OriginGPS
mini+mighty

ORIGINIOT (ORG2101) IOT SYSTEM

Datasheet (Rev A)

OriginGPS.com

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1. SCOPE

This document describes the features and specifications of OriginIoT ORG2101 Cellular IoT system.

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

6. RELATED DOCUMENTATION

№	DOCUMENT NAME
1	Spider and Hornet - NMEA Protocol Reference Manual
2	OriginSmart™ API specifications
3	OriginIoT™ EVK User Guide

TABLE 1 – RELATED DOCUMENTATION

7. REVISION HISTORY

REVISION	DATE	CHANGE DESCRIPTION
1.0	April 16, 2018	First release
1.1	April 22, 2018	Minor corrections on sections 10.2, 11.1, 12

TABLE 2 – REVISION HISTORY

8. GLOSSARY

A-GNSS Assisted GNSS

API Application Programming Interface
ARM Acorn RISC Machine
CE European Community conformity mark
CEP Circular Error Probability
EMC Electro-Magnetic Compatibility
ESD Electro-Static Discharge
EVB Evaluation Board
EVK Evaluation Kit
FCC Federal Communications Commission
FPU Floating Point Unit
FW FirmWere
GALILEO EU GNSS
GLONASS Global Navigation Satellite System
GNSS Global Navigation Satellite System
GPIO General Purpose Input/Output
GPS Global Positioning System
GSM Global System for Mobile Communications
IC Integrated **C**ircuit
I^2C Inter-Integrated Circuit
ISO International Organization for Standardization
LDO Low Dropout regulator
LGA Land Grid Array
LIN Local Interconnect Network
LNA Low Noise Amplifier
LPUART Low Power Universal Asynchronous Receiver/Transmitter
LTE 3GPP Long Term Evolution
MCU Micro Controller Unit
MSL Moisture Sensitivity Level
NB Narrow Band
NMEA National Marine Electronics Association
NFZ™ Noise-Free Zones System
M2M Machine To Machine
MEMS MicroElectroMechanical Systems
MIM Machine Identification Module
OTG On The Go
PCB Printed Circuit Board
PPS Pulse Per Second
REACH Registration, Evaluation, Authorisation and Restriction of Chemical substances
RF Radio Frequiency
RLS Remote Link Stability
RMS Root Mean Square
RoHS Restriction of Hazardous Substances directive
ROM Read-Only Memory
RTC Real-Time Clock
RTOS Real Time Operation System
SAW Surface Acoustic Wave
SIP System In Package
SMD Surface Mounted Device
SMT Surface-Mount Technology
SOC System On Chip

SPI Serial Peripheral Interface
SRAM Static Random-Access Memory
SSL Secure Socket Layer
TCXO Temperature-Compensated Crystal Oscillator
TLS Transport Layer Security
TTFF Time To First Fix
UART Universal Asynchronous Receiver/Transmitter
USART Universal Synchronous/Asynchronous Receiver/Transmitter
USB Universal Serial Bus
VEP Vertical Error Probability

9. ABOUT ORIGINIOT

The OriginIoT module ORG2101 is an analytic customizable system that collects data from sensors. The data can be transferred to a remote server or cloud platform by the OriginIoT system via wireless cellular communication (GSM or LTE).

The multi-purpose OriginIoT system can accommodate peripheral devices such as sensors or other components via UART, SPI, I^2C or GPIO and combines cellular communications module per customers choice, with superior positional accuracy of stand-alone GNSS. Peripheral devices are configured over a web interface, eliminating additional embedded FW efforts. The ease and flexibility of utilizing OriginIoT as a basis for vast array of applications quickens time to market while minimizing the size of your IoT sensor device.

OriginIoT devices enable developers to develop IoT products without writing a single line of embedded code and without RF engineering. A new rapid product cycle is created, dramatically cutting development resources.

10. ABOUT ORIGINGPS

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

OriginGPS develops fully-integrated, miniaturized GPS/GNSS, and integrated IoT solutions for developers. OriginGPS modules introduce unparalleled sensitivity and noise immunity by incorporating Noise Free Zone 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. For over a decade, our experts have been developing ultra-sensitive, reliable, high performance modules with the smallest footprint on the market, supporting a range of verticals, such as smart cities, drones, asset tracking, wearables, automotive, and IoT.

11. DESCRIPTION

11.1 FEATURES

- Compatible with wireless communication modules in 2G, 3G GSM and LTE Cat1, Cat-M, Cat-NB modules, with regional and global coverage
- Future proof design for next generation wide area networks

- OriginGPS Noise Free Zone System (NFZ™)
- Fully integrating:
  - STMicro Ultra-low-power with ARM Cortex-M4 MCU 80 MHz with 1 Mbyte Flash
  - Gemalto Cinterion® Industrial M2M product family for GSM and LTE radio technologies (2G, 3G, Cat1, Cat4, CatM, CatNB1)
  - OriginGPS Multi Spider (ORG4572) GNSS Receiver module
  - Optional M2M Industrial QUAD robust SMD MIM for Outdoor Applications (Embedded SIM)
- Hirose connectors for cellular (U.Fl) and GNSS (W.Fl) RF
- GSM/LTE features:
  - Design compatible with GSM 2G, GSM 3G, LTE Cat 1, LTE Cat M, LTE Cat NB (in development)
  - Multiple band configurations for regional or global coverage
  - Max. data rate download: 85.6kbps in 2G, 7.2Mbps in 3G, 10.3Mbps in Cat 1, 150Mbps in Cat 4, 300kbps in Cat M, 50kbps in Cat NB
  - Max. data rate upload: 42.8kbps in 2G, 5.7Mbps in 3G, 5.2Mbps in Cat 1, 50Mbps in Cat 4, 375kbps in Cat M, 50kbps in Cat NB
- GNSS Frequencies:
  - GPS L1 1575.42 frequency, C/A code
  - GLONASS L1 FDMA 1598-1606MHz frequency band, SP signal
  - SBAS (WAAS, EGNOS, MSAS) and QZSS support
- GNSS Features:
  - Concurrent tracking of multiple constellations
  - 52 channels
  - Ultra-high Sensitivity down to -165dBm
  - TTFF of <1s in 50% of trials under Hot Start conditions
  - High Accuracy of <1.5m in 50% of trials
  - External 1PPS output
  - NMEA / OSP® protocols
- Low power consumption:
  - GSM/LTE TBD
  - GNSS <15mW in ATP™ mode
  - Ultra-low power MCU
- External interfaces to control peripheral devices: I^2C, SPI, GPIOX12, USB, UARTx2, LPUART, ADC, DAC
- External MCU interfaces: RESET, WAKEUP, SW UPDATE, TIMER
- Single voltage supply 3.3-4.8 V
- Miniature dimensions: 27.6 mm x 18.8 mm
- Low height: 5.35 mm -4.7 mm
- Operating conditions from -40^0C to $+85^0C$
- FCC, CE certifications (in process)
- Operator certifications TBD
- RoHS II compliant

10.2 SYSTEM ARCHITECTURE

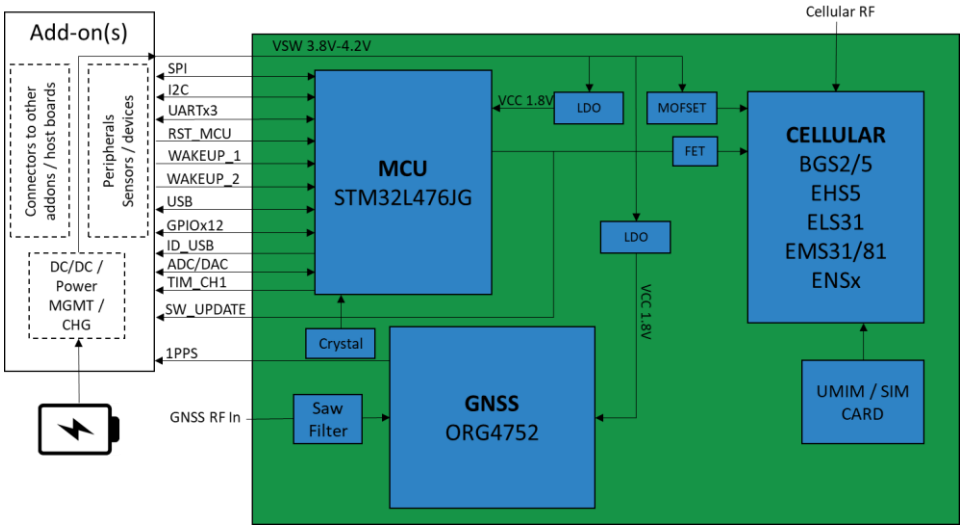

FIGURE 1 - ORG2101 STANDARD ARCHITECTURE

MCU STM 32L476JG

Ultra-low power ARM cortex microcontroller unit running OriginSmart™ embedded firmware. Embedded firmware allow configuration, provisioning of peripherals and managing messages to/from peripherals.

