OriginGPS
mini+mighty

ORG1518-MK06

GPS / GNSS Module with Integrated/External Antenna

DATASHEET

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ABBREVIATIONS

Abbreviation	Description
A-GPS	Assisted GPS
AC	Alternating Current
ADC	Analog to Digital Converter
AGC	Automatic Gain Control
BPF	Band Pass Filter
C/N_0	Carrier to Noise density ratio [dB-Hz]
CDM	Charged Device Model
CE	European Community conformity mark
CEP	Circular Error Probability
CMOS	Complementary Metal-Oxide Semiconductor
CPU	Central Processing Unit
CTS	Clear-To-Send
CW	Continuous Wave
DC	Direct Current
DOP	Dilution Of Precision
DR	Dead Reckoning
DSP	Digital Signal Processor
ECEF	Earth Centered Earth Fixed
ECHA	European Chemical Agency
EGNOS	European Geostationary Navigation Overlay Service
EIA	Electronic Industries Alliance
EMC	Electro-Magnetic Compatibility
EMI	Electro-Magnetic Interference
ENIG	Electroless Nickel Immersion Gold
ESD	Electro-Static Discharge
ESR	Equivalent Series Resistance
EU	European Union
EVB	Evaluation Board
EVK	Evaluation Kit
FCC	Federal Communications Commission
FSM	Finite State Machine
GAGAN	GPS Aided Geo-Augmented Navigation
GNSS	Global Navigation Satellite System
GPIO	General Purpose Input or Output
GPS	Global Positioning System
HBM	Human Body Model
HDOP	Horizontal Dilution Of Precision
I^2C	Inter-Integrated Circuit
I/O	Input or Output

Abbreviation	Description
IC	Integrated Circuit
ICD	Interface Control Document
IF	Intermediate Frequency
ISO	International Organization for Standardization
JEDEC	Joint Electron Device Engineering Council
KA	Keep Alive
KF	Kalman Filter
LDO	Low Dropout regulator
LGA	Land Grid Array
LNA	Low Noise Amplifier
LP	Low Power
LS	Least Squares
LSB	Least Significant Bit
MID	Message Identifier
MM	Machine Model
MSAS	Multi-functional Satellite Augmentation System
MSB	Most Significant Bit
MSL	Moisture Sensitivity Level
NFZ™	Noise-Free Zones System
NMEA	National Marine Electronics Association
NVM	Non-Volatile Memory
PCB	Printed Circuit Board
PLL	Phase Lock Loop
PMU	Power Management Unit
POR	Power-On Reset
PPS	Pulse Per Second
PRN	Pseudo-Random Noise
PSRR	Power Supply Rejection Ratio
PTF™	Push-To-Fix
QZSS	Quasi-Zenith Satellite System
RAM	Random Access Memory
REACH	Registration, Evaluation, Authorization and Restriction of Chemical substances
RF	Radio Frequency
RHCP	Right-Hand Circular Polarized
RMS	Root Mean Square
RoHS	Restriction of Hazardous Substances directive
ROM	Read-Only Memory
RTC	Real-Time Clock
RTS	Ready-To-Send
SAW	Surface Acoustic Wave
SBAS	Satellite-Based Augmentation Systems
SID	Sub-Identifier

Abbreviation	Description
SIP	System In Package
SMD	Surface Mounted Device
SMPS	Switched Mode Power Supply
SMT	Surface-Mount Technology
SOC	System On Chip
SPI	Serial Peripheral Interface
SV	Satellite Vehicle
TCXO	Temperature-Compensated Crystal Oscillator
TTFF	Time To First Fix
TTL	Transistor-Transistor Logic
UART	Universal Asynchronous Receiver/Transmitter
VCCI	Voluntary Control Council for Interference by information technology equipment
VEP	Vertical Error Probability
VGA	Variable-Gain Amplifier
WAAS	Wide Area Augmentation System

Related Documentation

Table 1. Related Documentation

№	Document Name
1	ORG1518-MK06 Evaluation Kit Datasheet
2	MTK NMEA Packet 3.5
3	MTK FAQ
4	Feature List and Command Usage- ORG4033, ORG1510MK-05 and ORG1518-MK06
5	MTK_SPI Application Notes

Revision History

Table 2. Revision History

Revision	Date	Change Description	Author
1.0	3/ February	First version	Gil M.
1.1	6-Feb-19	Update block diagram +minor changes	Gil M.
1.2	May 30, 2019	Update Hotstill	Gil M.
1.3	17 June 2019	Update Standby	Gil M.
1.4	30 July, 2019	Updated TR2	Igor M.
1.5	September 5, 2019	Update PCB Layout link	Ron T.
1.6	September 19, 2020	Updated Static Navigation Updated I2C Pads	Ron T.
1.7	May 7, 2023	New format, Added SPI, Updated V_backup, FORCE_ON, reference design, supply voltage ripple, accuracy (CEP)	Mark R.

SCOPE

This document describes the features and specifications of the ORG1510-MK04/5 GNSS receiver module with integrated antenna.

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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.

CONTACT INFORMATION

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1. About The 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.

2. About the ORG1518-MK06 Module

The ORG1518-MK06 is a complete SiP featuring miniature LGA SMT footprint designed to commit unique integration features for high volume cost sensitive applications and dual antenna: integrated and external.

Designed to support compact and traditional applications such as smart watches, wearable devices, asset trackers, the ORG1518-MK06 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.

The ORG1518-MK06 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 18mm x 18mm, the ORG1518-MK06 module is the industry's smallest sized solution of its kind.

The ORG1518-MK06 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.

3. ABOUT ORIGINGPS

OriginGPS develops, manufactures and supplies the world's smallest GNSS and cellular IoT solutions.

Our high-performance miniature GNSS products provide multiple constellation support to help you track everything valuable to you and your business. The OriginIoT™ makes IoT-enabling devices affordable and accessible by eliminating the need for additional embedded software and RF engineering knowhow. The low power cellular IoT system reduces project costs and dramatically shortens time-to-market when you develop cellular IoT devices.

OriginGPS miniature products are ideal for market verticals, such as asset tracking, fleet management, industrial IoT, law enforcement, pet/people tracking, precision agriculture, smart cities, sports and wearables.

