s duration.

14.2. RECOMMENDED OPERATING CONDITIONS

Exposure to stresses above Recommended Operating Conditions may affect device reliability.

PARAMETER	SYMBO	MODE / PAD	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Power supply voltage	V_{CC}	V_{CC}		+3	+3.3	+3.6	V
Backup Battery supply voltage ORG1510-MK05 only	V_{backup}	V_{backup}		+2.9	+3.3	+3.6	V
Input pin voltage range	Vin			-0.3		+3.6	V
Digital IO Pin Low level input voltage	Vil			-0.3		+0.7	V
Digital IO Pin High level input voltage	Vih			+2.1		+3.6	V
Digital IO Pin Low level output voltage	Vol		Iol=2mA	-0.3		+0.4	V
Digital IO Pin High level output voltage	Voh		Ioh=2mA	+2.4	+2.8	+3.1	V
Power Supply Current[1]	I_{CC}	Acquisition	GPS		23	32	mA
			GPS+GLONASS		28	32	mA
		Tracking	GPS		20.2		mA
			GPS+GLONASS		24		mA
		Standby				0.5	mA
		backup			10		µA
Input Impedance	Z_{IN}	RF Input	f_{IN} = 1575.5MHz		50		Ω
Input Return Loss	R_{LIN}			-7			dB
Input Power Range	P_{IN}		GPS or GLONASS	-165		-110	dBm
Input Frequency Range	f_{IN}			1560		1620	MHz
Operating Temperature	T_{AMB}			-40	+25	+85	°C
Storage Temperature[2]	T_{ST}			-50	+25	+125	°C
Relative Humidity[3]	R_H		T_{AMB}	5		95	%

TABLE 6 – RECOMMENDED OPERATING CONDITIONS

Notes:

1. Typical values under static signal conditions of -130dBm and ambient temperature of +25°C and low gain configuration.
2. Longer TTFF is expected while operating below -30°C to -40°C.
3. Relative Humidity is within Operating Temperature range.

15. PERFORMANCE

15.1. ACQUISITION TIME

TTFF (Time To First Fix) – is the period of time from module's power-up till valid position estimation.

15.1.1. HOT START

Hot Start results either from a software reset after a period of continuous navigation or a return from a short idle period that was preceded by a period of continuous navigation.
During Hot Start all critical data (position, velocity, time, and satellite ephemeris) is valid to the specified accuracy and available in RAM.

15.1.2. SIGNAL REACQUISITION

Reacquisition follows temporary blocking of GNSS signals.
Typical reacquisition scenario includes driving through tunnel.

15.1.3. AIDED START

Aided Start is a method of effectively reducing TTFF by providing valid satellite ephemeris data. Aiding can be implemented using Embedded Assist System (EASY) and Extended Prediction Orbit (EPO).

15.1.4. WARM START

Warm Start typically results from user-supplied position and time initialization data or continuous RTC operation with an accurate last known position available in RAM.
In this state position and time data are present and valid, but satellite ephemeris data validity has expired.

15.1.5. COLD START

Cold Start occurs when satellite ephemeris data, position and time data are unknown.
Typical Cold Start scenario includes first power application.

OPERATION[1]	MODE	VALUE	UNIT
Hot Start		< 1	s
Aided Start[3]		< 3	s
Warm Start	GPS + GLONASS	< 23	s
	GPS	< 29	s
Cold Start	GPS + GLONASS	< 23	s
	GPS	< 31	s
Signal Reacquisition[2]		< 3	s

TABLE 7 – ACQUISITION TIME

Notes:

1. EVK is 24-hrs. Static under signal conditions of -130dBm and ambient temperature of +25°C.
2. Outage duration ≤ 30s.
3. Dependent on aiding data connection speed and latency

15.2. SENSITIVITY

15.2.1. TRACKING

Tracking is an ability of receiver to maintain valid satellite ephemeris data.
During tracking receiver may stop output valid position solutions.
Tracking sensitivity defined as minimum GNSS signal power required for tracking.

15.2.2. REACQUISITION

Reacquisition follows temporary blocking of GNSS signals.
Reacquisition sensitivity defined as minimum GNSS signal power required for reacquisition.

15.2.3. NAVIGATION

During navigation receiver consequently outputs valid position solutions.
Navigation sensitivity defined as minimum GNSS signal power required for reliable navigation.

15.2.4. HOT START

Hot Start sensitivity defined as minimum GNSS signal power required for valid position solution under Hot Start conditions.

15.2.5. AIDED START

Aided Start sensitivity defined as minimum GNSS signal power required for valid position solution following aiding process.