MCU Interfaces:

- 3.3V DC to activate USB interface
- MCU power 1.8V DC
- Digital Interfaces to peripherals: I2C bus, SPI, LPUART, UARTx2, GPIOx12, USB
- Interrupts and reset pins – wakeup MCU as defined by add-on circuit
- UART and controls on Cellular modules and GNSS

MCU receives external timing from crystal oscillator at 12Mhz.

GNSS ORG4752-RO1

Miniature multi-channel GPS/ GLONASS with SBAS, QZSS and other regional overlay systems receiver that continuously tracks all satellites in view, providing real-time positioning data in industry's standard NMEA format. ORG4572-R01 module offers superior sensitivity and outstanding performance, achieving rapid TTFF in less than one second, accuracy of approximately one meter, and tracking sensitivity of -165dBm. ORG4572-R01 module integrates LNA, SAW filter, TCXO, RTC crystal and RF shield with market-leading SiRFstarV™ GNSS SoC. ORG4572-R01 module is capable to decode extremely weak satellite signals simultaneously from GPS and GLONASS thereby offering best-in-class positioning availability, unparalleled accuracy and extremely fast fixes under challenging signal conditions, such as in built-up urban areas or dense foliage. Additional Saw Filter is added in RF In of GNSS.

CELLULAR GEMALTO CINTERION® INDUSTRIAL M2M FAMILY

ORG2101 features compatible design housing Gemalto Cinterion Cellular modules from the Industrial M2M family in the foot print of 27.6 x 18.8 mm: BGS2-E, BGS2-W, BGS5, EHS5-E, EHS5-US, ELS31-V, ELS31-J, EMS31-V, EMS31-X, EMS31-W, EMS81-W, ENSx-E, ENx-C and additional future variants. This feature allows selection from different cellular radio technologies ranging from 2G GSM, 3G GSM, LTE Cat1, LTE Cat M and LTE Cat NB1 with different regional focus per customer definitions.

MACHINE IDENTIFICATION OPTIONS

ORG2101 has two options for machine identification:

- ORG2101-XXXX-T
- ORG2101-XXXX-E

ORG2101-XXXX-T uses traditional SIM card holder hosting plastic nano SIM cards (4FF) for machine identification. ORG2101-XXXX-E uses embedded-SIM option to be selected by customer according to his network provider.

12. ELECTRICAL SPECIFICATIONS

12.1 ABSOLUTE MAXIMUM RATINGS

Stresses exceeding Absolute Maximum Ratings may damage the device.

PARAMETER		SYMBOL	MIN	MAX	UNIT
Power Supply Voltage		V_{SW}	-0.3	4.5	V
Power Supply Current[1]		I_{SW}		1.2	A
GNSS RF Input voltage		V_{RFGNSS}	-25	+25	V
I/O Voltage		V_{IO}	-0.3	4.0	V
Output current sunk/sourced by any I/O and control pin		I_{IO}		20	mA
Total output current sunk/sourced by sum of all I/Os and control pins[2]		ΣI_{IO}		100	mA
GNNS RF Input power	1560MHz < f_{GNSSIN} > 1630MHz	P_{RF}		0	dBm
	f_{GNSSIN} <1560MHZ, >1630MHz				
Operating Temperature		T_{AMB}	-40	+85	^{0}C
Storage Temperature		T_{ST}	-55	+125	^{0}C
Voltage at SIM interface, in normal operation		CC_{VCC}	0	+3.3	V

TABLE 3 – ABSOLUTE MAXIMUM RATINGS

12.2 RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	Mode or Connector and Pin #	MIN	TYP	MAX	UNIT
Power Supply Voltage	V_{SW}	J1 – 27,28, 29, 30	3.3	3.7-4.2	4.5	V
Power Supply Current[3]	I_{SW}	J1 – 27,28, 29, 30	0	0.05-870	1200	mA
Input Voltage Low State	V_{IL}	J1-2,4,5,8,9,14,17,21,22,23,25 J2-3,4,6,8,9,10,11,13,15,18,19,20,23,24,26	-0.3		0.642	V
Input Voltage High State	V_{IH}	J1-2,4,5,8,9,14,17,21,22,23,25 J2-3,4,6,8,9,10,11,13,15,18,19,20,23,24,26	1.142		5.4	V
Output Voltage Low State	V_{OL}	J1-1,2,3,4,8,9,10,11,15,16,18,24 J2-3,5,7,8,9,12,13,14,16,17,19,20,24,26			0.45	V
Input Voltage High State	V_{OH}	J1-1,2,3,4,8,9,10,11,15,16,18,24 J2-3,5,7,8,9,12,13,14,16,17,19,20,24,26	1.35			V
I/O Pin Capacitance	C_{IO}	All I/O pins except for 1PPS (at I_{IO}=4mA)		5		pF
Cellular RF Output Power	RF_{OUT}	GSM 850/900		33		dBm
		GSM 1800/1900		30		
		UMTS		24		
		LTE		23		
Cellular Input Impedance	Z_{INCELL}			50		Ω

[1] According to power ratings of board-to-board connectors used.
[2] This current consumption must be correctly distributed over all I/Os and control pins.
[3] Highly dependent on cellular network

Max voltage drop during 2G Tx burst	V_{D2G}	Not relevant for ORG2101-CMXX-X, ORG2101-C1XX-X		400		mV
Voltage Ripple	V_{RIP}	Normal Condition, power control level for Pout max at f<250kHz & F>250kHz	25		190	mVpp
GNSS Input Impedance	Z_{INGNSS}	GNSS RF Input	f_{IN}=1575.5MHz		50		Ω
GNSS Input Return Loss	R_{LIN}			-7			dB
GNSS Input Power Range	P_{IN}		GPS or GLONASS	-165		-100	dBm
GNSS Input Frequency Range	f_{IN}			1560		1620	MHz
Operating Temperature[4]	T_{AMB}			-30	+25	+95	^{0}C
Storage Temperature	T_{ST}			-55	+25	+125	^{0}C
Relative Humidity[5]	R_H	At T_{AMB}		5		95	%

TABLE 4 - RECOMMENDED OPERATING CONDITIONS

13. PERFORMANCE

13.1 MCU

13.1.1 ARM® CORTEX®-M4 CORE WITH FPU

The ARM® Cortex®-M4 with FPU processor is the latest generation of ARM processors for embedded systems. It was developed to provide a low-cost platform that meets the needs of MCU implementation, with low-power consumption, while delivering outstanding computational performance and an advanced response to interrupts.

The ARM® Cortex®-M4 with FPU 32-bit RISC processor features exceptional code-efficiency, delivering the high-performance expected from an ARM core in the memory size usually associated with 8- and 16-bit devices.

13.1.2 ADAPTIVE REAL-TIME MEMORY ACCELERATOR (ART ACCELERATOR™)

The ART Accelerator™ is a memory accelerator which is optimized for STM32 industry-standard ARM® Cortex®-M4 processors. It balances the inherent performance advantage of the ARM® Cortex®-M4 over Flash memory technologies, which normally requires the processor to wait for the Flash memory at higher frequencies.

13.1.3 MEMORY PROTECTION UNIT

The memory protection unit (MPU) is used to manage the CPU accesses to memory to prevent one task to accidentally corrupt the memory or resources used by any other active task. This memory area is organized into up to 8 protected areas that can in turn be divided up into 8 subareas. The protection area sizes are between 32 bytes and the whole 4 gigabytes of addressable memory.

The MPU is especially helpful for applications where some critical or certified code has to be protected against the misbehavior of other tasks. It is managed by an

[4] Longer TTFF is expected while operating below -30^{0}C.

[5] Relative Humidity is within Operating Temperature range.

RTOS. If a program accesses a memory location that is prohibited by the MPU, the RTOS can detect it and take action.

13.1.4 EMBEDDED FLASH MEMORY

STM32L476JG feature a 1 Mbyte of embedded Flash memory available for storing RTOS, OriginSmart™ embedded firmware, configuration files and data. The Flash memory is divided into two banks allowing read-while-write operations. This feature allows to perform a read operation from one bank while an erase or program operation is performed to the other bank. The dual bank boot is also supported. Each bank contains 256 pages of 2 Kbyte.