4. ORG1518-MK06 MODULE DESCRIPTION

This section describes the ORG1518-MK06 module.

- Autonomous operation
- RF switch controlled by logic level provides choice of integrated antenna or external passive antenna.
- 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, RF switch.
- Concurrent tracking of multiple constellations
- Control signal switches between integrated and external antenna.
- Uses GPS, GLONASS GALILEO and 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
- High accuracy of 1.3m@CEP, open sky conditions during 24 hours
- 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 / I2C or UART /SPI interface
- High update messages rate of 1,2,5,10Hz
- 1PPS Output
- Static Navigation
- Single voltage supply 3.3V with battery input
- Ultra-small LGA footprint of 17mm x 17mm
- Ultra-low weight of 8g
- 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

4.1. Architecture

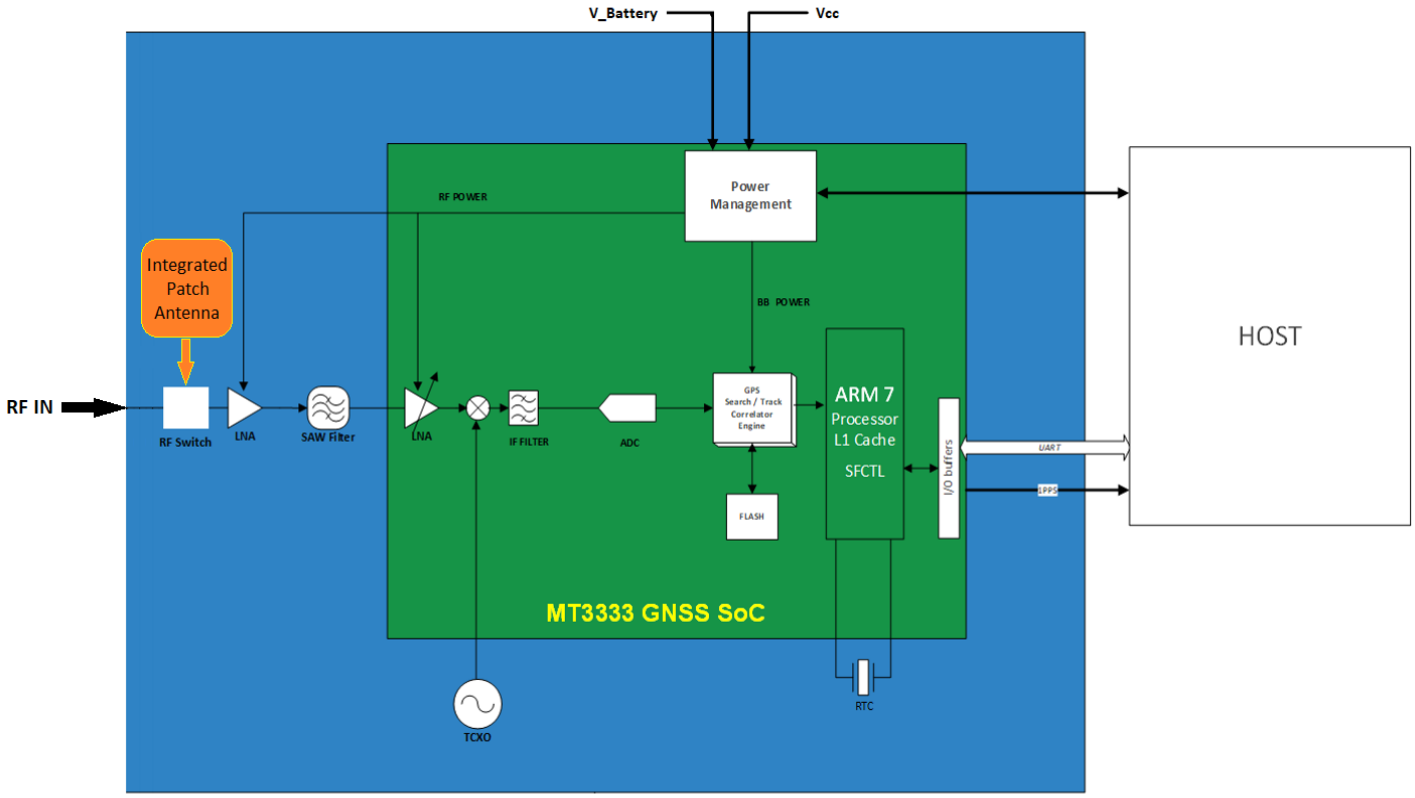

Figure 1. ORG1518-MK06 Architecture

- **Antenna** OriginGPS proprietary Microstrip Patch Antenna collects GNSS signals from the outer space. Antenna is built from hi-Q ceramic element mounted on top of RF shield, providing stable resonance.
- **RF switch** connects integrated antenna or external antenna to LNA corresponding to status of control signal.
- **GNSS SAW Filter**

  Band-Pass SAW filter attenuates 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**

  A highly stable 26MHz temperature compensated 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.

