EBYTE E28-2G4M12SX

EBYTE E28-2G4M12SX SX1281 LoRa Wireless Module User Manual

Model: E28-2G4M12SX

1. Introduction

The EBYTE E28-2G4M12SX is a 2.4GHz wireless module designed for long-distance communication with ultra-low power consumption. This SMD module integrates the SX1281 RF chip, offering multiple physical layers and modulation methods including LoRa, FLRC, and GFSK. It is suitable for a wide range of applications such as smart home systems, security, tracking, and wireless distance measuring. This manual provides essential information for the proper setup, operation, and maintenance of the module.

2. Product Overview

The E28-2G4M12SX module is a compact SMD component featuring a built-in PCB antenna and an IPEX antenna connector for external antenna options. It utilizes a high-precision 52MHz crystal for stable performance.

Figure 2.1: EBYTE E28-2G4M12SX LoRa Wireless Module. This image shows the top view of the E28-2G4M12SX module, highlighting its compact size (22mm x 19mm) and the EBYTE branding.

2.1 Key Features

- **RF Chip:** Based on Semtech SX1281, supporting LoRa, FLRC, and GFSK modulation.
- **Frequency:** 2.4GHz band.
- **Communication Distance:** Up to 3km (tested).
- **Transmission Power:** Maximum 18mW, software multi-level adjustable.
- **Data Rate:** Supports air data rates from 0.476kbps to 2Mbps.
- **BLE Compatibility:** Compatible with Bluetooth Low Energy protocol.
- **Ranging Function:** Integrated Time-of-Flight (ToF) for distance measurement with accuracy as high as 1m.
- **Power Supply:** 1.8V to 3.6V (optimal performance above 3.3V).
- **Operating Temperature:** Industrial grade standard design, -40°C to 85°C.
- **Antenna Options:** IPEX and PCB antenna.
- **FIFO:** Large capacity 256-Byte data buffer.