13.1.5 EMBEDDED SRAM

STM32L476xx devices feature up to 128 Kbyte of embedded SRAM.

13.1.6 REAL TIME OPERATION SYSTEM

OriginIoT™ systems are delivered pre-programmed with OriginSmart™ embedded firmware running on freeRTOS kernel.

13.1.7 ORIGINSMART™ EMBEDDED FIRMWARE

OriginIoT™ devices are managed by OriginSmart™ Embedded Firmware. OriginSmart™ Embedded Firmware allows IoT device development from a cloud environment via OriginGPS's proprietary messaging protocol. The OriginSmart™ Embedded Firmware allows quick and hassle-free development via API specified in document OriginSmart™ API Specifications.

13.2 INTERFACES

13.2.1 GENERAL-PURPOSE INPUTS/OUTPUTS (GPIOS)

OriginIoT™ enables 12 GPIOs via connector J2. Each of the GPIO pins can be configured by software as output (push-pull or open-drain), as input (with or without pull-up or pull-down) or as peripheral alternate function.

13.2.2 ANALOG TO DIGITAL CONVERTER (ADC)

OriginIoT™ provides interface to embedded successive approximation analog-to-digital converter with the following features:

- 12-bit native resolution, with built-in calibration
- 5.33 Msps maximum conversion rate with full resolution
- Low power design

13.2.3 DIGITAL TO ANALOG CONVERTER (DAC)

OriginIoT™ provides a 12-bit buffered DAC channel that can be used to convert digital signals into analog voltage signal outputs.

13.2.4 INTER-INTEGRATED CIRCUIT INTERFACE (I2C)

OriginIoT™ provides interface to embedded I2C. Refer to OriginSmart™ API Specifications for implementation features. The I2C bus interface handles communications between the microcontroller and the serial I2C bus. It controls all I2C bus-specific sequencing, protocol, arbitration and timing.

The I2C interface supports:

- I^2C-bus specification and user manual rev. 5 compatibility
- System Management Bus (SMBus) specification rev 2.0 compatibility
- Power System Management Protocol (PMBus™) specification rev 1.1 compatibility

13.2.5 UNIVERSAL SYNCHRONOUS/ ASYNCHRONOUS RECEIVER TRANSMITTER (USART)

OriginIoT™ devices have two embedded universal synchronous receiver transmitters:

- USART1, HW connected to GNSS module
- USART2, for external devices (connector J1)

And two universal asynchronous receiver transmitters:

- UART4, HW connected to cellular module
- UART5, for external devices (connector J1)

These interfaces provide asynchronous communication, multiprocessor communication mode, single-wire half-duplex communication mode and have LIN Master/Slave capability. They are able to communicate at speeds of up to 10Mbit/s.

13.2.6 LOW-POWER UNIVERSAL ASYNCHRONOUS RECEIVER TRANSMITTER (LPUART)

OriginIoT™ embeds one Low-Power UART. The LPUART supports asynchronous serial communication with minimum power consumption. It supports half duplex single wire communication. It allows multiprocessor communication.

13.2.7 SERIAL PERIPHERAL INTERFACE (SPI)

A single SPI interface allow communication up to 40 Mbits/s in master and up to 24 Mbits/s slave modes, in half-duplex, full-duplex and simplex modes. The 3-bit prescaler gives 8 master mode frequencies and the frame size is configurable from 4 bits to 16 bits.

13.2.8 UNIVERSAL SERIAL BUS ON-THE-GO FULL-SPEED (OTG_FS)

OriginIoT™ embeds an USB OTG full-speed device/host/OTG peripheral with integrated transceivers. The USB OTG FS peripheral is compliant with the USB 2.0 specification and with the OTG 2.0 specification.

13.3 CELLULAR

13.3.1 SELECTION OF CELLULAR MODULES

OriginIoT™ enables selection of variants from Gemalto Cinterion® M2M Industrial product family customer requirement. The applicable selection covers GPRS, HSPA, LTE and IOT NB standards, in varied regional focuses. The table below covers all applicable modules and features:

OriginIoT P/N	**ORG2101-2GXX-X**	**ORG2101-2GXX-X**	**ORG2101-3GXX-X**	**ORG2101-C1XX-X**	**ORG2101-CMXX-X**	**ORG2101-NBXX-X**
Cellular Module	BGS2-E/W	BGS5	EHS5-E/US	ELS31	EMS31/81-W	ENSx
Radio Technology	GPRS	GPRS	HSPA	LTE Cat 1	LTE Cat M	LTE Cat NB1
Regional Focus	ORG2101-2GEU-X **EMEA/APAC**	**Global**	ORG2101-3GEU-X **EMEA/APAC**	ORG2101-C1US-X **NORAM**	ORG2101-CMUS-X **NORAM**	ORG2101-NBEU-X **EMEA**
	ORG2101-2GGL-X **Global**		ORG2101-3GUS-X **NORAM**	ORG2101-C1JA-X **Japan**	ORG2101-CMGL-X **GLOBAL incl. Japan and Australia**	ORG2101-NBCH-X **China**
Frequency bands	ORG2101-2GEU-X **2G Dual Band**	**2G Quad Band**	ORG2101-3GEU-X **3G (1,8) 2G Dual Band**	ORG2101-C1US-X **LTE (4,13)**	ORG2101-CMUS-X **LTE (2,4,12,13)**	ORG2101-NBEU-X **LTE (3,8,20)**
	ORG2101-2GGL-X **2G Quad Band**		ORG2101-3GUS-X **3G (2,5) 2G Dual Band**	ORG2101-C1JA-X **LTE (1,18,19)**	ORG2101-CMGL-X **LTE Multiband**	ORG2101-NBCH-X **LTE (TBD)**

Max. Data Rate DL/UL	Multislot Class 10 85.6/42.8 kbps (DL/UL)	Multislot Class 12 85.6/85.6 kbps (DL/UL)	7.2/5.7 Mbps (DL/UL)	Cat 1 10.3/5.2 Mbps (DL/UL)	Cat M 300/375 kbps (DL/UL)	Cat NB1 50/50 kbps (DL/UL)

TABLE 5 - CELLULAR COMMUNICATIONS MATRIX

13.3.2 GEMALTO SECURITY

All Gemalto Cinterion® modules that are accommodated on OriginIoT™ supports Gemalto SSL/TLS internet services to allow secure communication with a server. OriginSmart™ firmware allows developers to enable or disable this option (under development)

13.3.3 JAMMING DETECTION

2G and 3G based systems support RLS monitoring to provide network performance information which enables effective customized jamming detection. This feature will be delivered upon request.

13.3.4 IDENTITY MANAGEMENT

OriginIoT comes in two variants regarding subscriber identity management. ORG2101-XXXX-T accommodates traditional plastic nano-SIM card (1.8V in all variants, 3.3V in all variants except ORG2101-CMXX-X). ORG2101-XXXX-E accommodates Industrial QUAD robust SMD MIM (Embedded SIM) according to a specific customer request.

13.4 GNSS

13.4.1 OPERATIONS

TTFF (Time To First Fix) – is the period of time the module is powered-up until valid position fix is reached

- 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 GPS signal power required for tracking.

- Navigation - During navigation receiver consequently outputs valid position solutions.
- 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.
- Signal Reacquisition - Reacquisition follows temporary blocking of GNSS signals. Typical reacquisition scenario includes driving through a tunnel.
- Aided Start - Aided Start is a method of effectively reducing TTFF by providing valid satellite ephemeris data. Aided start functionality is implemented in OriginSmart™ firmware. Please refer to document OriginSmart™ API specifications for more details.
- 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.
- Cold Start - Cold start occurs when satellite ephemeris data, position and time data are unknown. Typical Cold Start scenario includes first power application.

13.4.2 ACQUISITION TIMES

OPERATION[1]	MODE	VALUE	UNIT
Hot Start		<1	s
Aided Start		<10	s
Warm Start	GPS + GLONASS	<26	s
	GPS	<32	s
Cold Start	GPS + GLONASS	<27	s
	GPS	<35	s
Signal Reacquisition		<1	s

TABLE 6 - ACQUISITION TIME

Notes:

1. Tested on ORG4572 EVK. EVK is 24-hrs. static under signal conditions of -130dBm and ambient temperature of +25^{0}C
2. Outage duration ≤ 30s.

