Emerald GP500C Product Description

The Emerald GP500C is the only IEEE 802.15.4 standard compliant chip available today with extreme low power features enabling energy harvesting solutions in wireless sensor networks.
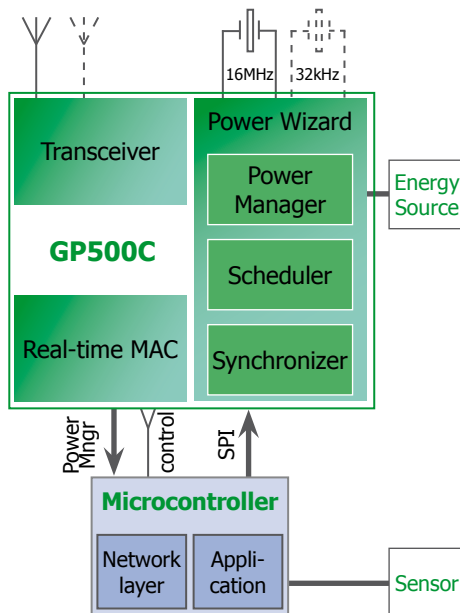
Designed for Ultra Low Power

The Emerald GP500C only consumes a fraction (10-25%) of the energy of traditional microcontroller based designs by using a lower peak current, an ultra low leakage current, and very short transmission times via just-in-time transmission scheduling.

The GP500C supports optimized sleep modes with extreme low supply currents:

▶ for time driven beaconed applications (with 32 kHz watch crystal): 250 nA
▶ for time driven non beaconed applications with internal clock: 150 nA
▶ for event driven applications: 100 nA

The GP500C supports full CPU power management, so eliminating the contribution of the CPU to the sleep currents. The real time MAC is able to handle communication on MAC and PHY level without the assistance of the CPU, reducing the overall power consumption and reducing the peak currents on system level during transmit and receive.

The Emerald GP500C typically saves up to 85% of the energy of comparable products

The GP500C's low energy consumption allows developers to build sensor systems with a peak current of about 20mA (two times lower than typical) and a system sleep mode of below 100nA (ten times less than typical) without compromising the network reliability.

GP500C-driven networks powered by energy harvesting bring true maintenance-free operation

▲▲ *The Emerald GP500C has a ground-breaking architectural concept. It is a communications controller that incorporates a transceiver with a fully integrated communications layer and an on-chip energy manager. Unlike traditional solutions, the Emerald GP500C device is an "autonomous transceiver" able to drive and control the data communication instead of being driven by a microcontroller. This allows the GP500C to greatly reduce energy consumption and enables end nodes to run on energy harvesting.*

Excellent Range and Reliability

The GP500C is optimized for reliable communication in harsh radio environments. The -96 dBm receiver sensitivity allows extended coverage. Built-in antenna diversity improves the effective link budget by 9 dB in noisy and reflective environments, resulting in improved robustness and up to 80% more range. In high density networks the packet-in-packet resynchronization further improves the communication reliability. The potential risks of interference by WiFi and/or Bluetooth devices have been reduced by the combination of excellent receiver dynamic range and an auto tuned band-pass filter.

Reference Designs

The Emerald GP500C is delivered with a reference design and development kit that allows OEMs to build their own communication modules and applications and a quick time-to-market. The GP500C will also support a wide range of software stacks that can run on different processors including ZigBee as well as Low Power Routing, Low Power Sensing (robust communication under intermittent power availability), a Micro stack and other application-dedicated low power protocols.

Highly Integrated

Since the GP500C communications controller is an integrated solution, all key functions and features are integrated. A minimum number of off-chip components is required: a 16 MHz crystal, a decoupling power supply capacitor and a printed circuit antenna. A 32 kHz sleep mode crystal is optional. The total system bill of material (BOM) will be lower and makes the GP500C best in class for total system cost, allowing for the opening of mass markets for maintenance-free sense and control applications.

GP500C Quick Facts

▶ IEEE802.15.4 PHY and full real time MAC in hardware, for low-est CPU power and lowest software complexity

▶ Fully integrated power management enables energy harvesting

▶ Optimized for lithium coin cell batteries (low active currents and ultra low sleep currents)

▶ Hardware accelerated AES-128 CCM* security mode with automatic encryption, decryption, authentication and key management

▶ Smallest form factor by minimal package and minimal external component count (QFN-40, 6x6 mm)

▶ Excellent range by antenna diversity: 9 dB improved link budget

▶ Additional improved robustness by packet-in-packet resynchronization

▶ Support for external PA and LNA

▶ Operates in the worldwide 2.4 GHz ISM-band

6 mm

QFN-40
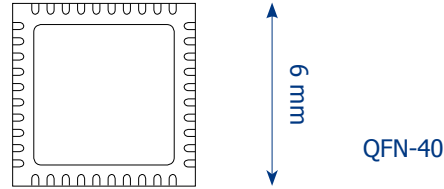
GP500C Features (*)

(*) The following features contain preliminary data

▶ High performance RF-CMOS 2.4 GHz Transceiver

▶ Industry leading in system integration

  ▶ IEEE802.15.4 PHY and Full Real Time MAC in hardware

  ▶ Hardware accelerated AES-128 CCM* security mode with automatic encryption, decryption, authentication and key management