15.2.6. COLD START

Cold Start sensitivity defined as minimum GNSS signal power required for valid position solution under Cold Start conditions, sometimes referred as ephemeris decode threshold.

OPERATION[1]	MODE	VALUE	UNIT
Tracking	GPS	-165	dBm
	GLONASS	-165	dBm
Navigation	GPS	-163	dBm
	GLONASS	-163	dBm
Reacquisition[2]	GPS+GLONASS	-160	dBm
Hot Start	GPS+GLONASS	-163	dBm
Aided Start	GPS+GLONASS	-160	dBm
Cold Start	GPS+GLONASS	-148	dBm

TABLE 8 – SENSITIVITY

** The above values have been tested at update rate of 1 Hz.
While working in a higher update rate there is some signal degradation.

15.3. RECEIVED SIGNAL STRENGTH

PARAMETER[4]	VALUE	UNIT
C/N_0	45	dB-Hz

TABLE 9 – RECEIVED SIGNAL STRENGTH

Notes:

1. EVK is static, ambient temperature is +25°C.
2. Outage duration ≤ 30s.
3. Aiding using Broadcast Ephemeris (Ephemeris Push™) or Extended Ephemeris (CGEE™ or SGEE™).
4. Average C/N_0 reported for 4 SVs, EVK is 24-hrs. Static, outdoor, ambient temperature is +25°C.

15.4. POWER CONSUMPTION

OPERATION[1]	MODE	VALUE	UNIT
Acquisition	GPS	75.5	mW
	GPS + GLONASS	91.8	mW
Tracking	GPS	66.2	mW
	GPS + GLONASS	78.7	mW
Periodic: Low Power Tracking	15 sec asleep 3 sec awake	14.5	mW
Standby state		1.65	mW
Backup state		49.5	uW

TABLE 10 – POWER CONSUMPTION

Note:

1. Typical values under static signal conditions of -130dBm and ambient temperature of +25°C. Measured voltage= 3.28V.

15.5. POSITION ACCURACY

Parameter	Constellation	CEP[1] (m)
Horizontal Position Accuracy	GPS	2.5
Horizontal Position Accuracy	Glonass	2.6
Horizontal Position Accuracy	BeiDou	10.2
Horizontal Position Accuracy	GPS + Glonass	2.5
Horizontal Position Accuracy	GPS + BeiDou	2.5

TABLE 11 – ORG1510-MK04 POSITION ACCURACY

Notes:

1. Module is static under signal conditions of -130dBm, ambient temperature is +25°C.

15.6. DYNAMIC CONSTRAINS

PARAMETER	Metric	Imperial
Velocity	515m/s	1,000knots
Altitude	10000m	32808ft
Altitude Balloon mode	80000m	262467 ft
Acceleration	4g	

TABLE 12 – DYNAMIC CONSTRAINS

Note:

1. Standard dynamic constrains according to regulatory limitations.

16. INTERFACE

16.1. POWER SUPPLY

It is recommended to keep the power supply on all the time in order to maintain RTC block active and keep satellite data in RAM for fastest possible TTFF. When V_{CC} is removed settings are reset to factory default and the receiver performs Cold Start on next power up.

16.1.1. Nominal VCC = 3.3V

V_{CC} is 3.3v DC and must be provided from regulated power supply.
During tracking the processing is less intense compared to acquisition, therefore power consumption is lower.
Filtering is important to manage high alternating current flows on the power input connection.
An additional LC filter on ORG1510-MK04 power input may be needed to reduce system noise.
The high rate of ORG1510-MK04 input current change requires low ESR bypass capacitors.
Additional higher ESR output capacitors can provide input stability damping.
The ESR and size of the output capacitors directly define the output ripple voltage with a given inductor size. Large low ESR output capacitors are beneficial for low noise.

16.1.2. GROUND

Ground pad must be connected to host PCB Ground with shortest possible trace or by multiple VIAs.

16.2. CONTROL INTERFACE

16.2.1 UART- HOST INTERFACE

Multi Micro Hornet ORG1510-MK04 has a standard UART port:

16.2.1.1 TX

TX used for GPS data reports. Output logic high voltage level is 2.8V.
The TX serial data line outputs NMEA serial data at a default bit rate of 9600 bps.
When no serial data is being output the TX data line idles high.

16.2.1.2 RX

RX used for receiver control. Input logic high voltage level is 2.8V.
The RX data line accepts NMEA commands at a default bit rate of 9600 bps.
When the receiver is powered down, do not back drive this or any other GPIO line.
The idle state for serial data from the host computer is logic 1.