13.4.3 SENSITIVITY

Sensitivity is defined as minimum GPS signal power required for in a certain operation

OPERATION[1]	MODE	VALUE	UNIT
Tracking	GPS	-167	dBm
	GLONASS	-165	dBm
Navigation	GPS	-164	dBm
	GLONASS	-164	dBm
Reacquisition[4]		-162	dBm
Hot Start[4]		-160	dBm
Aided Start[5]		-156	dBm
Cold Start	GPS	-148	dBm

TABLE 7 – SENSITIVITY

Notes:

1. Tested on ORG4572 EVK . EVK is static, ambient temperature is +25°C, RF signals are conducted.
2. R01 - Dual-stage LNA standard ordering option.
3. Outage duration ≤ 30s.
4. Hibernate state duration ≤ 5m.
5. Aiding using Broadcast Ephemeris (Ephemeris Push™) or Extended Ephemeris (CGEE™ or SGEE™).

13.4.4 ACCURACY

PARAMETER[1]		FORMAT (% of samples)	MODE	VALUE	UNIT
Position[2]	Horizontal	CEP (50%)	GPS + GLONASS	< 1.5	m
			GPS + SBAS	< 2.0	m
			GPS	< 2.5	m
		2D RMS (95%)	GPS + GLONASS	< 3.0	m
			GPS + SBAS	< 4.0	m
			GPS	< 5.0	m

	Vertical	VEP (50%)	GPS + GLONASS	< 2.5	m
			GPS + SBAS	< 3.5	m
			GPS	< 4.0	m
		2D RMS (95%)	GPS + GLONASS	< 5.0	m
			GPS + SBAS	< 6.5	m
			GPS	< 7.5	m
Velocity[3]	over ground	50%		< 0.01	m/s
Heading	to north	50%		< 0.01	°
Time[4]		RMS jitter	1 PPS	≤ 30	ns

TABLE 8 – ACCURACY

Notes:

1. Test on ORG4572 EVK
2. Module is static under signal conditions of -130dBm, ambient temperature is +25°C.
3. EVK is 24-hrs. static, ambient temperature is +25°C.
4. Speed over ground ≤ 30m/s.

13.4.5 DYNAMIC CONSTRAINTS

PARAMETER	Metric	Imperial
Velocity and Altitude[1]	515m/s and 18,288m	1,000knots and 60,000ft
Velocity	600m/s	1,166knots
Altitude	-500m to 24,000m	-1,640ft to 78,734ft
Acceleration	4g	
Jerk	5m/s^3	

TABLE 9 – DYNAMIC CONSTRAINS

Note:

1. Standard dynamic constrains according to regulatory limitations.

12.5 POWER CONSUMPTION (ESTIMATED)

Power Mode				**Cellular Technology**				**Units**
#[1]	**MCU[2]**	**Cellular[3]**	**GNSS[4]**	2G GSM	3G HSPA	LTE Cat1	LTE Cat M	
1	Shutdown	Off	Hibernate	96-100	110-120	50-70	TBD	µA
2	Shutdown	PSM[5]	Hibernate	N/A	N/A	N/A	TBD	
3	LP Run	Off	Hibernate	368-371	380-390	335-345	TBD	µA
4	Shutdown	Off	On	0.45-50.1	1-51	0.45-50.1	TBD	mA
5	Run	Off	Hibernate	8.9-9.1	8.9-9.1	8.9-9.1	TBD	mA
6	Run	Off	On	9.4-59.1	9.4-59.1	9.4-59	TBD	mA
7	Run	IDLE	Hibernate	17.5-30.1	22-23.1	13-14.6	TBD	mA
8	Run	IDLE	On	18-80	22-73	13-65	TBD	mA
9	Run	TX	Hibernate	146-340	189-500	709-820	TBD	mA
10	Run	Tx	On	146-319	189-550	710-870	TBD	mA

TABLE 10 – ESTIMATED POWER CONSUMPTION

Notes:

1. List of popular power modes of operation. Not all possible power modes are presented.
2. MCU power consumption figures are based on STMicro Electronics documentation. MCU LP is a power saving mode of STM32 running in with slower system clocks.
3. Cellular power consumption figures are based on Gemalto documentation and are given as a range. Power consumption rates are highly dependent of signal quality and network infrastructure configuration on the location of the testing. Cellular ON is IDLE state: all module systems on, device registered but not sending or receiving data. Cellular Tx is average current during data Tx.
4. GNSS power consumption figures are based on ORG4572 documentation. GNSS ON: a range is given between full power tracking and PTF™ mode 30:30 (30s max. on-time – 18s typical, 30m period), GPS-only tracking
5. Power saving mode is unique to LTE Cat M technology

14. POWER MANAGMENT

14.1 GENERAL

OriginSmart™ firmware allows control of different power modes of GNSS, Cellular and MCU modules by sending messages from a server to over the air. To learn more about the message structure, please review the document OriginSmart™ API specifications.

14.2 ORIGINIOT™ IMPLMENTED MCU POWER MODES

14.2.1 RUN

Default power mode at wakeup. The user can change to low power run or to shutdown. Transferring the device to shutdown is recommended only after setting wakeups or scheduled wakeup events (see OriginSmart™ API specifications)

14.2.2 LOW POWER RUN

This mode is achieved with by operating the low-power regulator to minimize the operating current. The code can be executed from SRAM or from Flash, and the CPU frequency is limited to 2 MHz.

13.2.3 SHUTDOWN

The Shutdown mode allows to achieve the lowest power consumption. The internal regulator is switched off. The oscillators are also switched off. The RTC can remain active. SRAMs and register contents are lost except for registers in the Backup domain. The device exits Shutdown mode when an external reset, a wakeup pin event (configurable rising or falling edge), or an RTC event occurs (alarm, periodic wakeup, timestamp, tamper). Wakeup and Reset pins are available through J1 pins 21, 23 or 25.

14.3 CELLULAR

14.3.1 SLEEP MODE

Various power saving modes controllable by OriginSmart™ firmware. Software is active to minimum extent. If the module was registered to the GSM network in IDLE mode, it is registered and paging in SLEEP mode, too.

14.3.2 IDLE

Module is ready for data transfer, but no data is currently sent or received. Power consumption depends on network settings and configuration.

14.3.3 DATA

Data transfer in progress. Power consumption depends on network settings, and uplink/downlink data rates.

14.3.4 POWER DOWN

Only a voltage regulator is active for powering the RTC. Software is not active. Interfaces are not accessible. Operating voltage remains applied. It is important to set a scheduler or wakeup logic prior to switching the cellular modules power off.

14.3.5 POWER SAVING WHILE ATTACHED TO LTE NETWORKS

In LTE Cat 1, and LTE Cat M modules, the power saving possibilities while attached to a LTE network depend on the paging timing cycle of the base station.

During normal LTE operation, i.e., the module is connected to a LTE network, the duration of a power saving period varies. It may be calculated using the following formula:

t = DRX Cycle Value* 10 ms

DRX (Discontinuous Reception) value in LTE networks is any of the four values: 32, 64, 128 and 256, thus resulting in power saving intervals between 0.32 and 2.56 seconds. The DRX value of the base station is assigned by the LTE network operator.

In the pauses between listening to paging messages, the module resumes power saving, as shown in Figure 2.

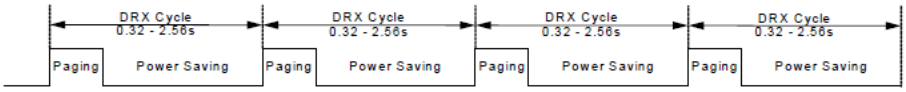

FIGURE 2: POWER SAVING AND PAGING IN LTE NETWORKS

The varying pauses explain the different potential for power saving. The longer the pause the less power is consumed.

14.4 GNSS

14.4.1 FULL POWER ACQUISITION

Module stays in Full Power Acquisition state until a reliable position solution is made. Switching to GPS-only mode turns off GLONASS RF block lowering power consumption.

14.4.2 FULL POWER TRACKING

Full Power Tracking state is entered after a reliable position solution is achieved. During this state the processing is less intense compared to Full Power Acquisition, therefore power consumption is lower. Full Power Tracking state with navigation update rate at 5Hz consumes more power compared to default 1Hz navigation.

14.4.3. CPU ONLY

CPU Only is the transitional state of ATP™ power saving mode when the RF and DSP sections are partially powered off. This state is entered when the satellites measurements have been acquired, but navigation solution still needs to be computed.

14.4.3. STANDBY

Standby is the transitional state of ATP™ power saving mode when RF and DSP sections are completely powered off and baseband clock is stopped.

14.4.4. HIBERNATE

During this state RF, DSP and baseband sections are completely powered off leaving only RTC and Battery-Backed RAM running. The module will perform Hot Start if stayed in Hibernate state less than 4 hours from last valid position solution.