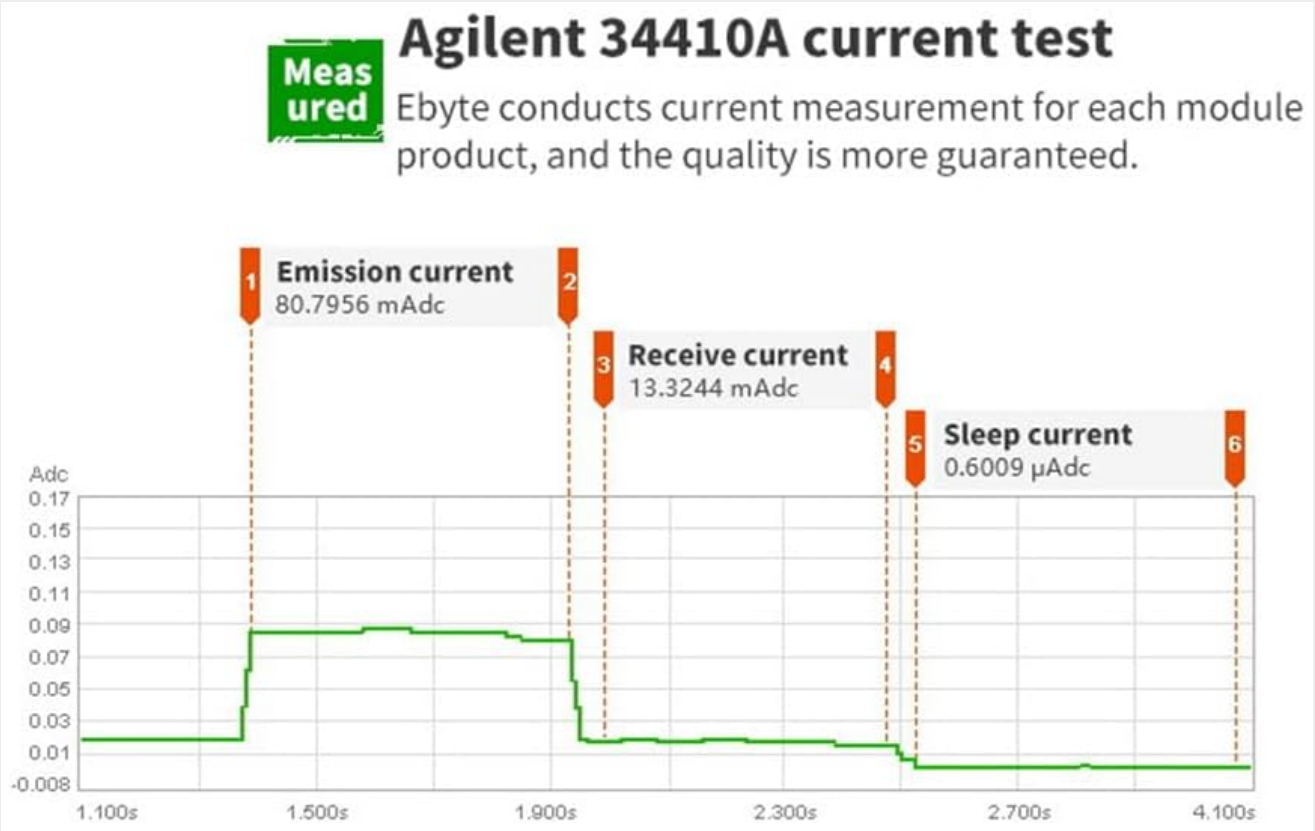

Figure 2.2: E28 Module Practical Functions. This diagram illustrates the key functionalities of the E28 module, including BLE protocol compatibility, multiple modulation modes (GFSK, FLRC, LoRa), ranging engine, and high-speed LoRa capabilities.