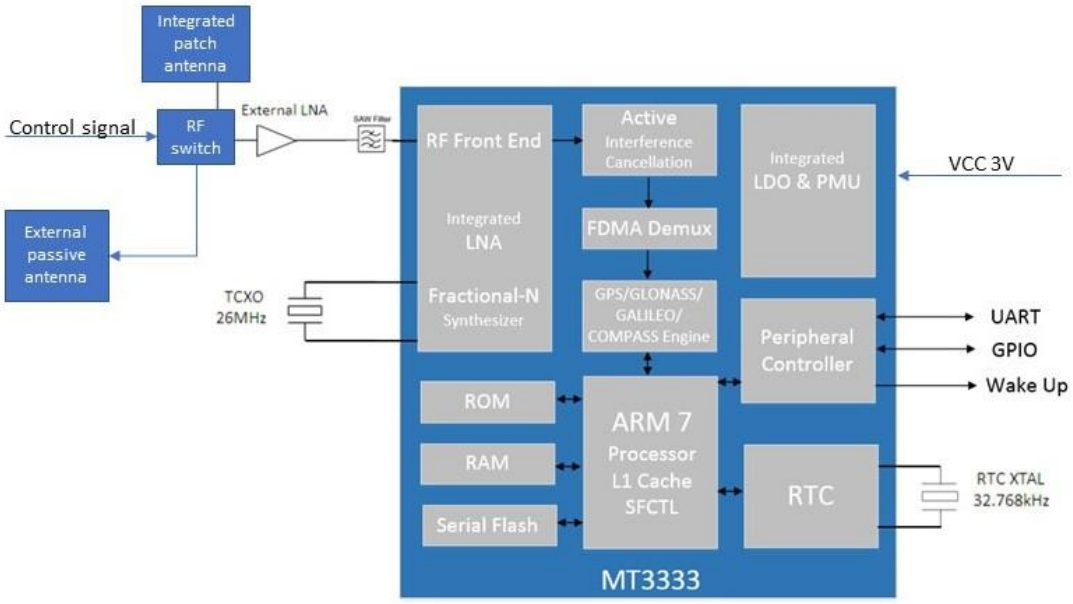

Figure 2. ORG1518-MK06 System Block Diagram and Peripheral

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.

4.2. ORG1518-MK06 Features Description

This section describes the features of the ORG1518-MK06 module.

4.2.1. Constellation Configuration

- GPS, GLONASS and GALILEO (default)
- GPS and BEIDOU available.

4.2.2. 1PPS

1PPS (Pulse Per Second) may be selected to be outputted in one the following configurations:

- Output PPS in either 2D or 3D fix mode
- Output PPS only in 3D fix mode
- Output PPS After the first Fix
- Always output PPS - default configuration

The following features may be configured via a command:

- Pulse duration
- Pulse frequency
- Active high or active low pulse

The pulse may vary ±30nS (1 σ). There is no correlation between the PPC signal and the UTC.

4.2.3. 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. The speed threshold can be set via a command (PMTK 386).

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.

4.2.4. 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.

ORG1518-MK06 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.

4.2.4.1. Locally-generated AGPS (Embedded Assist System – EASY)

The EASY™ is embedded assist system for quick positioning, the GPS engine will calculate and automatically predict the single emperies (Max. up to 3 days) when power on, and save the predict information into the memory, GPS engine will use this information for positioning if not enough information from satellites is received, so the function will be helpful for positioning and TTFF improvement under indoor or urban conditions.

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

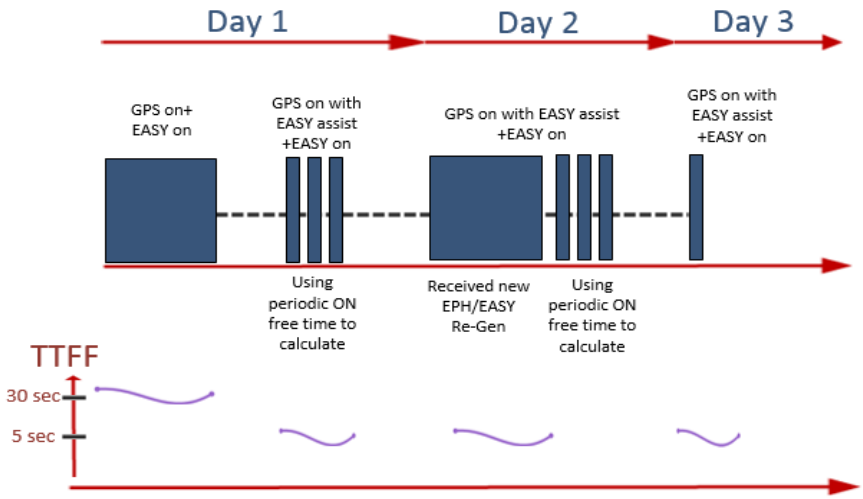

Figure 3 EASY™ TTFF Timing

4.2.4.2. 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 their 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.

4.2.4.3. 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.

4.2.4.4. 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.

4.2.4.5. Satellite-Based Augmentation System (SBAS)

The ORG1518-MK06 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 it's enabled by default.

4.2.4.6. 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 either the RTCM SC-104 messages or SBAS differential data.

4.2.4.7. Jamming Rejection – Active Interference Cancellation (AIC)

The ORG1518-MK06 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.

4.2.5. Power Management Modes

The ORG1518-MK06 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 saving mode to optimize power consumption:
    - Standby
    - Periodic
    - AlwaysLocate™
- Backup mode

4.2.5.1. 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), send the following command: **PMTK225,0** [Just after the module wakes up from its previous sleep cycle].

4.2.6. 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 the following commands: **PMTK161,0 – Standby stop mode = turn off VTXCO, 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.
While using I2C interface, please use Backup mode (see Backup Mode section). Exit Backup mode to enter Full Power mode only via FORCE_ON (see FORCE_ON section).

4.2.7. 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.

4.2.8. 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.

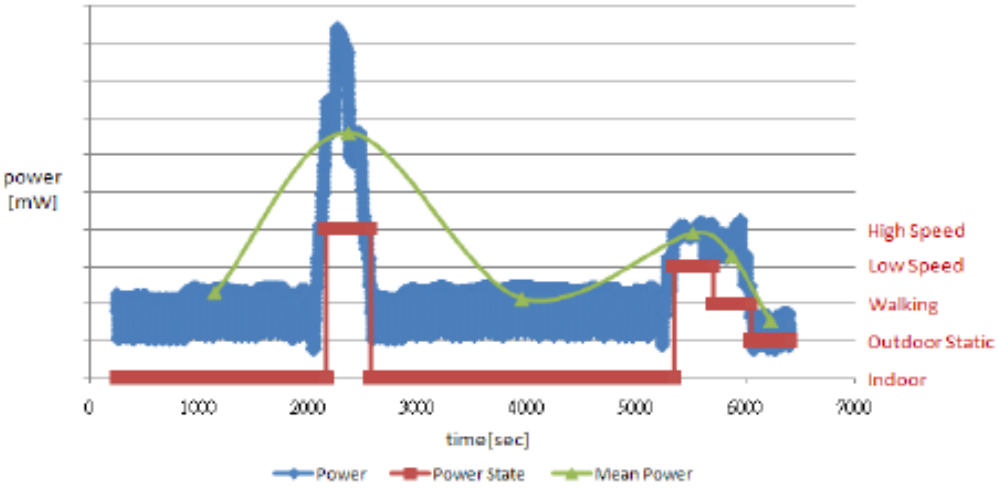

Figure 5. AlwaysLocate™ Mode: Power vs. Time

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.