14.4.5 BASIC POWER SAVING MODE

Basic power saving mode is allows the user to control the transfers between Full Power and Hibernate states. User may condition transfers by tracking duration, accuracy, satellites in-view or other parameters.

14.4.6 SELF MANAGED POWER SAVING MODES

The GNSS module has several self-managed power saving modes tailored for different use cases. These modes provide several levels of power saving with degradation level

of position accuracy. Initial operation in Full Power state is a prerequisite for accumulation of satellite data determining location, fine time and calibration of reference clocks.

14.4.7 ADAPTIVE TRICKLE POWER (ATP™)

ATP™ is best suited for applications that require navigation solutions at a fixed rate as well as low power consumption and an ability to track weak signals. This power saving mode provides the most accurate position among self-managed modes.

In this mode module is intelligently cycled between Full Power state, CPU Only state consuming 15mA and Standby state consuming ≤ 0.1mA, therefore optimizing current profile for low power operation.

ATP™ period that equals navigation solution update can be 1 second to 10 seconds. On-time including Full Power Tracking and CPU Only states can be 200ms to 900ms.

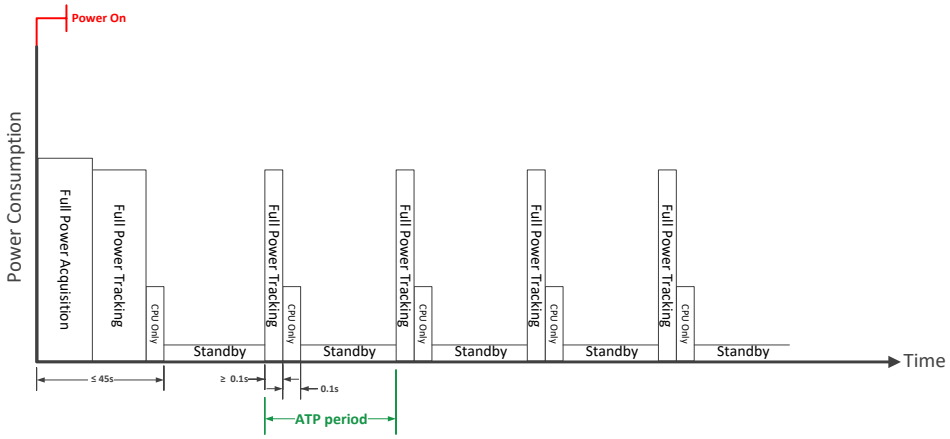

FIGURE 2 – ATP™ TIMING

14.4.8 PUSH TO FIX (PTF™)

PTF™ is best suited for applications that require infrequent navigation solutions. In this mode GNSS module is mostly in Hibernate state, drawing ≤ 54µA of current, waking up for satellite data refresh in fixed periods of time. PTF™ period can be anywhere between 10 seconds and 2 hours.

During fix trial module will stay in Full Power state until good position solution is estimated or pre-configured timeout for it has expired.

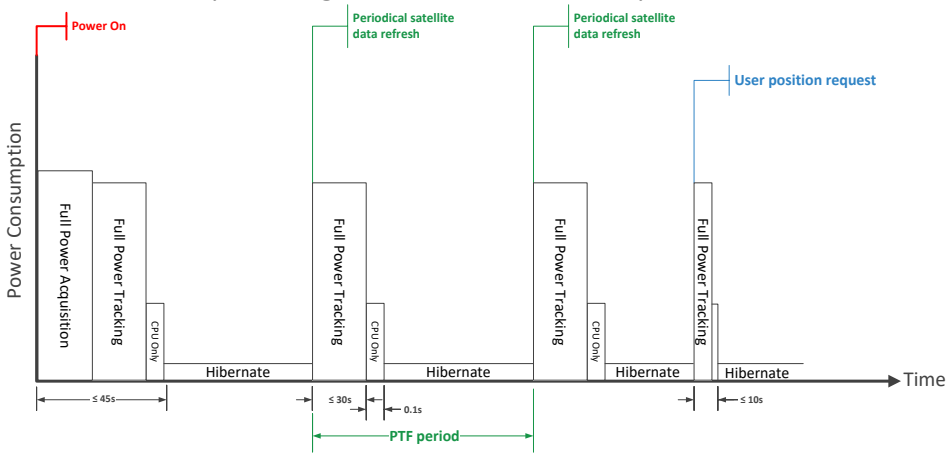

FIGURE 3 – PTF™ TIMING

14.4.9 ADVANCED POWER MANAGEMENT (APM™)

APM™ mode is designed for Aided-GPS wireless applications. APM™ allows power savings while ensuring that the **Q**uality **o**f the **S**olution (QoS) in maintained when signals level drop.

In APM™ mode the module is intelligently cycled between Full Power and Hibernate states.
In addition to setting the position report interval, a QoS specification is available that sets allowable error estimates and selects priorities between position report interval and more power saving.
User may select between Duty Cycle Priority for more power saving and Time Between Fixes (TBF) priority with defined or undefined maximum horizontal error. TBF range is from 10s to 180s between fixes, Power Duty Cycle range is between 5% to 100%. Maximum position error is configurable between 1 to 160m.
The number of APM™ fixes is configurable up to 255 or set to continuous.

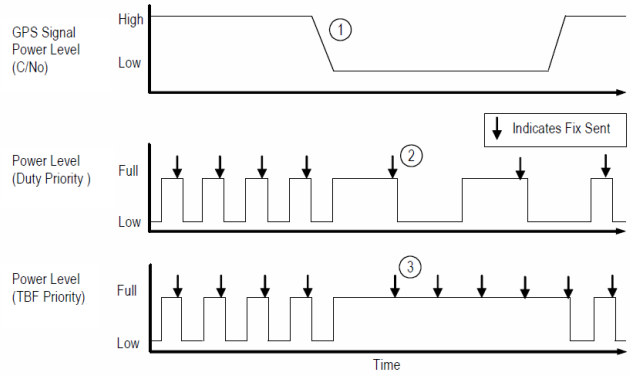

FIGURE 4 – APM™ TIMING

Notes:
1. GPS signal level drops (e.g. user walks indoor).
2. Lower signal results in longer ON time. To maintain Duty Cycle Priority, OFF time is increased.
3. Lower signal means missed fix. To maintain future TBFs module goes Full Power state until signal levels improve.

15. INTERFACE

15.1 CONNECTOR-PIN ASSIGNMENT

Con.	Pin	NAME	FUNCTION	DIRECTION
Connector J1	1	SPI1_SCK	SPI Serial Clock	Output
	2	USB_OTG_FSDN	USB On the Go Full Speed Data Signal Minus	Bi-directional
	3	SPI1_MOSI	SPI Master Output Slave Input	Output
	4	USB_OTG_FSDP	USB On the Go Full Speed Data Signal Plus	Bi-directional
	5	SPI1_MISO	SPI Master Input Slave Output	Input
	6	GND	System Ground	Power
	7	GND	System Ground	Power
	8	SWDIO	Debug Port Input/ Output	Bi-directional
	9	I2C1_SDA	I²C Serial Data	Bi-directional
	10	SWCLK	Debug Port Clock	Output
	11	I2C1_SCL	I²C Serial Clock	Output
	12	GND	System Ground	Power
	13	GND	System Ground	Power

	14	UART5_RX	UART 5 Receive	Input
	15	LPUART1_TX	Low Power UART 1 Transmit	Output
	16	UART5_TX	UART 5 Transmit	Output
	17	LPUART1_RX	Low Power UART 1 Receive	Input
	18	UART4_TX	UART 4 Transmit	Output
	19	GND	System Ground	Power
	20	GND	System Ground	Power
	21	RST_MCU	MCU Reset	Input
	22	UART4_RX	UART 4 Receive	Input
	23	WAKEUP_1_PIN	MCU Wakeup pin 1	Input
	24	1PPS	UTC Time Mark From GNSS Module	Output
	25	WAKEUP_2_PIN	MCU Wakeup pin 2	Input
	26	GND	System Ground	Power
	27	VSW	System Power	Power
	28	VSW	System Power	Power
	29	VSW	System Power	Power
	30	VSW	System Power	Power
Connector J2	1	GND	System Ground	Power
	2	GND	System Ground	Power
	3	GPIO8	General Purpose Input/Output 8	Bi-directional
	4	GPIO_IN_3	General Purpose Input 3	Input
	5	GPIO_OUT_2	General Purpose Output 2	Output
	6	GPIO_IN_1	General Purpose Input 1	Input
	7	GPIO_OUT_1	General Purpose Output 1	Output
	8	GPIO6	General Purpose Input/Output 6	Bi-directional
	9	GPIO11	General Purpose Input/Output 11	Bi-directional
	10	ID_USB	USB Device Identification	Input
	11	GPIO_IN_2	General Purpose Input 2	Input
	12	TIM1_CH1	MCU Timer Channel 1	Output
	13	GPIO14	General Purpose Input/Output 14	Bi-directional
	14	GPIO_OUT_4	General Purpose Output 4	Output
	15	SW_UPDATE	Power Shutdown to Cellular Module After Software Update	Input
	16	GPIO_OUT_3	General Purpose Output 3	Output
	17	DAC1_OUT1	Digital to Analog Converter Output	Output
	18	GPIO_IN_4	General Purpose Input 4	Input