  ▶ Reducing software complexity

  ▶ API in C-code available

▶ Improved RF link robustness and excellent range

  ▶ Antenna diversity with two antennas

  ▶ Packet preamble based antenna selection, resulting in up to 9 dB improvement in the link budget for fading channels

  ▶ Packet in Packet resynchronisation, reducing risk on lost packets in high density networks

  ▶ Excellent receiver sensitivity: -96 dBm

  ▶ Transmit power: 0 dBm, programmable in 12 steps of 1 dB

▶ High degree of WiFi and Bluetooth interference reduction

  ▶ Excellent receiver dynamic range, P-1dB RX fronted: -25dBm in normal mode, 0 dBm in overload protection mode providing sufficient protection for very nearby / co-located WiFi devices

  ▶ Auto tuned highly selective receive band-pass filter

▶ Industry leading Full Power Management

  ▶ Supporting multiple sleep modes with timer or event based wake-ups

  ▶ The GP500C is able to handle the communication of the IEEE802.15.4 layer in the GP500C without assistance of the MCU. Assistance (powering) of the he MCU is only needed in exceptional cases

  ▶ Complete configuration data including commissioning data is retained in the GP500C during standby, so enabling very fast start-up times from sleep mode to active mode

  ▶ 1.8kB retention RAM available for the MCU

▶ Enabling CR2032 batteries by reducing peak currents

  ▶ RX current 21 mA, TX current 23 mA (0dBm)

  ▶ Sleep current 100 nA in Event Mode, 150 nA in internal timer mode and 250 nA in 32 kHz mode

  ▶ 2.1 ~ 3.6 V supply range

  ▶ No MCU action during actual RX/TX due to Full Real time MAC in HW

  ▶ Includes battery life time monitor

▶ Low Rest of BOM cost

  ▶ No crystal required for the MCU, a – programmable - MCU-clock is provided by the GP500C

  ▶ Multiple banks of One Time Programmable memory available, so no EEPROM required

  ▶ Enabling ZigBee and IEEE802.15.4 applications with low cost MCUs

  ▶ Integrated antenna diversity switch

  ▶ In case of external LNA/PA control signals for antenna switches are available via GPIO

  ▶ 7 digital GPIO pins available, enable low pin-count microprocessor use

▶ Package: 40 pin 6 * 6 mm QFN

▶ Standards 2.4 GHz IEEE802.15.4-2003 and IEEE802.15.4-2006

▶ Radio Regulations: ETSI EN 300 328 and EN 300 440, FCC CFR-47 Part 15, ARIB STD-T66

▶ Green product: RoHS compliant

GreenPeak Emerald GP500C
2.4 GHz ZigBee-ready IEEE 802.15.4 Communications Controller

Radio Features [(*)]

► Standards	IEEE 802.15.4-2003
	IEEE 802.15.4-2006
► Radio Regulations	ETSI EN 300 328 & EN 300 440
	FCC CFR-47 Part 15
	ARIB STD-T66
► Frequency Band	2400 – 2483.5 MHz
► Channels	16
	(programmable 5 MHz step size)
► Modulation	IEEE 802.15.4
► Chip rate	2 Mchips/s
► Data Rate	250 kbps
► Receiver Sensitivity	-96 dBm (typical) [(1)]
Antenna diversity gain	9 dB [(2)]
► Co-channel Rejection	> -6 dB
► Adjacent Channel Rejection	> 30 dB
► Alternative Channel Rejection	> 40 dB
► WiFi IEEE 802.11g Rejection	> 30 dB [(3)]
► Bluetooth Rejection	> 30 dB [(4)]
► Transmit Power	-12 – 0 dBm
	(programmable)
► Radio Management	Antenna Diversity
Digital RSSI	
Link Quality Indication	

(*) The features listed contain preliminary data

1) At 3.0V and 25°C, unless specified otherwise

2) For typical indoor usage in an environment with 50nsec delay spread and 2 MHz signal bandwidth using the Rayleigh fading model: antenna diversity with 2 antennas results in a 9 dB improved link budget at a 1% outage probability compared to no antenna diversity. The 9 dB in link budget translates to 80% more range, if using a two slope range model with the breakpoint at 10m and g1 = 2, g2 = 3.5.

3) At +12 MHz and -13 MHz

4) At +4 MHz and -4 MHz

Electrical Characteristics [(*)]

► Sleep Mode Currents [(1)]			
Beaconed			
Using		32 kHz crystal	250 nA
		16 MHz crystal	200 µA
Non Beaconed			
Time Driven (Internal oscillator)			150 nA
Event Driven			100 nA
► Wake-up delay			2 ms
From sleep mode to either receive or transmit			
► Operational Currents [(1)]			
Receive		21 mA	
Transmit		23 mA (at 0 dBm)	
► Supply Voltage		2.1 – 3.6 V	
► Interface		SPI Slave	
		CPU power output	
		CPU clock output	
		CPU reset output	
		Wake-up input	
		External LNA PA control	
		GPIO	
► Crystal Frequencies			
Operational		16.000 MHz (±40 ppm)	
Sleep		32.768 kHz (±40 ppm)	

General Characteristics

► Package	QFN-40, 6x6 mm
► Operating Temperature	-40 – +85°C (industrial)
► Storage Temperature	-55 – +150°
► Compliance	RoHS

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