16.2.2 I2C- HOST INTERFACE

ORG1510-mk has a standard I2C interface.
I2C interface in enabled by default starting from F.W version 5.1.1.
The I2C interface pads are: I2C Data – pad 7 – CTS I2C Clock – pad 9 – RTS.
I2C host interface features are:

- I2C Slave mode – host initiates clock and data, operating speed 400kbps.
- ORG1510-mk support 7 bit I 2C address.
- I2C default slave address ‘0x10’.
- Individual Tx FIFO buffer length of 255 bytes. Master can read one I2C data packet of max. 255 bytes at a time.
- In order to read entire NMEA packet of one second, master need to read several I2C data packets and extract valid NMEA data. After reading one I2C data packet, sleep 2ms before reading the next packet. In case entire packet of 1 second was read, wait for a longer period for the next NMEA packet.

16.3. HARDWARE INTERFACE

16.3.1 FORCE-ON

Entering into BACKUP mode by sending SW command and tied to ground the FORCE_ON pin [pin 1].
FORCE_ON must be tied to ground in order to stay in BACKUP mode.
Module will stay in BACKUP mode while FORCE ON is tied to ground.
To Exit from BACKUP mode, disconnect FORCE_ON from ground and force full power.
When inactive, it should be floating.

16.3.2 RESET

(Valid only for mk04)

In addition, to NMEA command for reset- $PMTK104*37, external reset is available through $\overline{\text{RESET}}$ pad. Active low signal. Signal logic level of 2.8V.

16.3.3 1PPS

Pulse-Per-Second (PPS) output provides a pulse signal for timing purposes.
The pulse is configurable for required duration, frequency and active high/low via command.
The pulse may vary 30 nS (1 σ). The relationship between the PPS signal and UTC is unspecified.
Use Proprietary Mediatek command PMTK255 to enable or disable this functionality:

- **PMTK255,1 => enable PPS**
- **PMTK255,0 => disable PPS**

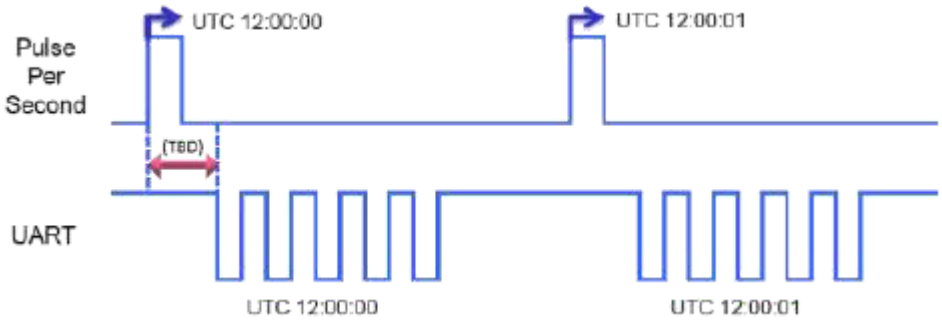


FIGURE 8 – 1PPS AND UTC

1PPS supports 1Hz NMEA output, but at baud rate of 9600 bps, if there are many NMEA sentences output, per second transmission may exceed one second.

16.3.4 WAKEUP

When the ORG1510-mk04 is on (full power) the output will be high at ~2.5V level.

When the ORG1510-mk04 in on Standby or backup mode the output will be low (ground).

On low power modes (Periodic and AlwaysLocate) when the ORG1510-mk04 is off the wakeup level is low (and the wakeup returns to high level when the module returns to full power).

The Wakeup output is designed only for probing to determine if the module is in active mode or in standby/backup states. Depending on the type of the probe there might be a possible influence on the voltage high level.