	19	GPIO3	General Purpose Input/ Output 3	Bi-directional
	20	GPIO16	General Purpose Input/ Output 16	Bi-directional
	21	GND	System Ground	Power
	22	GND	System Ground	Power
	23	ADC1_EXT1S	Analog to Digital Converter Input from External Device	Input
	24	GPIO15	General Purpose Input/ Output 15	Bi-directional
	25	GND	System Ground	Power
	26	GPIO12	General Purpose Input/ Output 12	Bi-directional
	27	VCC3V3	3.3V Power Supply to USB Interface and Cellular Power On Signal[1]	Power
	28	GND	System Ground	Power
	29	VCC3V3	3.3V Power Supply to USB Interface and Cellular Power On Signal[1]	Power
	30	GND	System Ground	Power

TABLE 11 – PIN-OUT

Notes:

1. Must be applied if using ORG2101-C1XX-X (LTE Cat1 versions)

BOTTOM VIEW

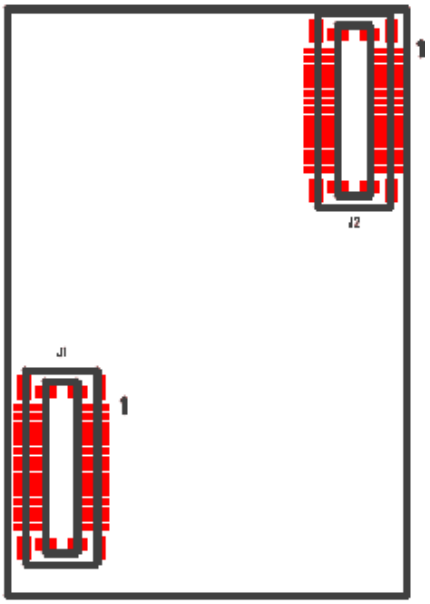

FIGURE 5 – CONNECTOR AND PIN NUMBER 1 ON BOARD POSITION

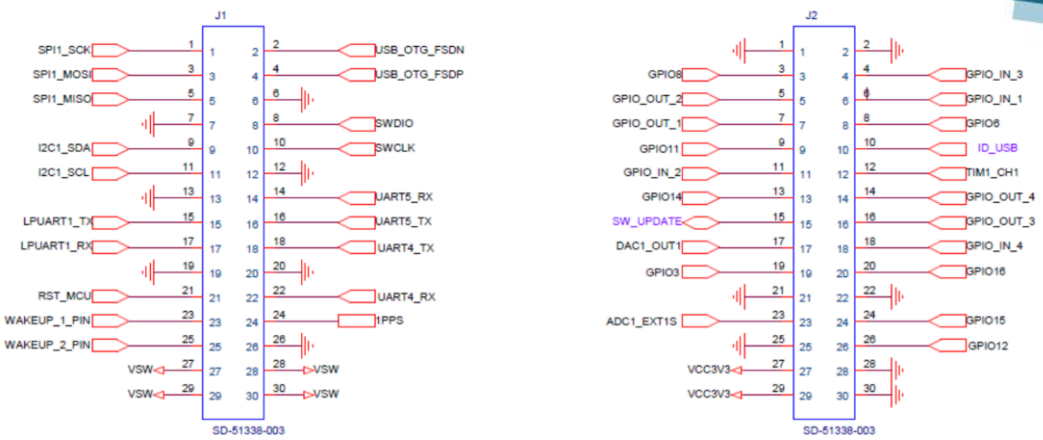

FIGURE 6 – CONNECTOR AND PINS SCHEMATICS

15.2 POWER SUPPLY

It is recommended to keep the power supply on all the time in order to maintain MCU ready for wakeup events and keep GNSS satellite data in RAM for fastest possible TTFF.

15.2.1 VSW

MCU and GNSS modules are internally regulated by on board low-dropout regulators.

VSW is 4.0V ±5% is used to provide power directly to Cellular module and MCU/GNSS power regulators. VSW must be provided from regulated power supply. Maximum current is 1.2A in peak power of cellular module transmit.

If using a battery, it is recommended to power the module with a buck-boost DC/DC converter (e.g. TPS63070 by Texas Instruments).

15.2.2 VCC3V3

Supply 3.3V to power USB interface. Connection is mandatory

If using ORG2101-C1XX-X, LTE Cat 1 versions, VCC3V3 power supply is mandatory in order to power the ON signal required to power on the cellular module

15.2.3 GROUND

All ground pins must be connected.

15.3 RF INPUT/OUTPUT

15.3.1 CELLULAR

J4 is a u.Fl connector for cellular antenna. Make sure the selected antenna supports the bands you plan to use. See table 12 for the bands used in each module.

OriginIoT™ P/n	Frequency Bands
ORG2101-2GEU-X	GSM 900/1800MHz (2G Dual Band)
ORG2101-2GGL-X	GSM 850/900/1800/1900MHz (2G Quad Band)
ORG2101-3GUS-X	GSM 850/1900MHz (2G Dual Band), UMTS 850/1900MHz (3G Bands 5 and 2)
ORG2101-3GEU-X	GSM 900/1800MHz (2G Dual Band), UMTS 900/2100MHz (3G Bands 8 and 1)
ORG2101-C1US-X	LTE: 700/1700 AWS (LTE Bands 13 and 4)
ORG2101-C1JA-X	LTE: 800/850/2100 (LTE Bands 19, 18 and 1)
ORG2101-CMUS-X	LTE 700/1700 AWS (LTE Bands 13 and 4)

TABLE 12 – ORIGINIOT™ SUPPORTED FREQUENCY BANDS

ESD protection for cellular antenna implemented on-board.

Using a dipole antenna is recommended for improving reception and minimizing power supply.

15.3.2 GNSS

RF input impedance is 50Ω, DC blocked up to ±25V. In case Active antenna implementation is required, it should be designed over specific add-on by the user.

- Passive antenna - OriginIoT™ system supports passive antenna interface via w.Fl connector J3.
  A short trace of 50Ω controlled impedance to conduct GNSS signal from antenna to GNSS component is already implemented on-board.
  In design with passive antenna attention should be paid on antenna layout.
- Active Antenna - Active antenna net gain including conduction losses should not exceed +25dB.
  One should implement a coax connection between J3 w.Fl connector and active antenna power control PCB. DC bias voltage for active antenna can be externally applied on coax connection through bias-T.

15.4 SIM INTERFACE

If using ORG2100-XXXX-T, a nano SIM card is required to connect the module to cellular networks. A nano SIM holder slot is available on ORG2100-XXXX-T to place the SIM in it. The nano SIM holder has a correct insertion mechanism so SIM can't place in a wrong direction.
SIM card holder does not have a locking mechanism. It is recommended to design device enclosure with a mechanism that will prevent SIM from falling out during usage.
Nano SIM holder is designed to withhold 1500 mating cycles.

15.5 CONTROL INTERFACE

15.4.1 ON/OFF, WAKEUP, RESET

Applying power supply to the module via VSW starts the MCU. MCU is responsible to wakeup GNSS module and cellular module, this functionality is implemented in OriginSmart™ firmware.
With power supply connected, the module can be switched to lower power modes. One can wake the device in several ways:

- Interrupts from GNSS or external sources (Has to set up prior to MCU shutdown)
- Network wake up from a server (available only in power modes with cellular module IDLE)
- Automatic wakeup upon scheduler (has to be set up prior to MCU shutdown)

To learn more on wakeup functionality please review OriginSmart™ API Specification document.
A reset pin allows to reset the module. Set RST_MCU pin to low for at least 500ms to ensure correct reset.

15.4.2 MCU SOFTWARE DEBUGGER

Pins SWDIO and SWCLK are used for serial wire debug and local load of new firmware. It is recommended to connect these pins to PC using ST-LINK debugger ST-Link/v2 ISOL STM8 & STM32.
The ST-Link debugger should also be connected to ground and 3.3V reference voltage.
Please refer to ORG2101 EVK User Guide for more details on local firmware upload.
Firmware update over the air (FOTA) is enabled by OriginSmart™ firmware, please refer to OriginSmart™ API Specification for details.