4.2.9. Backup Mode

Backup Mode means a low quiescent power state where receiver operation is stopped.

V_backup 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 ~12uA in BACKUP mode (VCC & V_BACKUP).

Entering Backup Mode:

Option 1

Entering to backup mode is done by a NMEA software command –

PMTK225,4 (+checksum).

Important: Before sending the command the FORCE_ON pin must be tied to ground.

While in Backup mode, the module will consume ~12uA from VCC & V_BACKUP.

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 ~12uA in BACKUP mode while FORCE_ON pin of module is tied to ground with jumper. In real cases FORCE_ON pin is grounded by active device with residue resistance differ from zero so current consumption may be 2-3 times higher i.e., 25uA.

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

Example:

PMTK225,4 Enter backup mode

NMEA Return feedback:

PMTK001,225,3

The module will stay in BACKUP mode while FORCE_ON is connected to ground.

To exit 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 with a software command.

Option 2

The backup mode can be entered by disconnecting the VCC.

Connect the V_backup to an external battery, and then disconnect the VCC from the module. The module will now enter the backup mode.

To return to Full Power, reconnect the VCC and the module will switch to the active state and acquire a hot start.

During this process, make sure to keep the FORCE_ON pin at a low level.

4.2.10. 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.

4.3. Pad Assignment – ORG1518-MK06

Table 3. ORG1518-MK06 Pin-Out

Pad	Name	Function	Direction	Logic level
1	RX	UART Receive (Serial Input)	Input	2.8 V
2	TX	UART Transmit (Serial Output)	Output	2.8V
3	V BACKUP	Input for battery backup	Input power	2.8-4.2V
4	SCK	SPI clock	Input /Output	2.8 V
5	SCS	SPI chip selects	Input /Output	2.8V
6	MISO	Master input slave output	Input /Output	2.8V
7	CTRL	LOW integrated antenna / HIGH for external antenna	Input	2.8V
8	VCC	System Power	Input Power	3.3V
9	MOSI	Master output slave input	Input /Output	2.8V
10	GND	System Ground		
11	GND	System Ground		
12	GND	System Ground		
13	RF	RF input from external antenna	Input	-
14	GND	System Ground		
15	WAKEUP	WAKEUP	Output	2.8 V
16	RESET	System Reset– Active Low	input	2.8V
17	FORCE_ON	Forced full-power mode signal – Active Low	Input	2.8 V
18	CTS	UART Clear To Send/I2C Clock	Input /Output	2.8 V
19	RTS	UART Ready To Send/I2C Data	Input /Output	2.8V
20	EINT	EXTERNAL INTERUPT	Output	2.8 V
21	1PPS	UTC Time Mark	Output	2.8 V
22	FIX	FIX LED	Output	2.8V

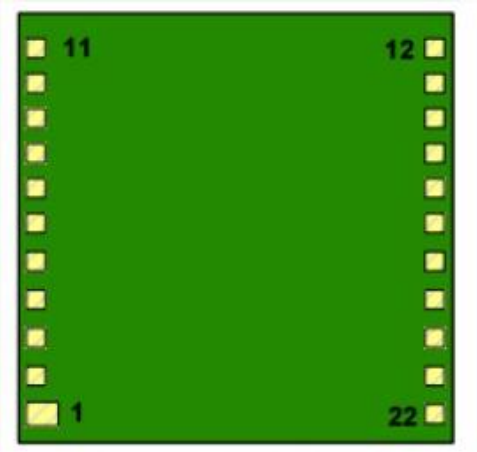

Figure 6. Module Footprint

5. MECHANICAL SPECIFICATIONS

- ORG1518 module has advanced ultra-miniature LGA SMD packaging sized 17mm x 17mm.
- ORG1518 built on a PCB assembly enclosed with metallic RF shield box and antenna element on top of it.
- There are 22 castellated LGA SMT pads made Cu base and ENIG plating on bottom side.

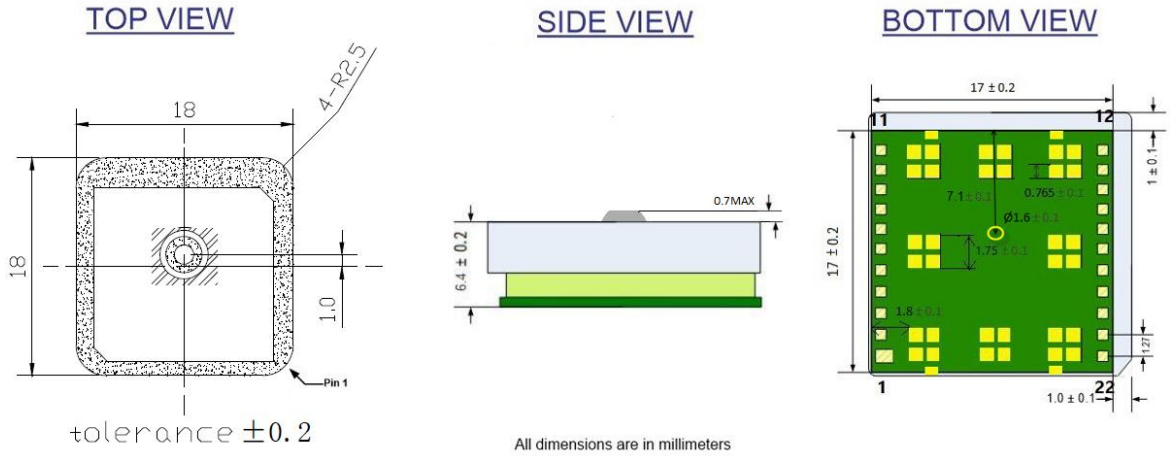

Figure 7. Mechanical Drawing

Table 4. Mechanical Details Summary

Dimension	Length	Width	Height	Weight
mm	17.00 +0.20/ -0.10	17.00 +0.20/ -0.10	6.70 +0.20/ -0.20	8g
inch	0.669 +0.008/ -0.004	0.669 +0.008/ -0.004	0.264 ± 0.008	0.28oz

6. ELECTRICAL SPECIFICATIONS

This section describes the electrical specifications of the ORG1518-MK06 module.