17. TYPICAL APPLICATION CIRCUIT For ORG1510 MK04

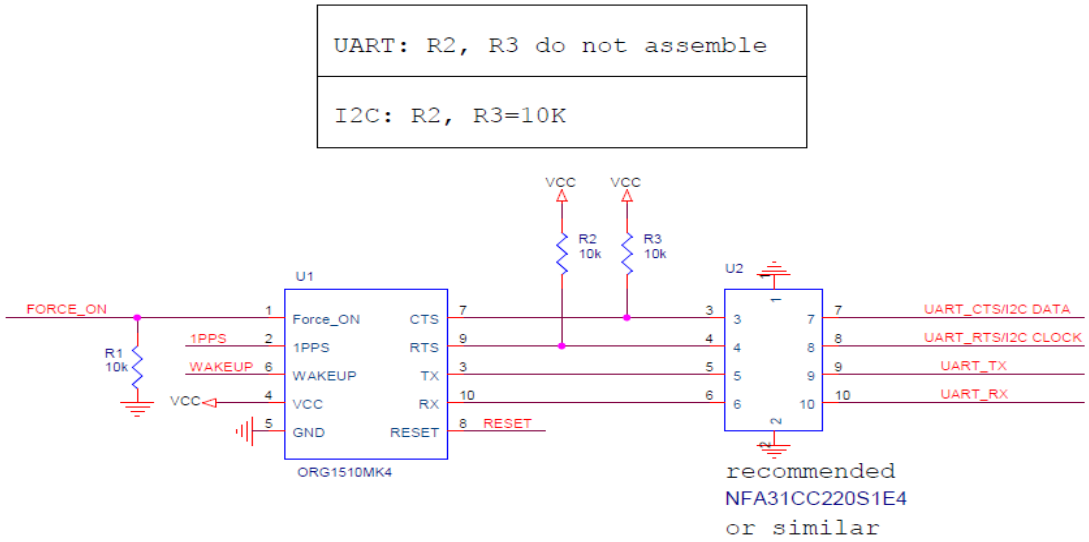


FIGURE 9 – REFERENCE SCHEMATIC DIAGRAM

18. RECOMMENDED PCB LAYOUT

Please follow the instructions listed on the following link:

https://origingps.com/wp-content/uploads/2018/08/Hornet-Modules-Layout-Recommendations-andIntegration-Application-Note.pdf

DESIGN CONSIDERATIONS

ORG1510 incorporates on-board antenna element that is perfectly matched to receiver front-end, frequency trimmed to GPS band and Right-Hand Circularly Polarized (RHCP).

OriginGPS proprietary module structure is providing stable resonance of antenna in GPS band with very low dependence on host PCB size, it's conducting planes geometry and stack-up.

To prevent PCB factor on antenna resonance avoid copper pouring on module side.

To prevent module orientation from causing polarization losses in on-board antenna avoid long and narrow copper planes beneath.

ORG1510 operates with received signal levels down to -167dBm and can be affected by high absolute levels of RF signals out of GNSS band, moderate levels of RF interference near GNSS band and by low-levels of RF noise in GNSS band.

RF interference from nearby electronic circuits or radio transmitters can contain enough energy to desensitize ORG1510. These systems may also produce levels of energy outside of GNSS band, high enough to leak through RF filters and degrade the operation of the radios in ORG1510.

This issue becomes more critical in small products, where there are industrial design constraints.

In that environment, transmitters for Wi-Fi, Bluetooth, RFID, cellular and other radios may have antennas physically close to ORG1510.

To prevent degraded performance of ORG1510, OriginGPS recommends performing EMI/jamming susceptibility tests for radiated and conducted noise on prototypes and assessing risks of other factors.

Contact OriginGPS for application specific recommendations and design review services.

19. COMMANDS DESCRIPTION

Command ID	Description
PMTK000	Test. This command will be echoed back to the sender (for testing the communications link).
PMTK101	Perform a HOT start
PMTK102	Perform a WARM start
PMTK103	Perform a COLD start
PMTK104	Perform a system reset (erasing any stored almanac data) and then a COLD start
PMTK120	Erase aiding data stored in flash memory
PMTK127	Erase EPO data stored in flash memory
PMTK161,0	Standby - Stop mode
PMTK161,1	Standby - Sleep mode
PMTK251,Baudrate	Set NMEA Baudrate
PMTK313,0	Disable SBAS feature
PMTK313,1	Enable SBAS feature
PMTK353,1,0,0,0,0	Enable GPS only mode
PMTK353,0,1,0,0,0	Enable GLO only mode
PMTK353,0,0,0,0,1	Enable BDS only mode
PMTK353,1,1,0,0,0	Enable GPS and GLO mode
PMTK353,1,0,0,0,1	Enable GPS and BDS mode

TABLE 13– NMEA INPUT COMMANDS

20. FIRMWARE UPDATES

The FW stored in the internal Flash memory may be upgraded via the serial port TX/RX pads. In order to update the FW, the following steps should be performed to perform reprogramming:

1. Remove all power to the module.
2. Connect serial port to a PC.
3. Apply main power.
4. Run the software utility to re-flash the module. Clearing the entire flash memory is strongly recommended prior to programming.
5. Upon successful completion of re-flashing, remove main power to the module for a minimum of 10 seconds.
6. Apply main power to the module.
7. Verify the module has returned to the normal operating state.

21. HANDLING INFORMATION

21.1. MOISTURE SENSITIVITY

ORG1510 modules are MSL 3 designated devices according to IPC/JEDEC J-STD-033B standard.

Module in sample or bulk package should be baked prior to assembly at 125°C for 48 hours.

21.2. ASSEMBLY

The module supports automatic pick-and-place assembly and reflow soldering processes.