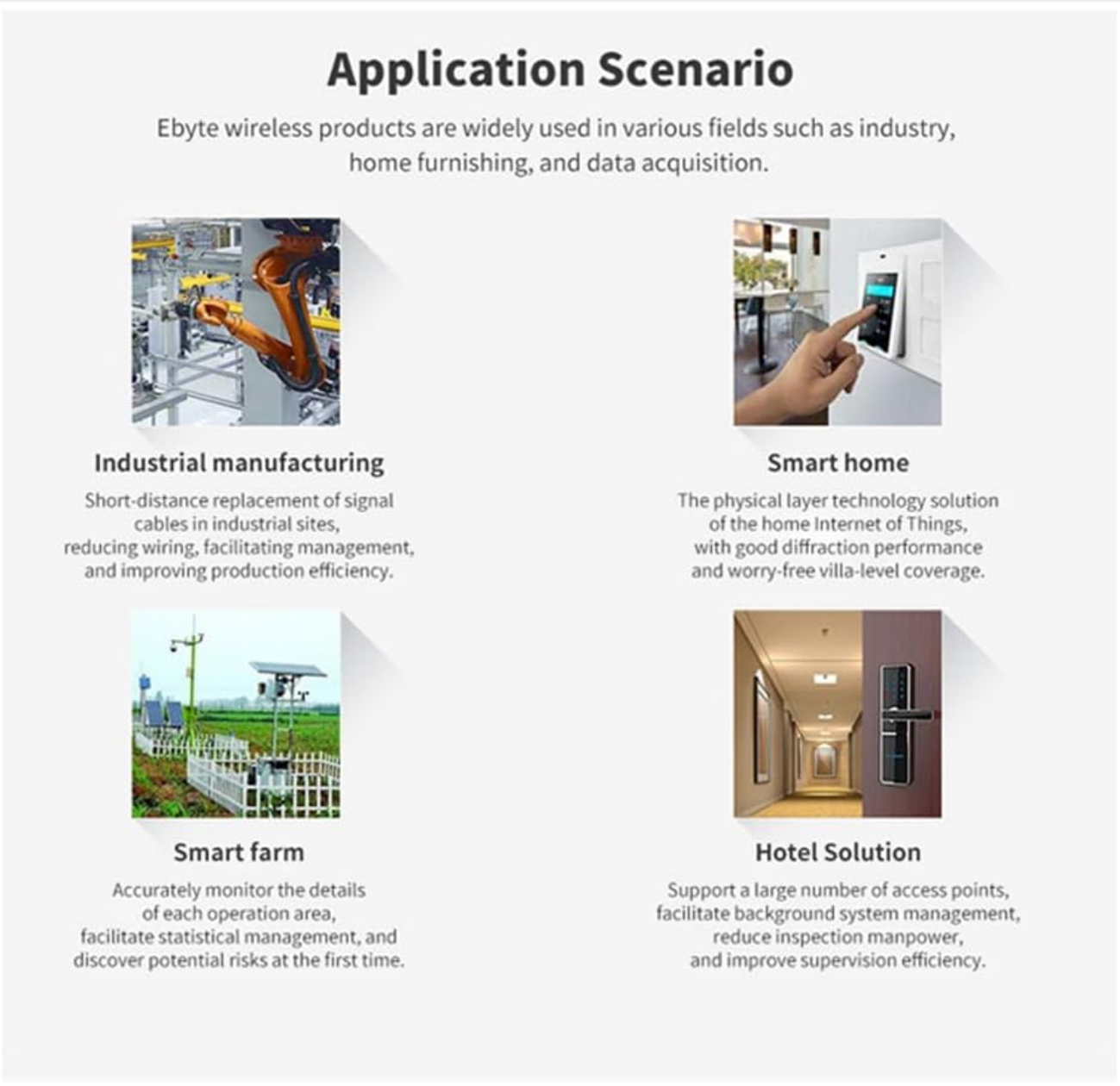

Figure 2.3: SX1280 2.4G LoRa Spread Spectrum. This image highlights the SX1280 chip solution, emphasizing its various physical layers and modulation methods (LoRa, FLRC, GFSK) for increased transmission distance and high-speed IoT performance. It also includes a note about the SPI hardware module.

3. Specifications

Parameter	Value
Model	E28-2G4M12SX
RF Chip	SX1281
Frequency Range	2.4GHz
Modulation Methods	LoRa, FLRC, GFSK
Max Transmission Power	18mW (12dBm)
Communication Distance	Up to 3KM
Air Data Rate	0.476kbps ~ 2Mbps

Parameter	Value
Power Supply Voltage	1.8V ~ 3.6V
Operating Temperature	-40°C ~ 85°C
Antenna Interface	IPEX, PCB Antenna
Module Dimensions	22mm x 19mm

3.1 Internal Components and Quality

The E28-2G4M12SX module is built with high-quality components to ensure reliable performance. It features an original Semtech SX1280 chip solution, an industrial-grade high-precision low-temperature crystal oscillator, and carefully selected high-line brand capacitive and inductive devices. The design also incorporates impedance matching for optimal signal integrity.

