MIPOT MiP Series Wireless Protocol Modules Owner's Manual

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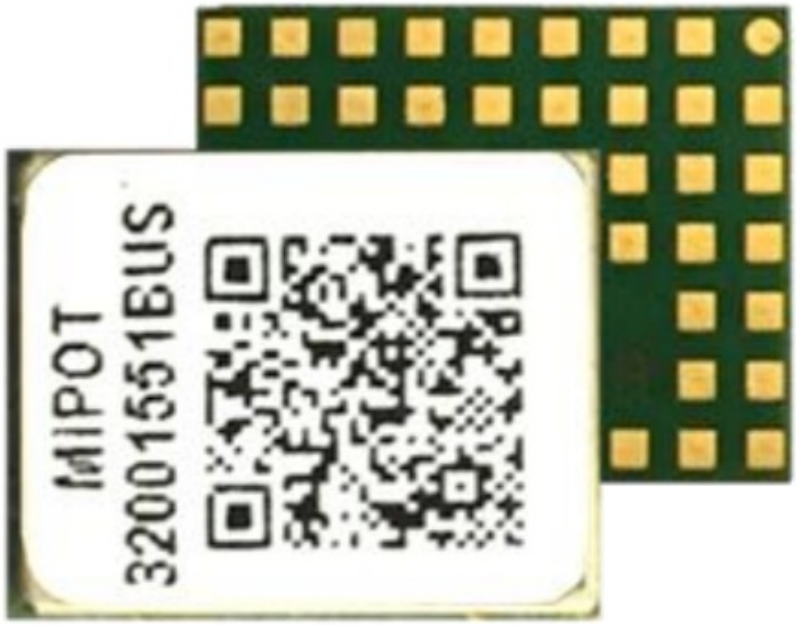
MIPOT MiP Series Wireless Protocol Modules



Overview

The 32001551xUS is a family of transceivers operating in the 915 MHz SRD Band optimized for very long-range, low-power applications, suitable for LPWA networks. Based on LoRa® RF Technology provides ultra-long range spread spectrum communication and high interference immunity.

Thanks to its small LGA form factor (11.3 x 8.9 mm only) and its low current consumption, this module allows the implementation of highly integrated low-power (battery-operated) solutions for Internet of Things (IoT) applications, security systems, sensor networks, metering, smart buildings, agriculture, and supply chain. The 32001551xUS family features a dual-core microcontroller in which one is dedicated to the radio stack and the ARM Cortex M4 is free for the customer application firmware. It also includes a Secure Element chip to store the root of trust, sensitive data, keys, and certificates.

The available radio stacks support a wide range of applications as the wM-Bus standard (32001551AUS), accelerating the development of a LoRaWAN application (32001551BUS) using the LoRa modulation, or performing a local star network using the LoRa Mipot stack (32001551CUS). Using the LoRa Modem stack (32001551DUS), it is easy to create point-to-point applications or build a more complex custom stack. The 32001551FUS contains all the aforementioned stack allowing to switch between them at runtime.

Product Features

Mechanical highlights

- Extremely compact dimensions
- LGA pattern

Low power characteristics

- Sleep current consumption 2.2 µA
- 11 mA in RX mode

Memories

- 196 kB Flash memory
- 32 kB RAM
- 512 B OTP
- (One Time Programmable) memory

RF performances

- -135 dBm Sensitivity LoRa
- +20 dBm Output power

Additional features

- ARM Cortex-M4 CPU
- Preloaded radio library
- Internal communication channel with the radio peripheral
- Based on STM32WLE5J

Multiple Stacks available

- wM-Bus (32001551AUS)
- LoRaWAN (32001551BUS)
- LoRa Mipot (32001551CUS)
- LoRa Modem (32001551DUS)
- LoRa Multistack (32001551FUS)