6.1. Absolute Maximum Ratings

Stresses exceeding Absolute Maximum Ratings may damage the device.

Table 5. Absolute Maximum Ratings

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}		120	mA
RF Input power	V_{RF}		0	dBm
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
Operating Temperature	T_{AMB}	-45	+90	°C
Storage Temperature	T_{ST}	-50	+125	°C
Lead Temperature[4]	T_{LEAD}	-5	+260	°C

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

6.2. Recommended Operating Conditions

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

Table 6. Recommended Operating Conditions

Parameter	Symbol	Mode/Pad	Test Conditions	Min	Typ	Max	Unit
Power supply voltage	V_{CC}	V_{CC}		+3.00	+3.3	+3.60	V
Backup Battery supply	V_{backup}	V_{backup}		+2.80	+3.60	+4.30	V
Digital IO Pin Low level input	Vil			-0.3		+0.7	V
Digital IO Pin High level input	Vih			+2.1		+3.6	V
Digital IO Pin Low level output	Vol		Iol=2mA	-0.3		+0.4	V
Digital IO Pin High level output	Voh		Ioh=2mA	+2.4	+2.8	+3.1	V
Power Supply Current[1]	I_{CC}	Acquisition	GPS		40		mA

Parameter	Symbol	Mode/Pad	Test Conditions	Min	Typ	Max	Unit
			GPS+GLONASS		45		mA
		Tracking	GPS		28		mA
			GPS+GLONASS		35		mA
		Standby			0.5		mA
		Backup		7	12	25	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		1607	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	%

Note: 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.

7. PERFORMANCE

This section describes the performance of the ORG1518-MK06 module.

7.1. Acquisition Time

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

7.1.1. 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.

7.1.2. Signal Reacquisition

Reacquisition follows temporary blocking of GNSS signals.

Typical reacquisition scenario includes driving through tunnel.

7.1.3. 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).

7.1.4. 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.

7.1.5. Cold Start

Cold Start occurs when satellite ephemeris data, position and time data are unknown.

Typical Cold Start scenario includes first power application.

Table 7. Acquisition Time

Operation[1]	Mode	Value	Unit
Hot Start		< 1	s
Aided Start[3]		< 3	s
Warm Start	GPS + GLONASS	< 23	s
	GPS	< 29	s
	GPS + GLONASS	< 23	s

Operation[1]	Mode	Value	Unit
Cold Start	GPS	< 31	s
Signal Reacquisition[2]		< 3	s

Note: 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

7.2. Sensitivity

7.2.1. 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.

7.2.2. Reacquisition

Reacquisition follows temporary blocking of GNSS signals.

Reacquisition sensitivity defined as minimum GNSS signal power required for reacquisition.

7.2.3. Navigation

During navigation receiver consequently, outputs valid position solutions.

Navigation sensitivity defined as minimum GNSS signal power required for reliable navigation.

7.2.4. Hot Start

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

7.2.5. Aided Start

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

7.2.6. 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.

Table 8. Sensitivity

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

** The above values have been tested at update rate of 1 Hz.

7.3. Received Signal Strength

Table 9. Received Signal Strength

Parameter[4]	Value	Unit
C/N_0	45	dB-Hz

Note: 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/N0 reported for 4 SVs, EVK is 24-hrs. Static, outdoor, ambient temperature is +25°C.

7.4. Power Consumption

Table 10. Power Consumption

Operation[1]	Mode	Value	Unit
Acquisition	GPS	132	mW
	GPS + GLONASS	148.5	mW
Tracking	GPS	92.4	mW
	GPS + GLONASS	115.5	mW
Standby state		1.65	mW
Backup state		39.6	uW

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

7.5. Position Accuracy

Table 11. ORG1518-MK06 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

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

7.6. Dynamic Constraints

Table 12. Dynamic Constraints

Parameter	Metric	Imperial
Velocity	515m/s	1,000knots
Altitude[1]	10,000m	32808ft
Altitude Balloon mode	80,000m	262,467ft
Acceleration	4g	

Note: 1. In Normal / Fitness / Aviation modes the Altitude limitation is 10000 m. In Balloon mode it's 80000 m.

8. INTERFACE

This section describes the general interfaces of the ORG1518-MK06 module.

8.1. 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 the fastest possible TTFF. When V_{CC} is removed, settings are reset to factory default and the receiver performs Cold Start on next power up.

8.1.1. 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 ORG1518-MK06 power input may be needed to reduce system noise.

The high rate of ORG1518-MK06 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. Voltage ripple below 40mVPP is allowed. Higher voltage ripple may compromise ORG1518 performance.

8.1.2. Ground

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

8.2. Control Interface

The ORG1518-MK06 module has three host interfaces: UART, I2C and SPI.

The switching between the interfaces is by firmware update.

8.2.1. UART- Host Interface

The ORG1518-MK06 module has a standard UART port:

8.2.1.1. 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.

8.2.1.2. 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.

8.2.2. I2C - Host Interface

ORG1518-MK06 has a standard I2C interface.

The I2C host interface includes the following features:

- The I2C Slave mode – the host initiates the clock and data, and an operating speed 400kbps.
- The ORG1518-MK06 module supports a 7 bit I 2C address.
- The I2C default slave address is '0x10'.
- An individual Tx FIFO buffer length of 255 bytes. The master can read one I2C data packet of max. 255 bytes at a time.

In order to read an entire NMEA packet of one second, the master needs to read several I2C data packets and to extract valid NMEA data. After reading one I2C data packet, sleep 2ms before reading the next packet. When the entire packet of 1 second has been read, make sure to wait for a longer period for the next NMEA packet.

8.2.3. SPI – Host Interface

The ORG1518-MK06 will work in a slave mode, while the master can read one SPI data packet with 255 bytes max. each time.