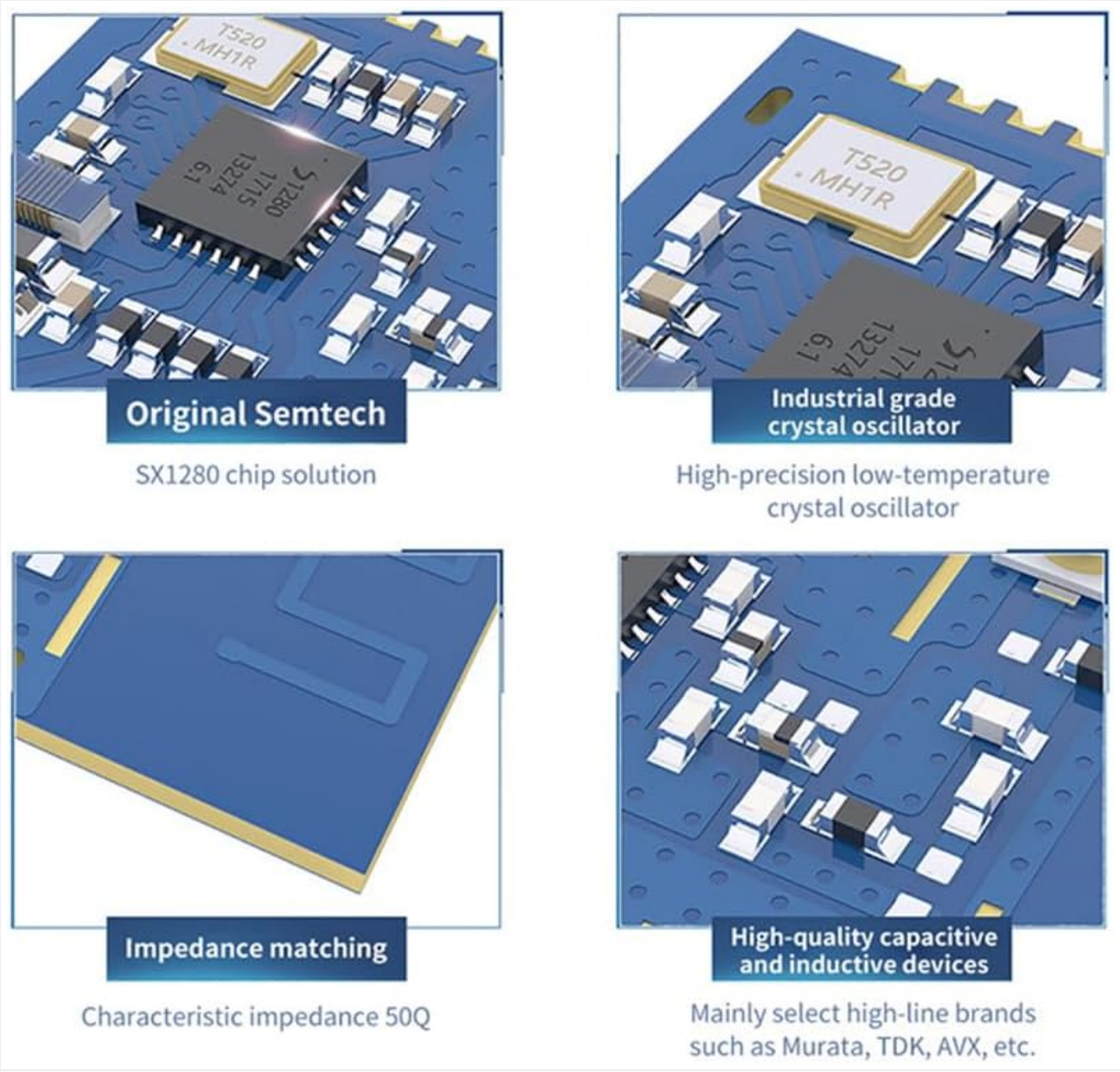

Figure 3.1: Internal Components and Quality Features. This image displays the internal components of the module, highlighting the original Semtech SX1280 chip, industrial-grade crystal oscillator, impedance matching, and high-quality capacitive and inductive devices.

4. Pin Definitions and Circuit Diagram

The E28-2G4M12SX module communicates via an SPI interface. Proper connection to a Microcontroller Unit (MCU) is crucial for its operation. Below is a typical circuit diagram illustrating the pin connections.