Suggested solder paste stencil is 5 mil to ensure sufficient solder volume.

21.3. SOLDERING

Reflow soldering of the module always on component side (Top side) of the host PCB according to standard IPC/JEDEC J-STD-020D for LGA SMD.

Avoid exposure of ORG1510 to face-down reflow soldering process.

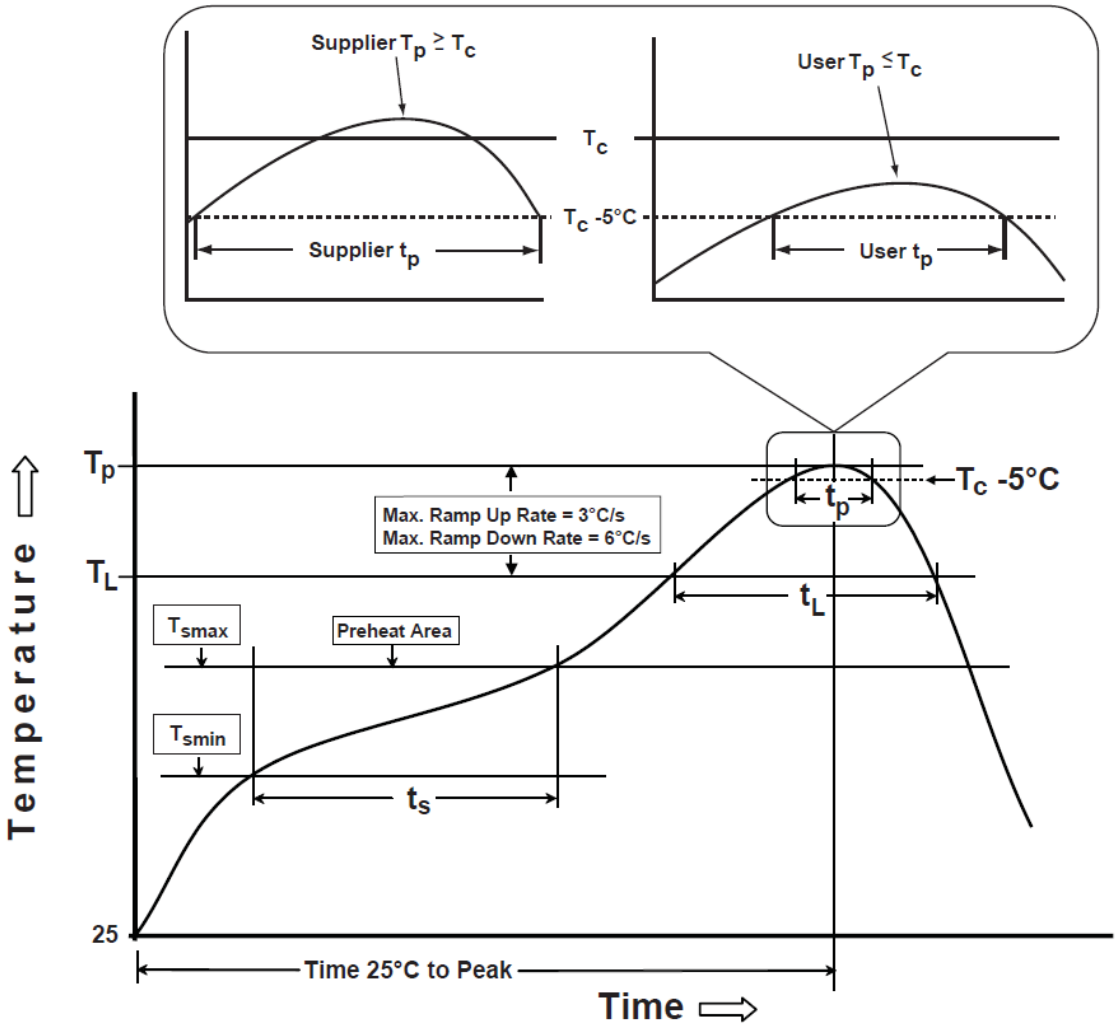


FIGURE 10 – RECOMMENDED SOLDERING PROFILE

Referred temperature is measured on top surface of the package during the entire soldering process.

Suggested peak reflow temperature is 250°C for 30 sec. for Pb-Free solder paste.

Actual board assembly reflow profile must be developed individually per furnace characteristics.

Reflow furnace settings depend on the number of heating/cooling zones, type of solder paste/flux used, board design, component density and packages used.