- To read one NMEA packet, the master should send padding bytes ("0xFF") for receiving NMEA data from the slave
- To read the entire NMEA packet of one second, the master should read several SPI data packets and extract valid NMEA data from them.
- Baud rate is up to 700kbit/s

for more detailed information, please refer to "MTK_SPI application notes" document.

Note: the ORG1518-MK06 with SPI option has a different part number. Please refer to the "Ordering information" (section 17)

8.3. Hardware Interface

This section describes the hardware interfaces of the ORG1518-MK06 module.

8.3.1. Force-On

FORCE-ON is an input pin which controls the power states of the module.

The pin has two optional states – LOW and HIGH.

LOW state:

When the command "PMTK225,4", is sent, the module will enter the Backup mode which is also the lowest power consumption mode.

To return to Full Power mode:

- Set FORCE_ON to HIGH
- Wait 1sec
- Set FORCE_ON to LOW

When the command "PMTK225,1 ....." is sent, the module will enter the periodic backup mode.

To return to Full Power mode:

- Set FORCE_ON to HIGH
- Send command "PMTK225,0"
- Wait 100ms
- Set FORCE_ON to LOW

HIGH state:

- When the FORCE_ON is in the HIGH state, the module cannot enter the backup mode.
- When the command "PMTK225,4" is sent, the module will enter the Standby-stop mode.

There are two ways to return to the Full Power mode:

Option 1:

- Send any byte on the Rx line

Option 2:

- Set FORCE_ON to LOW
- Wait 1sec
- Set FORCE_ON to HIGH.

8.3.2. Reset

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.

8.3.3. 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**

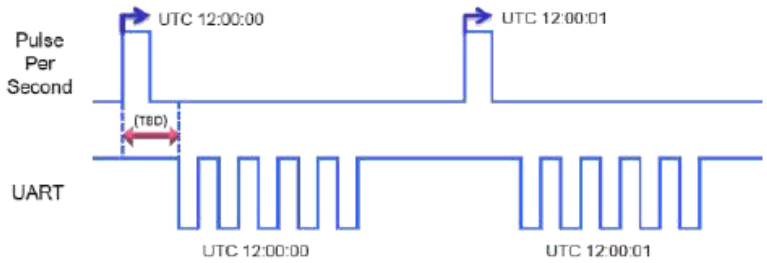

Figure 8. 1PPS AND UTC

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.

8.3.4. Wakeup

When the ORG1518-MK06 is on (full power) the output will be high at ~2.5V level.

When the ORG1518-MK06 in on Standby or backup mode the output will be low (ground).

On low power modes (Periodic and AlwaysLocate) when the ORG1518-MK06 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.

9. TYPICAL APPLICATION CIRCUIT

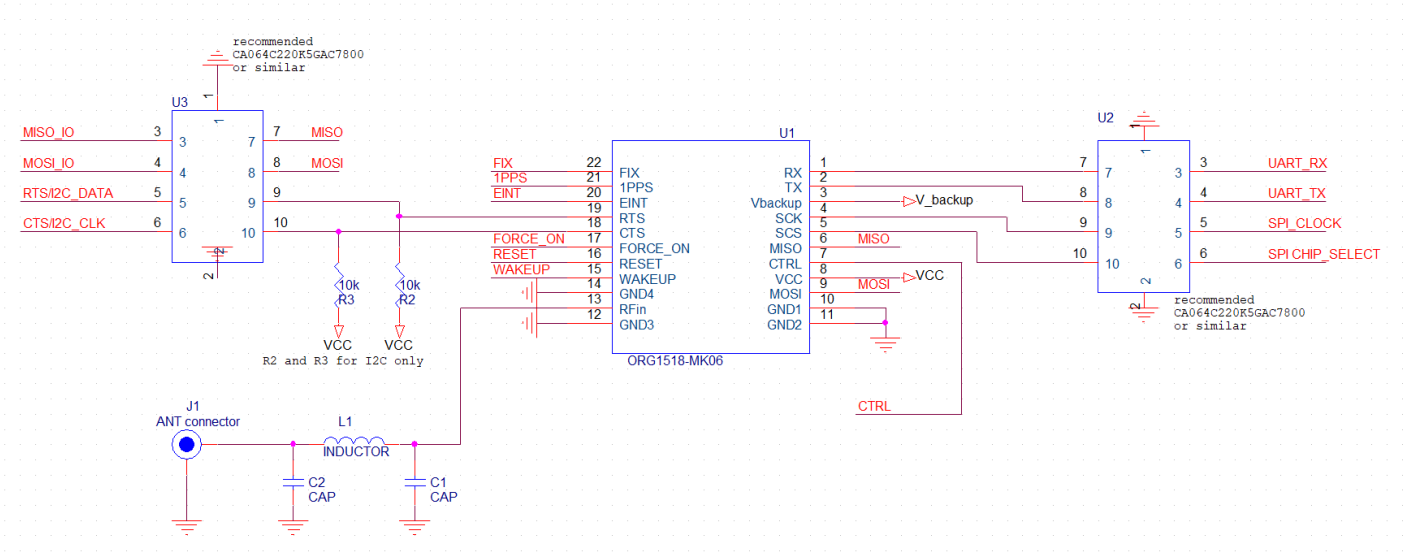

Figure 9. Reference Schematic Diagram

10. RECOMMENDED PCB LAYOUT

Please refer to the Hornet Modules Layout Recommendations and Integration Application Note in the following link: https://origingps.com/gnss-modules/gnss-resources/

11. DESIGN CONSIDERATIONS

ORG1518-MK06 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 low dependence on host PCB size, it's conducting planes geometry and stack-up.

To prevent PCB factor on antenna resonance, avoid copper pour areas on the module side.

If pad of RF input (pin 13) has excessive capacitance to ground, remove copper in the ground plane under pad. This may occur if the layer thickness is not thick enough, and the 50 Ohm transmission line is less than the width of the pad.

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

ORG1518-MK06 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 ORG1518-MK06 . 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 ORG1518-MK06 .

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 ORG1518-MK06 .

To prevent degraded performance of ORG1518-MK06 , 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.

12. COMMANDS DESCRIPTION

Table 13. NMEA Input Commands

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

13. FIRMWARE UPDATES

The FW stored in the internal Flash memory may be upgraded via the (UART) 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.