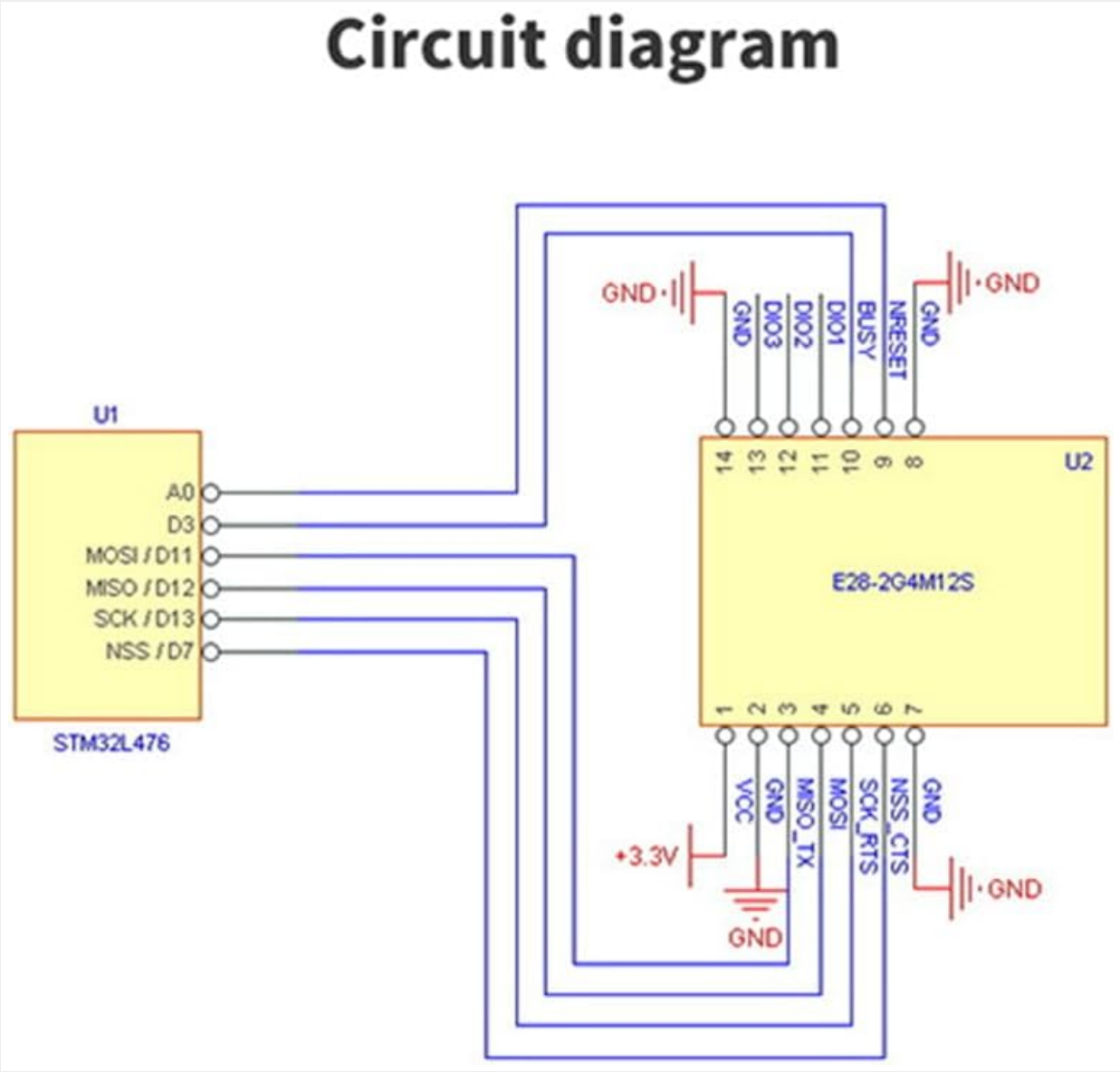

Figure 4.1: E28-2G4M12SX Circuit Diagram. This diagram shows the typical wiring connections between the E28-2G4M12S module (U2) and an STM32L476 microcontroller (U1), detailing the SPI, GPIO, and power supply pins.

4.1 Pin Descriptions

- **VCC:** Power supply input (1.8V-3.6V).
- **GND:** Ground connection.
- **MOSI:** Master Out Slave In (SPI data output from MCU, input to module).
- **MISO:** Master In Slave Out (SPI data input to MCU, output from module).
- **SCK:** Serial Clock (SPI clock signal).
- **NSS:** Slave Select (SPI chip select, active low).
- **DIOx:** Digital I/O pins, configurable for various functions (e.g., interrupt, busy status).
- **NRESET:** Reset pin (active low).