SYMBOL	PARAMETER	MIN	TYP	MAX	UNIT
T_C	Classification Temperature		250		°C
T_P	Package Temperature			250	°C
T_L	Liquidous Temperature		217		°C
T_S	Soak/Preheat Temperature	150		200	°C
t_S	Soak/Preheat Time	60		120	s
t_L	Liquidous Time	60		150	s
t_P	Peak Time		30		s

TABLE 14 – SOLDERING PROFILE PARAMETERS

21.4. CLEANING

If flux cleaning is required, module is capable to withstand standard cleaning process in vapor degreaser with the Solvon® n-Propyl Bromide (NPB) solvent and/or washing in DI water.

Avoid cleaning process in ultrasonic degreaser, since specific vibrations may cause performance degradation or destruction of internal circuitry.

21.5. REWORK

If localized heating is required to rework or repair the module, precautionary methods are required to avoid exposure to solder reflow temperatures that can result in permanent damage to the device.

21.6. ESD SENSITIVITY

This product is ESD sensitive device and must be handled with care.

21.7. SAFETY INFORMATION

Improper handling and use can cause permanent damage to the product.

21.8. DISPOSAL INFORMATION

This product must not be treated as household waste.

For more detailed information about recycling electronic components contact your local waste management authority.

22. COMPLIANCE

The following standards are applied on the production of ORG1510 modules:

- IPC-6011/6012 Class2 for PCB manufacturing
- IPC-A-600 Class2 for PCB inspection
- IPC-A-610D Class2 for SMT acceptability

ORG1510 modules are manufactured in ISO 9001:2008 accredited facilities.
ORG1510 modules are manufactured in ISO 14001:2004 accredited facilities.
ORG1510 modules are manufactured in OHSAS 18001:2007 accredited facilities.
ORG1510 modules are designed, manufactured and handled in compliance with the Directive 2011/65/EU of the European Parliament and of the Council of June 2011 on the Restriction of the use of certain Hazardous Substances in electrical and electronic equipment, referred as RoHS II.
ORG1510 modules are manufactured and handled in compliance with the applicable substance bans as of Annex XVII of Regulation 1907/2006/EC on Registration, Evaluation, Authorization and Restriction of Chemicals including all amendments and candidate list issued by ECHA, referred as REACH.
ORG1510 modules comply with the following EMC standards:

- EU CE EN55022:06+A1(07), Class B
- US FCC 47CFR Part 15:09, Subpart B, Class B
- JAPAN VCCI V-3/2006.04

23. PACKAGING AND DELIVERY

23.1. APPEARANCE

ORG1510 modules are delivered in reeled tapes for automatic pick and place assembly process.

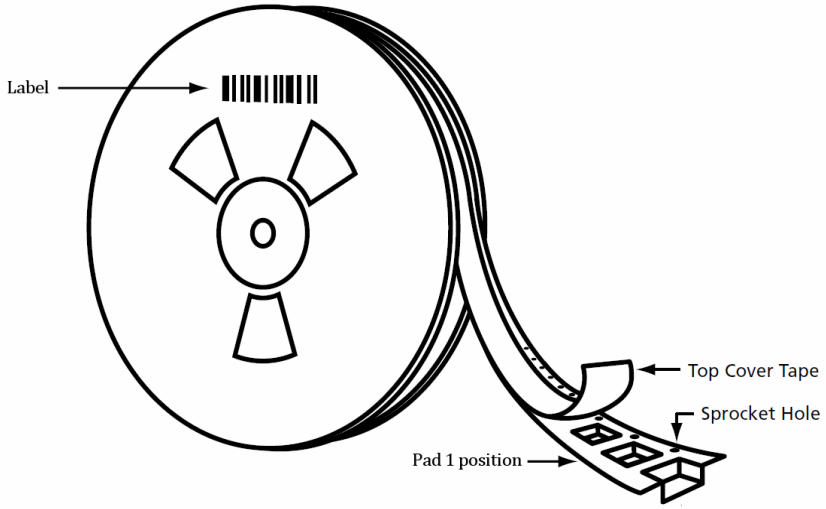


FIGURE 11 – MODULE POSITION

ORG1510 modules are packed in 2 different reel types.

SUFFIX	TR1	TR2
Quantity	150	500

TABLE 15 – REEL QUANTITY

Reels are dry packed with humidity indicator card and desiccant bag according to IPC/JEDEC J-STD-033B standard for MSL 3 devices.

Reels are vacuum sealed inside anti-static moisture barrier bags.

Sealed reels are labeled with MSD sticker providing information about:

- MSL
- Shelf life
- Reflow soldering peak temperature
- Seal date

Sealed reels are packed inside cartons.

Reels, reel packs and cartons are labeled with sticker providing information about:

- Description
- Part number
- Lot number
- Customer PO number
- Quantity
- Date code

23.2. CARRIER TAPE

Carrier tape material - polystyrene with carbon (PS+C).