14. HANDLING INFORMATION

This section describes the handling information of the ORG1518-MK06 module.

14.1. Moisture Sensitivity

ORG1518-MK06 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.

14.2. 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.

14.3. 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 ORG1518-MK06 to face-down reflow soldering process.

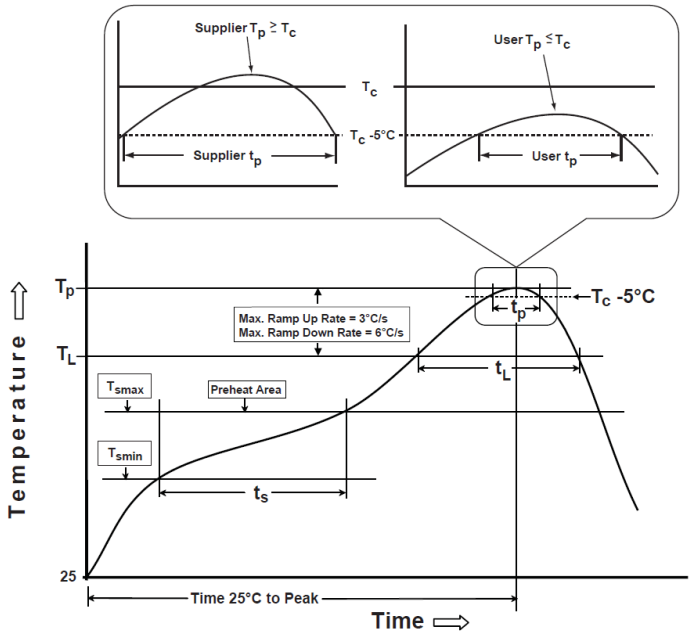

Figure 10. Recommended Soldering Profile

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.

Table 14. Soldering Profile Parameters

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

14.4. 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.

14.5. 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.

14.6. ESD Sensitivity

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

14.7. Safety Information

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

14.8. 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.

15. COMPLIANCE

The following standards are applied on the production of ORG1518 modules:

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

ORG1518-MK06 modules are manufactured in ISO 9001:2008 accredited facilities.

ORG1518-MK06 modules are manufactured in ISO 14001:2004 accredited facilities.

ORG1518-MK06 modules are manufactured in OHSAS 18001:2007 accredited facilities.

ORG1518-MK06 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.

ORG1518-MK06 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.

ORG1518-MK06 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

16. PACKAGING AND DELIVERY

This section describes the packaging and delivery of the ORG1518-MK06 module.

16.1. Appearance

ORG1518 modules are delivered in reeled tapes for automatic pick and place assembly process.

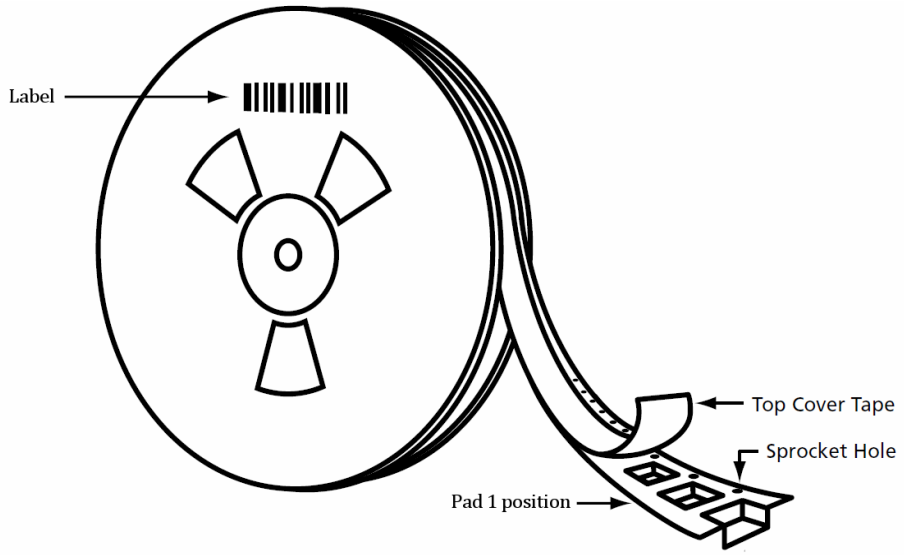

Figure 11. Module Position

ORG1518 modules are packed in 2 different reel types.

Table 15. Reel Quantity

Suffix	TR1	TR2
Quantity	150	300

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

16.2. Carrier Tape

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

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

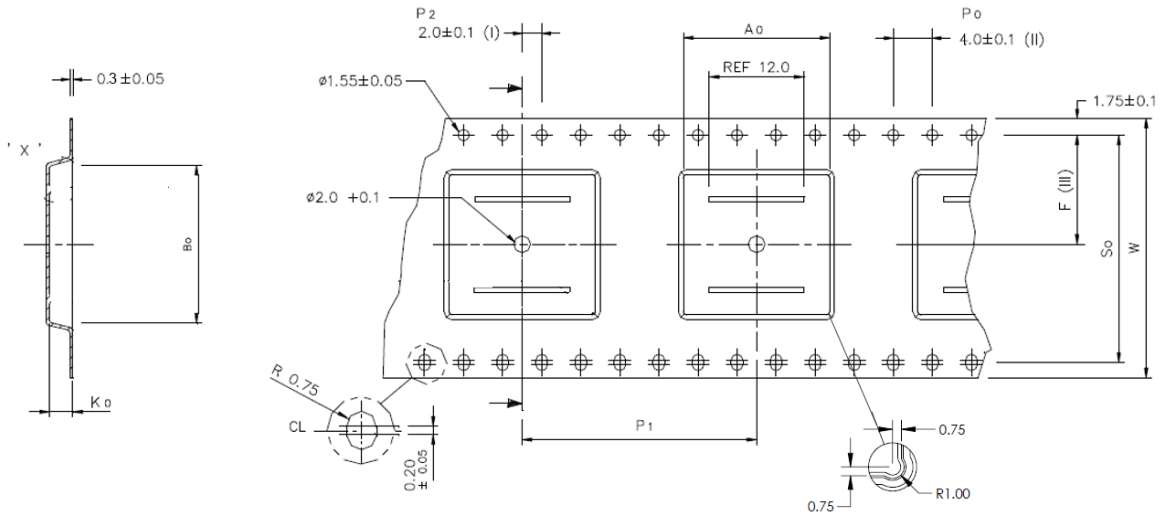

Figure 12. Carrier Tape

Table 16. Carrier Tape Dimensions

	mm
A_0	18.70 ± 0.2
B_0	18.70 ± 0.2
K_0	7.20 ± 0.2
F	14.20 ± 0.1
P_1	24.00 ± 0.2
S_0	28.40 ± 0.1
W	32.00 ± 0.3

16.3. Reel

Reel material - antistatic plastic.