5. Setup and Programming

The E28-2G4M12SX is a pure RF transceiver module. It requires an external MCU to drive it and configure its registers via the SPI interface. Users must perform secondary development based on their specific application

requirements.

5.1 Initial Setup Steps

1. **Power Connection:** Connect VCC to a stable power supply within the 1.8V to 3.6V range and GND to the system ground. Ensure the power supply can provide sufficient current.
2. **SPI Interface:** Connect the MOSI, MISO, SCK, and NSS pins of the module to the corresponding SPI pins on your MCU.
3. **GPIO Connections:** Connect the DIOx pins and NRESET to appropriate GPIOs on your MCU for control and status monitoring.
4. **Antenna:** Connect an appropriate 2.4GHz antenna to the IPEX connector, or utilize the integrated PCB antenna.

5.2 Programming Guidelines

- **SPI Communication:** Implement SPI communication routines on your MCU to read from and write to the SX1281's internal registers.
- **Register Configuration:** Configure the SX1281 registers for desired modulation mode (LoRa, FLRC, GFSK), frequency, spreading factor, bandwidth, coding rate, and transmission power.
- **Packet Handling:** Develop routines for sending and receiving data packets, including CRC checks and addressing if required.
- **Ranging Function:** For Time-of-Flight ranging, refer to the SX1281 datasheet for specific register settings and calculation methods.
- **BLE Protocol:** If using BLE, ensure your MCU firmware implements the necessary BLE stack and protocols.

6. Operating Modes and Modulation

The SX1281 chip supports various modulation methods, allowing flexibility for different application requirements.

- **LoRa Mode:** Offers long-range communication with high interference immunity, ideal for IoT applications where distance and reliability are critical.
- **FLRC Mode:** Provides high-speed data transmission with strong anti-interference performance, achieving up to 1.3 Mbps.
- **GFSK Mode:** Standard frequency shift keying, compatible with BLE protocol, suitable for shorter-range, higher-data-rate applications.

6.1 Ranging Function (Time-of-Flight)

The SX1281 integrates a Time-of-Flight (ToF) engine, enabling precise distance measurement. This feature is particularly useful for applications requiring location tracking or proximity sensing. The accuracy can be as high as 1 meter under optimal conditions.

7. Current Consumption

Understanding the module's current consumption is vital for power-sensitive applications. The E28-2G4M12SX is designed for ultra-low power operation.