Cover tape material – polyester based film with heat activated adhesive coating layer.

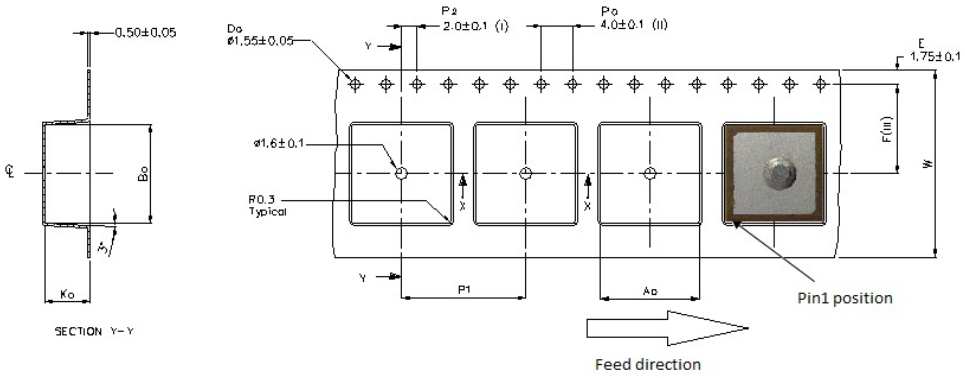


FIGURE 12 – CARRIER TAPE

	mm	inch
A_0	10.9 ± 0.1	0.429 ± 0.004
B_0	10.7 ± 0.1	0.421 ± 0.004
K_0	6.1 ± 0.1	0.240 ± 0.004
F	7.5 ± 0.1	0.295 ± 0.004
P1	12.0 ± 0.1	0.472 ± 0.004
W	16.0 ± 0.3	0.630 ± 0.012

TABLE 16 – CARRIER TAPE DIMENSIONS

23.3. REEL

Reel material - antistatic plastic.

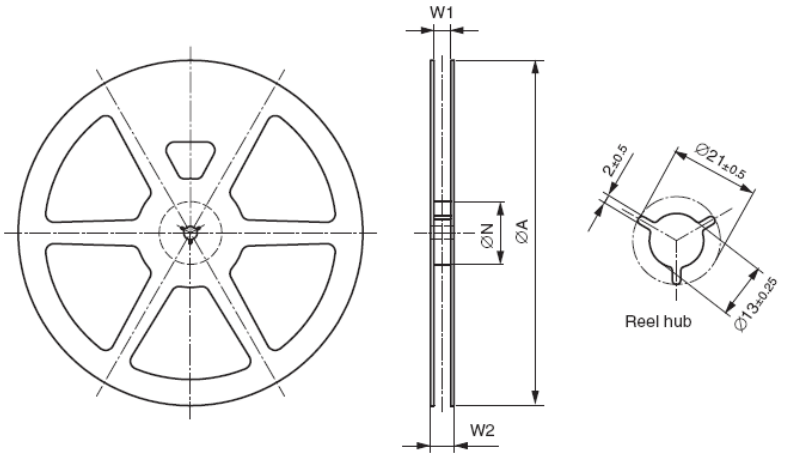


FIGURE 13 – REEL

SUFFIX	TR1		TR2	
	mm	inch	mm	inch
ØA	178.0 ± 1.0	7.00 ± 0.04	330.0 ± 2.0	13.00 ± 0.08
ØN	60.0 ± 1.0	2.36 ± 0.04	102.0 ± 2.0	4.02 ± 0.08
W1	16.7 ± 0.5	0.66 ± 0.02	16.7 ± 0.5	0.66 ± 0.02
W2	19.8 ± 0.5	0.78 ± 0.02	22.2 ± 0.5	0.87 ± 0.02