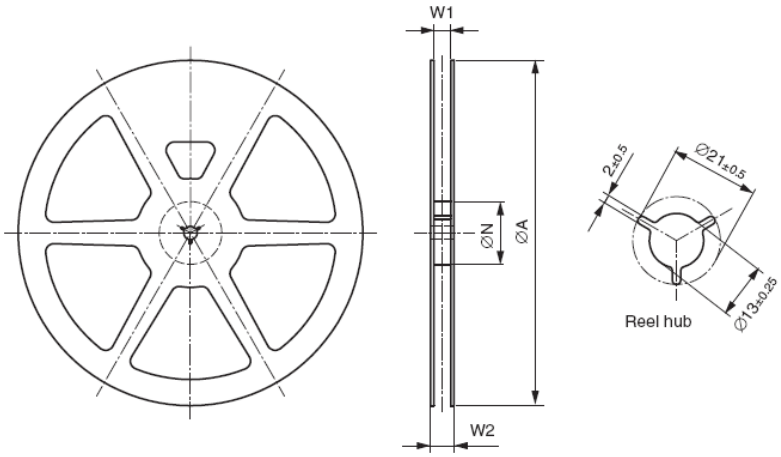

Figure 13. Reel

Table 17. Reel Dimensions

SUFFIX	TR1	
	mm	inch
ØA	330.0 ± 2.0	13.00 ± 0.08
ØN	102.0 ± 2.0	4.02 ± 0.08
W1	16.7 ± 0.5	0.66 ± 0.02
W2	22.2 ± 0.5	0.87 ± 0.02

17. ORDERING INFORMATION

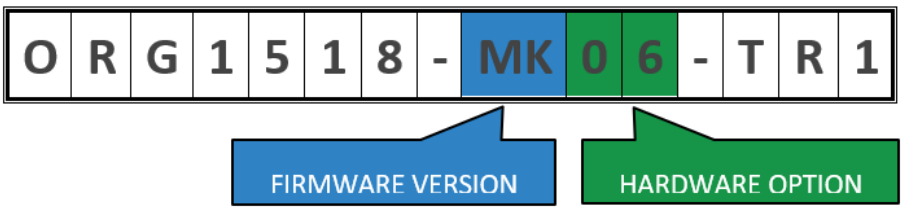

Figure 14. Ordering Options

Table 18. Orderable Devices

Part Number	FW Version	HW Option	V_{CC} Range	Packaging	SPQ
ORG1518-MK06-TR1	MK	06	3.3V	REELED TAPE	150
ORG1518-MK06-TR2	MK	06	3.3V	REELED TAPE	300
ORG1518-MK06-TR1-SPI	MK	06	3.3V	REELED TAPE	150
ORG1518-MK06-TR2-SPI	MK	06	3.3V	REELED TAPE	300
ORG1518-MK06-UAR	MK	06	5V USB	EVALUATION KIT	1
ORG1518-MK06-UAR-SPI	MK	06	5V USB	EVALUATION KIT	1

Appendix A. The ORG1518-MK06 Module

The ORG1518-MK06 module version 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. 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.

In addition, you need to consider using a charger for the battery or separating the VCC and V_BACKUP with using controlled LDO for each of them.

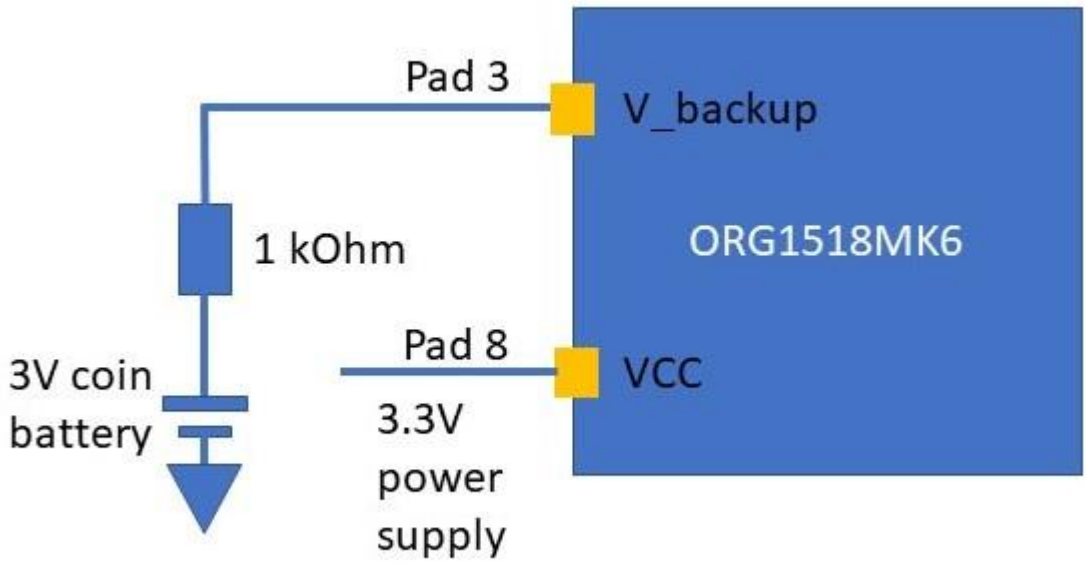

Figure 15. Battery Backup Implementation

Note: **If a battery is not connected to pad 3 in the ORG1518-MK06 module, pads 3 and 8 must be connected in order to operate the module.**