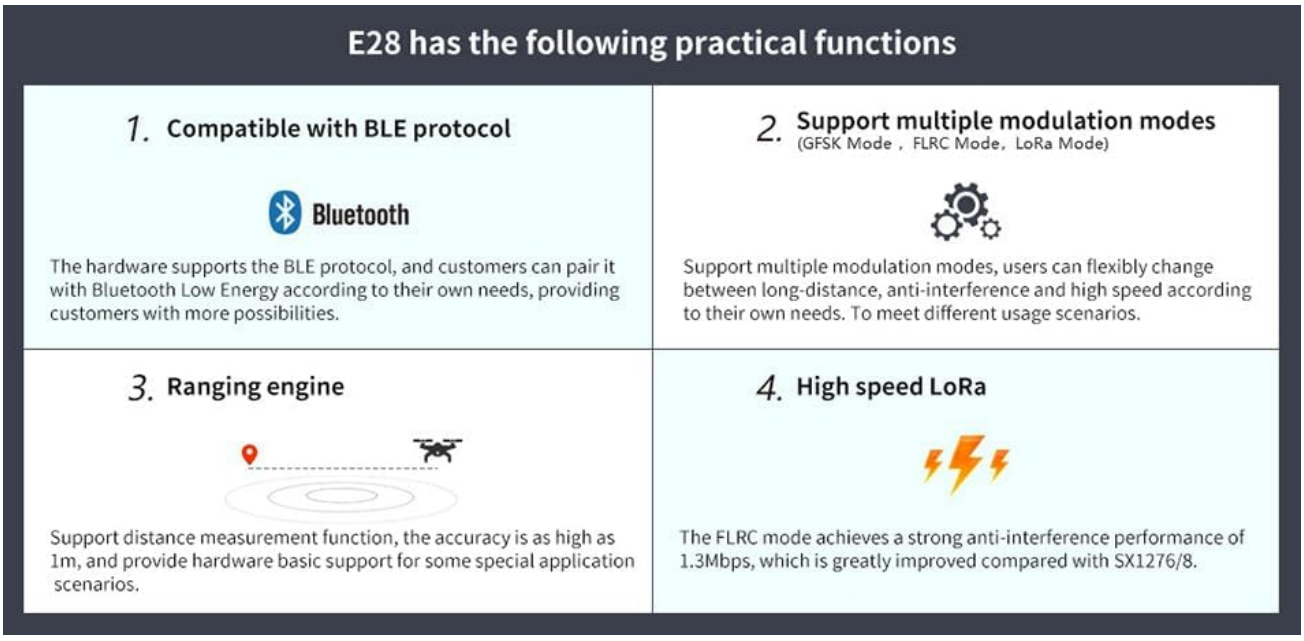

Figure 7.1: Agilent 34410A Current Test Results. This graph illustrates the current consumption of the module in different states: Emission current (approx. 80.7956 mAdc), Receive current (approx. 13.3244 mAdc), and Sleep current (approx. 0.6009 µAdc).

- **Emission Current:** Approximately 80.7956 mAdc during transmission.
- **Receive Current:** Approximately 13.3244 mAdc during reception.
- **Sleep Current:** Approximately 0.6009 µAdc in low-power sleep mode.

8. Application Scenarios

The versatility of the E28-2G4M12SX module makes it suitable for a broad range of wireless applications.