TABLE 17 – REEL DIMENSIONS

24. ORDERING INFORMATION

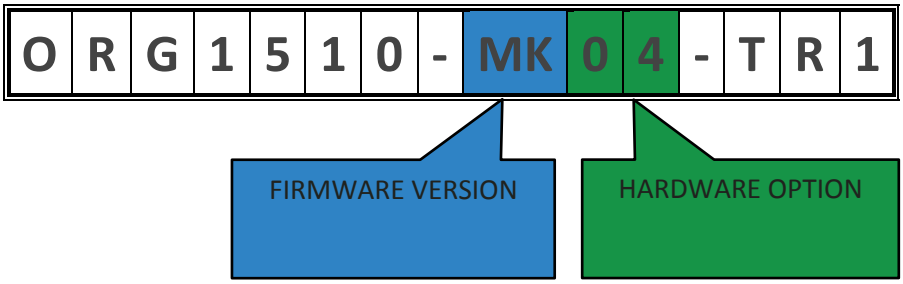


FIGURE 14 – ORDERING OPTIONS

PART NUMBER	FW VERSION	HW OPTION	V_{CC} RANGE	PACKAGING	SPQ
ORG1510-MK04-TR1	MK	04	3.3V	REELED TAPE	150
ORG1510-MK04-TR2	MK	04	3.3V	REELED TAPE	500
ORG1510-MK04-UAR	MK	04	5V USB	EVALUATION KIT	1
ORG1510-MK05-TR1	MK	05	3.3V	REELED TAPE	150
ORG1510-MK05-TR2	MK	05	3.3V	REELED TAPE	500
ORG1510-MK05-UAR	MK	05	5V USB	EVALUATION KIT	1

TABLE 18 – ORDERABLE DEVICES

The default constellation is GPS, GLONASS and Galileo, since May 28, 2017. Prior to May 28, 2017 the default constellation was GPS + GLONASS. GPS and BEIDOU constellation is also available. For ordering this option (ORG1510 MK14) contact marketing@origingps.com

25. APPENDIX 1 – MULTI MICRO HORNET ORG1510-MK05

The Org1510-MK05 version has the same features set as the ORG1510-MK04, the only difference is that it has an option to connect a coin battery (for example ECR2025 coin battery) to provide power in backup mode. Minimum voltage that the backup battery will support is 2.8V (typical battery 2.8-4.3 V). With a battery connection, after waking up, the receiver uses:
1. All internal aiding, including RTC time, Ephemeris, and Last Position, resulting in the fastest possible TTFF in either hot or warm start modes.
2. Configuration settings stored in flash after turning power off.

To keep alive the RTC time, the following circuit implementation using a 3V coin battery, can be used.

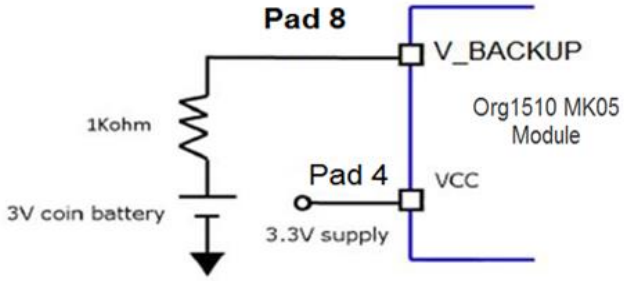


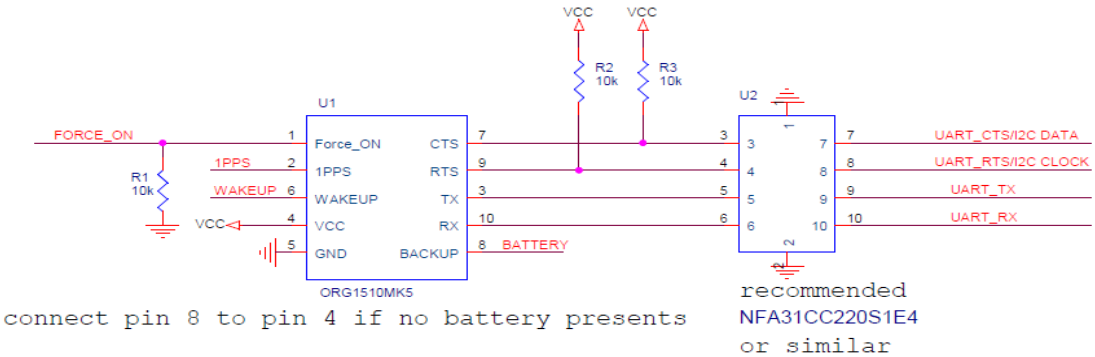
FIGURE 15 – BATTERY BACKUP IMPLEMENTATION

If a battery is not connected to pad 8 in ORG1510-mk05, connection between pads 8 and 4 is a MUST in order to operate the module.
Since Pin 8 at the ORG1510 MK04 is used for resetting, at the ORG1510 MK05 reset is only valid in s/w command $PMTK 104 (and the reset type).

26.1 PADS ASSIGNMENT – ORG1510-MK05

Please look on section 12.4 table 3 the only difference is pad # 8. In the ORG1510 MK05 use this pin to connect a backup battery.

Please notice: Entering Backup Mode is done differently for ORG1510-mk04 and ORG1510-mk05.
For details – see section 12.3.9.5 - Backup Mode.

26.2 TYIPICAL APPLICATION CIRCIT ORG1510 MK05

UART: R2, R3 do not assemble
I2C: R2, R3=10K