15.4.3 SERIAL DEBUG CONSOLE

UART5 interface is used by OriginSmart™ firmware for serial debug console.
OriginSmart™ firmware runs a serial debug console application in the background enabling the user to view commands set to/from the module, test and control the

interfaces, evaluate GNSS module functionality, set networking parameters and more.
Please review to ORG2101 EVK User Guide to learn how to use serial debug console.

15.4.4 1PPS

Pulse-Per-Second (PPS) output provides a pulse signal for timing purposes. PPS output starts when 3D position solution has been obtained using 5 or more GNSS satellites. PPS output stops when 3D position solution is lost.
Pulse length (high state) is 200ms with rising edge is less than 30ns synchronized to UTC epoch. The correspondent UTC time message is generated and put into output FIFO 300ms after the PPS signal. The exact time between PPS and UTC time message delivery depends on message rate, message queue and communication baud rate.
If user wants to use 1PPS signal as wakeup to MCU, he should connect it to one of the GPIOs or MCU wakeup pins.
Do not connect if not in use.

15.4.5 CELLULAR MODULE SW UPDATE

SW_UPDATE pin is used to generate cold reset to cellular module after cellular module software update. It is normally governed by OriginSmart™ FW. To control this feature externally please review OriginSmart™ API Specification document.

15.4.6 ID_USB

Used as input to USB for USB On-the-go functionality.

15.6 DATA INTERFACE

OriginIoT™ module has 6 types of physical interface ports to connect to peripheral devices – UARTx3, SPI, I²C, GPIOx12, ADC/DAC, USB 2.0 – each interface has its own pin.
The modules communicate data from physical interfaces wirelessly to a remote server using cellular technology (GSM, HSPA, LTE). Data forwarding, interfaces configurations, and messages for peripheral devices can be controlled from a remote server. See OriginSmart™ API Specification for details.

15.6.1 UART

1 External UART interface, and 1 external LPUART interface is available for the user to connect external peripheral devices. UART5 is used by serial debug console. 1 internal UART3 is used by USB and USART used by cellular module.
UART communication parameters (baud rate, stop bits, flow control) are controllable from remote server.

15.6.2 SPI

1 external 3 wire SPI bus is available for the user. One of 12 GPIOs must be used for Slave Select line. Interface parameters are configurable via a remote server.

15.6.3 I²C

1 external 2 wire I2C bus is available for the user. I/o domain is 1.8V. Interface parameters are configurable via a remote server. Module acts as a master, peripherals must act as slaves.

15.6.4 USB

1 externa 2 wire USB is available for the user. I/o domain is 3.3v therefore VCC3V3 should be connected to a regulated 3.3V source. ID_USB input can be used for USB On-The-Go functionality. Interface parameters are configurable via a remote server.

15.6.5 GPIO

12 General Purpose Input/Output interfaces are available for the user. I/o domain is 1.8V. Interfaces parameters are configurable via a remote server.

15.7 FLASH MEMORY INTERFACE

OriginIoT™ allows the user to log data into MCU flash memory through specific buffer commands sent from a remote server. Size of available flash memory for data logging is dynamic and it is dependent on FW version. Please refer to OriginSmart™ API Specification for details.

User has the capability to add another flash memory and attach it to user (via add-on) through one of the external interfaces provided.

16. TYPICAL APPLICATION CIRCUIT

16.1 POWER MANGMENT CIRCUIT

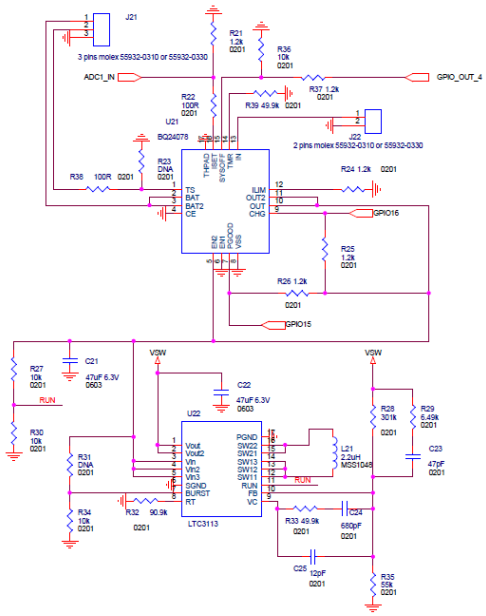

FIGURE 7–BUCK BOOST DC-DC AND POWER+CHARGING MANAGEMENT REFERENCE SCHEMATICS

16.2 I2C SENSORS - 9 DEGREES OF FREEDOM (ACCELEROMETER, GYROSCOPE, ECOMPASS)

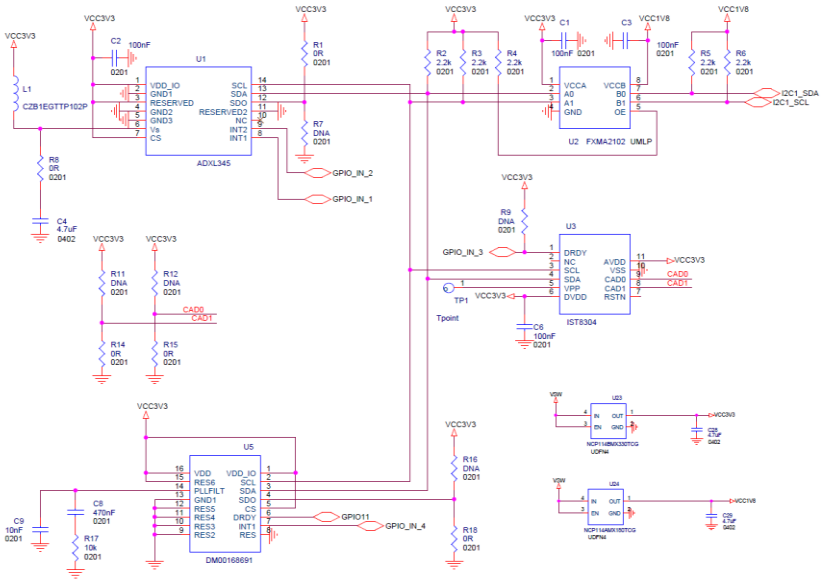

FIGURE 8 - REFERENCE SCHEMATICS OF I2C BUS WITH ACCELEROMETER, GYROSCOPE AND ELECTRONICS COMPASS

17. DESIGN CONSIDERATIONS

17.1 FORM FACTOR (MM)

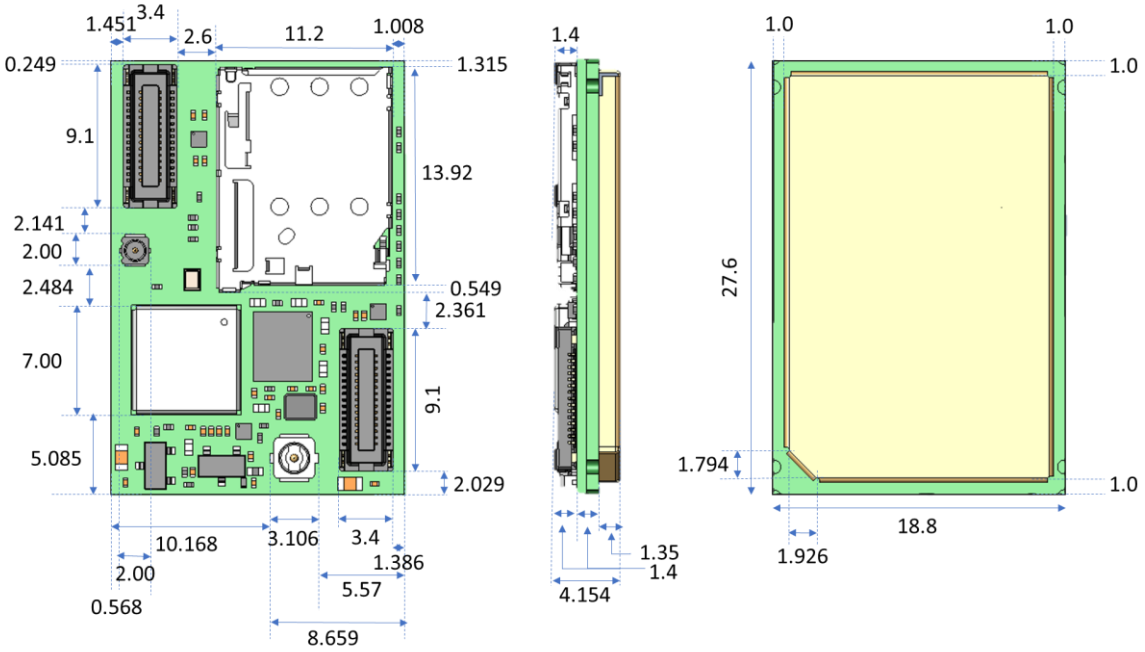

FIGURE 9– FORM FACTOR IN MM

Dimension	Length	Width	Height	Weight	
mm	27.6	18.8	4.154	gr	4.5
inch	1.086	0.74	0.164	oz	0.159

TABLE 13 – MECHANICAL SUMMARY

Note: form factor and mechanical summary shown is applicable for Rev.A versions ORG2101-2GGL-T, ORG2101-3GXX-T and ORG2101-CMXX-T. Please expect minor changes in versions ORG2101-2GEU-X, ORG2101-C1XX-X, and ORG2101-XXXX-E.

