

Application Note:

MCU Requirements for LoRaWAN™

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1. Introduction

This application note is targeted to any manufacturer wishing to develop a system based on the LoRaWAN™ wireless protocol stack. Its aim is to provide guidance on the MCU requirements as well as the connection between SX126x or SX127x chips and the MCU.

2. Module MCU Requirements for SX127x

Table 1: Module MCU Requirements for SX127x

Parameter	Minimum Settings	Recommended Settings
MCU RAM	8 KB ¹	16 KB
MCU Flash	128 KB ¹	256 KB
AES 128 bits	AES decryption in software	Secure Element ²
Radio DIOs connected to MCU IRQ inputs	DIO0, DIO1, DIO2	DIO0, DIO1, DIO2, DIO3
SPI (4 wires: SCK, MOSI, MISO, NSS)	Mandatory	
RTC (32.768 kHz XTAL) ³	Recommended for accurate time keeping	Mandatory for Class B nodes and FUOTA
IEEE 64-bit Extended Unique Identifier EUI-64 (OUI: 24 or 30 bits, SN: 40 or 34 bits)	Mandatory ⁴	

1. These parameters are only recommendation for the standalone LoRaWAN™ for Classes A, B and C and basic application. Depending on the integration level, the minimum memory size could be higher or lower.
2. The LoRaWAN™ Specification V1.1 mandates the use of a secure element to perform multicast downlink actuation. For other situations, the Secure Element is a nice to have.
3. The RTC should be able to handle sub-seconds. Otherwise, the RTC should be used in conjunction with another timer to have a sufficient resolution. A resolution of approximately 1 millisecond is recommended.
4. The EUI-64 can be obtained directly from the Secure Element (if used). Nevertheless, the application is free to use whichever EUI-64 as long as its uniqueness is guaranteed.

3. Radio DIO used by LoRaWAN™ for SX127x

Table 2: DIO Usage for SX127x in LoRa® and FSK

DIO Pin	LoRa® Parameter	FSK Parameter
DIO0	TxDone, RxDone	TxDone, RxDone
DIO1	RxTimeout	FifoLevel
DIO2	-	SyncAddrDetect
DIO3	ValidHeader ¹	-
DIO4	-	-
DIO5	-	-

1. Reserved for future use. The radio DIO must be connected to IRQ input lines of the MCU for good operation of LoRaWAN™.

4. Module MCU Requirements for SX126x

Table 3: Module MCU Requirements for SX126x

Parameter	Minimum Settings	Recommended Settings
MCU RAM	8 KB ¹	16 KB
MCU Flash	128 KB ¹	256 KB
AES 128 bits	AES decryption in software	Secure Element ²
Radio DIOs connected to MCU IRQ inputs	BUSY, DIO1	
SPI (4 wires: SCK, MOSI, MISO, NSS)	Mandatory	
RTC (32.768 kHz XTAL) ³	Recommended for accurate time keeping	Mandatory for Class B nodes and FUOTA
IEEE 64-bit Extended Unique Identifier EUI-64 (OUI: 24 or 30 bits, SN: 40 or 34 bits)	Mandatory ⁴	

1. These parameters are only recommendation for the standalone LoRaWAN™ for Classes A, B and C and basic application. Depending on the integration level, the minimum memory size could be higher or lower.
2. The LoRaWAN™ Specification V1.1 mandates the use of a secure element to perform multicast downlink actuation. For other situations, the Secure Element is a nice to have.
3. The RTC should be able to handle sub-seconds. Otherwise, the RTC should be used in conjunction with another timer to have a sufficient resolution. A resolution of approximately 1 millisecond is recommended.
4. The EUI-64 can be obtained directly from the Secure Element (if used). Nevertheless, the application is free to use whichever EUI-64 as long as its uniqueness is guaranteed.

5. Radio DIO used by LoRaWAN™ for SX126x

Table 4: DIO Usage for SX126x

DIO Pin	Usage
BUSY	Mandatory Used to indicate if the radio is ready to accept a new command
DIO1 ¹	Mandatory Used as generic IRQ flag
DIO2	Optional Can either be used as a generic IRQ flag or to control an external RF Switch
DIO3	Optional Can either be used as a generic IRQ flag or to power supply a TCXO. The TCXO is therefore powered and switched on or off directly by the radio

1. The radio DIO must be connected to IRQ input lines of the MCU for good operation of LoRaWAN™.

6. Revision History

Version	Date	Modifications
3	December 2017	Addition of Requirements for SX126x

7. Glossary

AES	Advanced Encryption Standard
DIO	Digital Input / Output
EUI	Extended Unique Identifier
FUOTA	Firmware Upgrade Over The Air
HW	Hardware
IEEE	Institute of Electrical and Electronics Engineers
IRQ	Interrupt Request
LoRa®	Long Range Communication
MCU	Microcontroller Unit
MISO	Master Input Slave Output
MOSI	Master Output Slave Input
NSS	Slave Select active low
OUI	Organizationally Unique Identifier
RAM	Random-Access Memory
RTC	Real-Time Clock
SCK	Serial Clock
SN	Serial Number
TCXO	Temperature-Compensated Crystal Oscillator
XTAL	Crystal



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