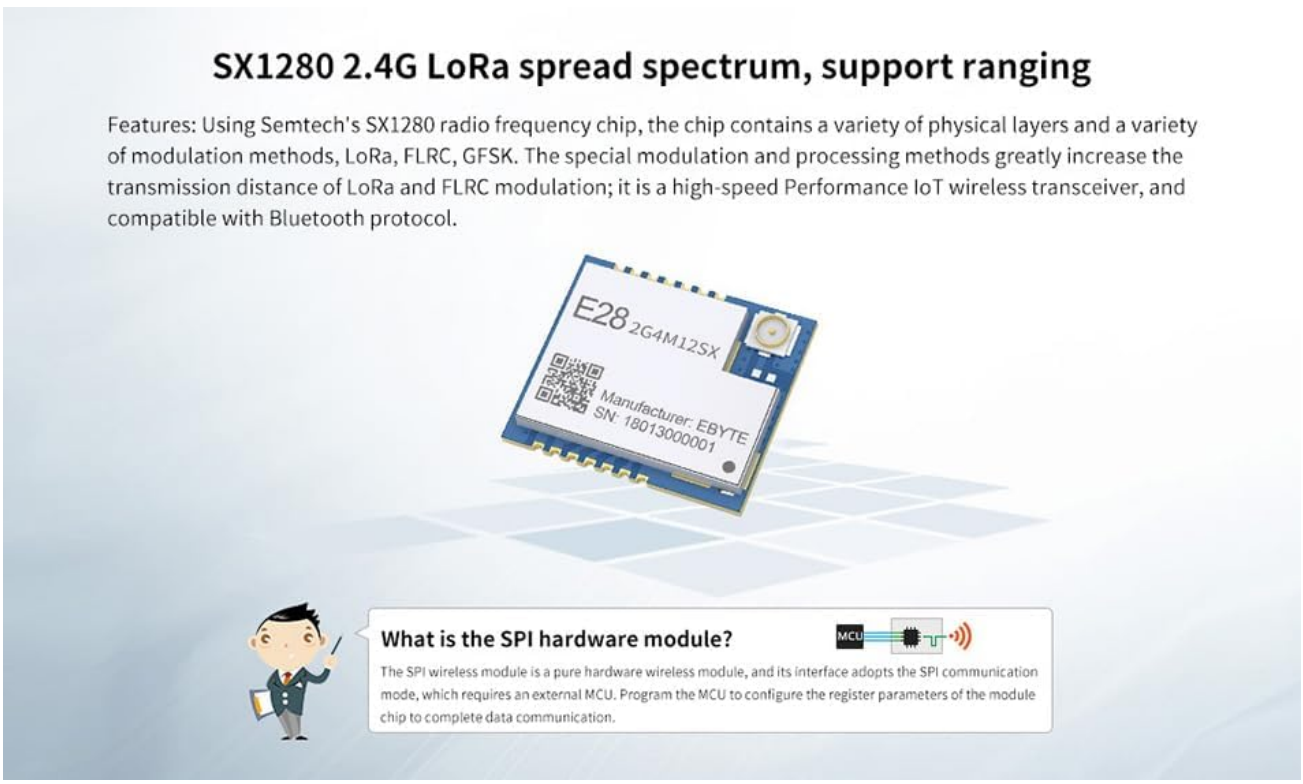

Figure 8.1: EBYTE Wireless Product Application Scenarios. This image displays various applications for EBYTE wireless products, including Industrial Manufacturing, Smart Home, Smart Farm, and Hotel Solutions.

- **Smart Home:** Home security alarm systems, remote keyless entry, smart sensors, building automation.

- **Industrial Applications:** Wireless industrial-grade remote control, short-distance replacement of signal cables, data acquisition.
- **Smart Farm:** Accurate monitoring of environmental details, statistical management, and risk detection.
- **Tracking and Locating:** Asset tracking, wireless distance measuring, wearable electronics, smart bracelets.
- **Health Management:** Health care products, advanced meter reading architecture (AMI).

9. Maintenance

To ensure the longevity and optimal performance of your E28-2G4M12SX module, follow these maintenance guidelines:

- **Environmental Conditions:** Operate the module within the specified temperature and humidity ranges. Avoid extreme conditions.
- **Power Supply:** Use a stable and clean power supply. Voltage fluctuations can affect performance and module lifespan.
- **Physical Handling:** Handle the module with care to prevent physical damage to pins or components. Use anti-static precautions during handling and installation.
- **Cleaning:** If necessary, gently clean the module with a soft, dry, anti-static brush. Avoid liquids or harsh chemicals.
- **Firmware Updates:** Keep your MCU firmware updated with the latest drivers and configurations for the SX1281 chip, as provided by EBYTE or Semtech, to benefit from performance improvements and bug fixes.

10. Troubleshooting

This section addresses common issues you might encounter with the E28-2G4M12SX module.

Problem	Possible Cause	Solution
No communication with MCU	Incorrect SPI wiring; Incorrect SPI configuration (clock, mode); Power supply issue; Module not reset properly.	Verify all SPI connections (MOSI, MISO, SCK, NSS). Check MCU SPI settings. Ensure VCC and GND are correctly connected and within range. Toggle NRESET pin.
Poor wireless range or signal quality	Antenna not connected or damaged; Incorrect antenna type; Environmental interference; Low transmission power setting; Incorrect modulation parameters.	Ensure antenna is securely connected. Use a 2.4GHz antenna. Check for obstacles or other 2.4GHz devices. Increase transmission power in software. Verify LoRa/FLRC/GFSK parameters.
High current consumption	Module not entering sleep mode; Continuous transmission/reception.	Implement proper sleep mode commands in MCU firmware. Optimize communication intervals to reduce active time.
Ranging function inaccurate	Environmental factors (multipath, obstacles); Incorrect ToF calibration or settings; Insufficient signal strength.	Ensure clear line-of-sight between modules. Review SX1281 datasheet for ToF calibration procedures. Improve antenna placement or signal strength.

11. Warranty and Support

EBYTE provides technical support and warranty services for its products. For detailed warranty information,

technical assistance, or further inquiries, please contact EBYTE directly or visit their official website.
Official Website: http://www.cdebyte.com/
When seeking support, please provide your module model (E28-2G4M12SX) and a detailed description of the issue.