17.2 STACKABLE ADD-ON FUNCTIONALITY

User can choose to design a stackable add-on structure to add functions to ORG2101 or choose OriginGPS designed add-on if suitable for the user's application. Please contact your OriginGPS representative to inquire about the functionalities supported by OriginGPS designed add-ons. Recommended PCB layout is as described in figure 11. Plug connectors should be Molex 55909-003 or compatible.

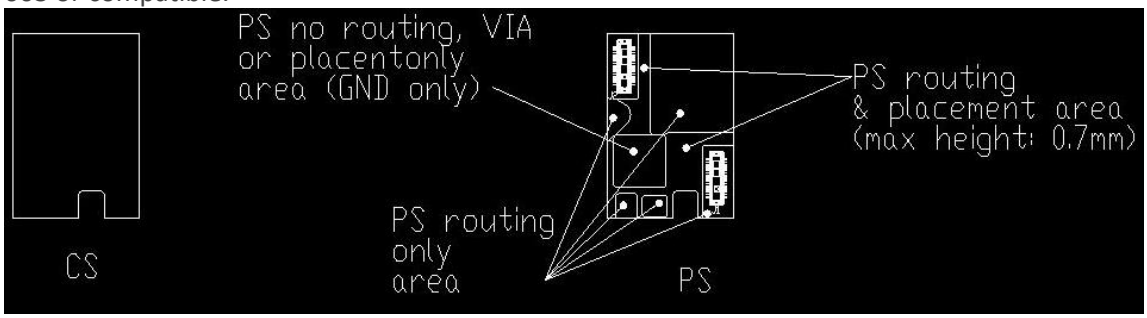

FIGURE 10 – PCB LAYOUT RECOMMENDATIONS AND LIMITATIONS

17.3 ANTENNAS

17.3.1 GNSS

GNSS module incorporated in ORG2101 operates with received signal levels down to -167dBm and can be affected by high absolute levels of RF signals, moderate levels of RF interference near the GNSS bands and by low-levels of RF noise in the GNSS band.

RF interference from nearby electronic circuits or radio transmitters can contain enough energy to desensitize ORG2101 GNSS functionality. 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.

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 the GNSS receiver antenna.

1. **Contact OriginGPS for application specific recommendations and design review services.**
2. Antennas for GPS and GLONASS have a wider bandwidth than pure GPS antennas.
3. Some wideband antennas may not have a good axial ratio to block reflections of RHCP GPS and GLONASS signals. These antennas have lower rejection of multipath reflections and tend to degrade the overall performance of the receiver.

17.3.2 CELLULAR

ESD protection for cellular antenna is implemented inside ORG2101.

18. OPERATION

18.1 STARTING THE SYSTEM

When power is first applied, ORG2101 MCU and GNSS module automatically receive operating power through 1.8V regulators integrated in the system. Gemalto cellular module starts after MCU is running and the Gemalto module operating voltage is toggled by internal GPIO from the MCU. The MCU is automatically configuring GNSS module to operate at 19200 baud-rate. Only after GNSS module is configured, the MCU toggles power to Gemalto module using internal GPIO.

18.2 INTERFACING WITH WEB APPLICATION

OriginGPS provides a server and web application for evaluation. Contact your OriginGPS representative to receive log-in credentials to the system. Please see OriginIoT EVK User Guide document for more details.

18.3 INTERFACING WITH SERIAL CONSOLE (EVK)

The user can connect the device to a serial debug console. The serial console allows the user to configure the connection parameters and to view the messages sent from the module to the remote server and vice versa. If using ORG210x Evaluation kit, please refer to OriginIoT EVK User Guide document for more details.

Alternatively, the user can connect a UART to USB circuit on his application to use the serial debug console in the same manner. Reference schematics for the circuit will be provided upon request.

18.4 INTERFACING VIA API

User can set up a server with TCP data transactions enabled and set it according to OriginSmart™ API Specification document.

19. FIRMWARE

OriginIoT™ comes with the latest firmware of OriginSmart™, a FW that allows transparent access to the sensors connected to OriginIoT and manages the continuous connectivity to the server.

19.1 DEFAULT CONFIGURATION

19.1.1MCU

Default configuration is MCU running at RUN state, with using external clock of 12Mhz as source for internal multipliers. To set the MCU to run in low power mode please see OriginSmart™ API Specification document.

19.1.2 CELLULAR

MCU will send cellular ON signal automatically after start-up. Cellular is configured to connect to port 3100 in server http://80.178.110.20*, using APN "internet.com". To change these settings please review OriginIoT EVK User Guide.

19.1.3 GNSS

UART Settings		19,200bps.
UART Data Format		NMEA
Satellite Constellation		GPS + GLONASS
NMEA Messages		$GNRMC @ 1 sec.
Firmware Defaults	SBAS	OFF
	ABP™	OFF
	Static Navigation	ON
	Track Smoothing	OFF
	Jammer Detector	ON
	Jammer Remover	OFF
	Fast Time Sync	OFF
	Pseudo DR Mode	ON
	Power Saving Mode	OFF
	3SV Solution Mode	ON

TABLE 14– GNSS MODULE DEFAULT CONFIGURATION

19.2 FIRMWARE UPDATE

Firmware update can be performed in one of two manners:

1. Locally: user must use EVK and ST-Link programmer for this action. Please refer to OriginIoT EVK User Guide for details.
2. Over the air: system should be connected to a server for this. Please refer to OriginSmart™ API Specifications for details.

20. HANDLING INFORMATION

20.1 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.

20.2 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.

20.3 ESD SENSITIVITY

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

20.4 SAFETY INFORMATION

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

20.5 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.

21. COMPLIANCE

ORG2101 modules are manufactured in ISO 9001:2008 accredited facilities.
ORG2101 modules are manufactured in ISO 14001:2004 accredited facilities.
ORG2101 modules are manufactured in OHSAS 18001:2007 accredited facilities.
ORG2101 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.
ORG2101 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.

22. PACKAGING AND DELIVERY

ORG2101 may be distributed in trays (for dimensions see Figure 12). The trays are not designed for machine processing. They contain modules to be (hand) picked onto an external application. Trays are packed and shipped including a moisture barrier bag with desiccant and humidity indicator card as well as a transportation box.

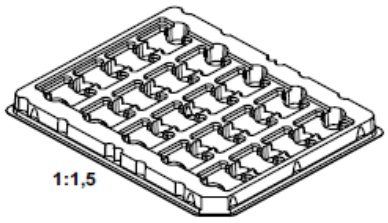

FIGURE 11– PACKAGING TRAY

23. ORDERING INFORMATION

O	R	G	2	1	0	1	-	X	X	X	X	-	X

1 2 3

1. Selection of communication technology:
   2G = 2G GPRS
   3G = 3G HSPA
   C1 = LTE Cat 1
   CM = LTE Cat M*
   NB = LTE Cat NB1 *

2. Selection of communication:
   EU= EMEA/APAC
   GL=Global
   US = North America
   JA = Japan
   CH = China
3. Selection of SIM type
   T = Traditional plastic SIM card holder
   E = Embedded SIM
   S = Special configuration

* Please contact iot@origingps.com

List of orderable parts			
ORG2101-2GEU-T	ORG2101-3GEU-T	ORG2101-C1US-T	
ORG2101-2GGL-E	ORG2101-3GEU-E	ORG2101-C1US-E	
	ORG2101-3GUS-T	ORG2101-C1JA-T	
	ORG2101-3GUS-E	ORG2101-C1JA-E	

TABLE 15 - LIST OF ORDERABLE PARTS