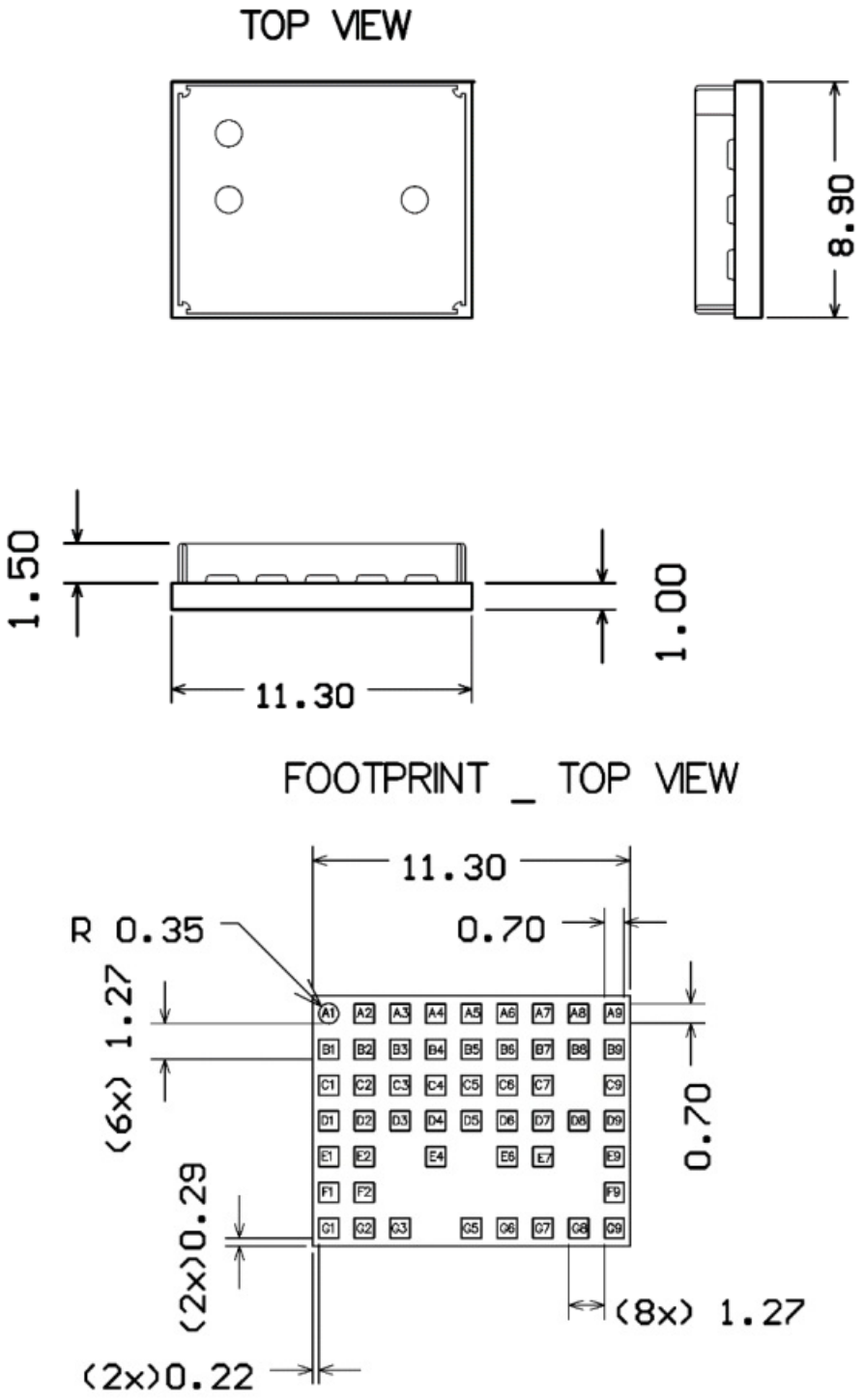
Emission designator

- LoRa® DTS: 500KF1D
- LoRa® FHSS: 125KFXD

Regulatory compliance

- USA FCC Rules and Regulations CFR 47, Part 15, Subpart B (10-1-20 Edition)
- USA FCC Part 15.247 (10-1-20 Edition): Operation within the bands 902 – 928 MHz, 2400 -2483.5 MHz, and 5725 – 5850 MHz.
- USA FCC Part 15.209 (10-1-20 Edition): Radiated emission limits; general requirements.
- USA FCC 47 CFR Part 2.1091 Radiofrequency radiation exposure evaluation: mobile devices.
- ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
- CANADA ICES-003 Issue 7 (October 2020)
- CANADA RSS-247 Issue 2 (February 2017).
- CANADA RSS-Gen Issue 5 amendment 1 (March 2019).
- CANADA ISED RSS-102 Issue 5 (2015-03) – Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

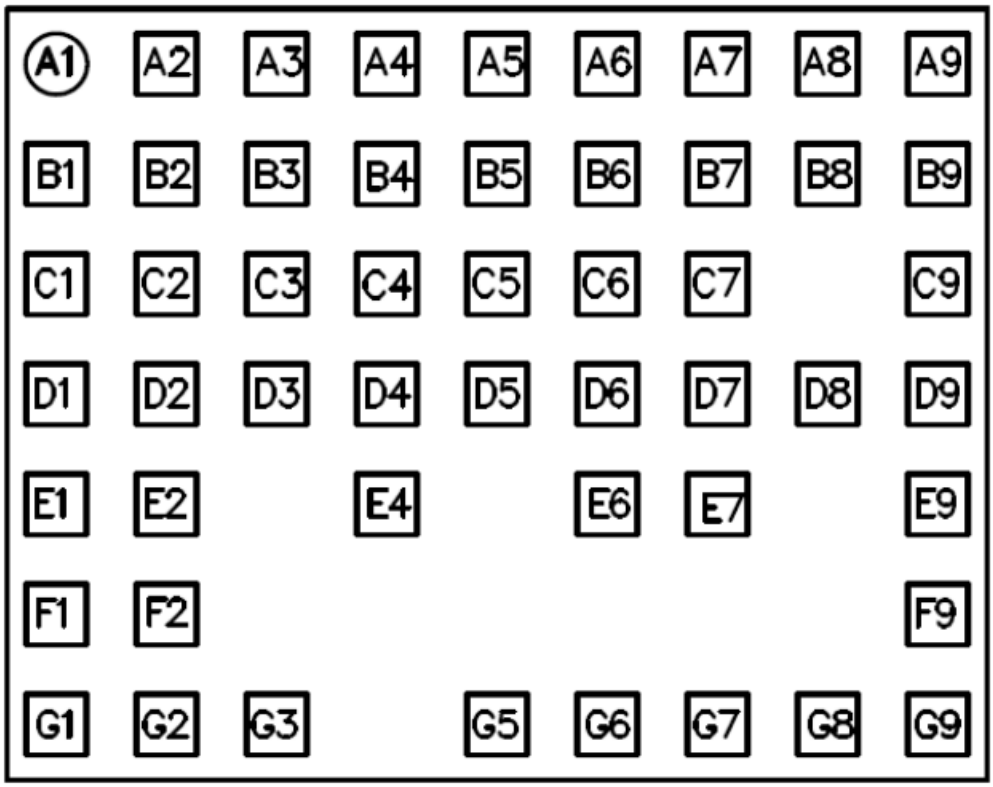
Mechanical Dimensions



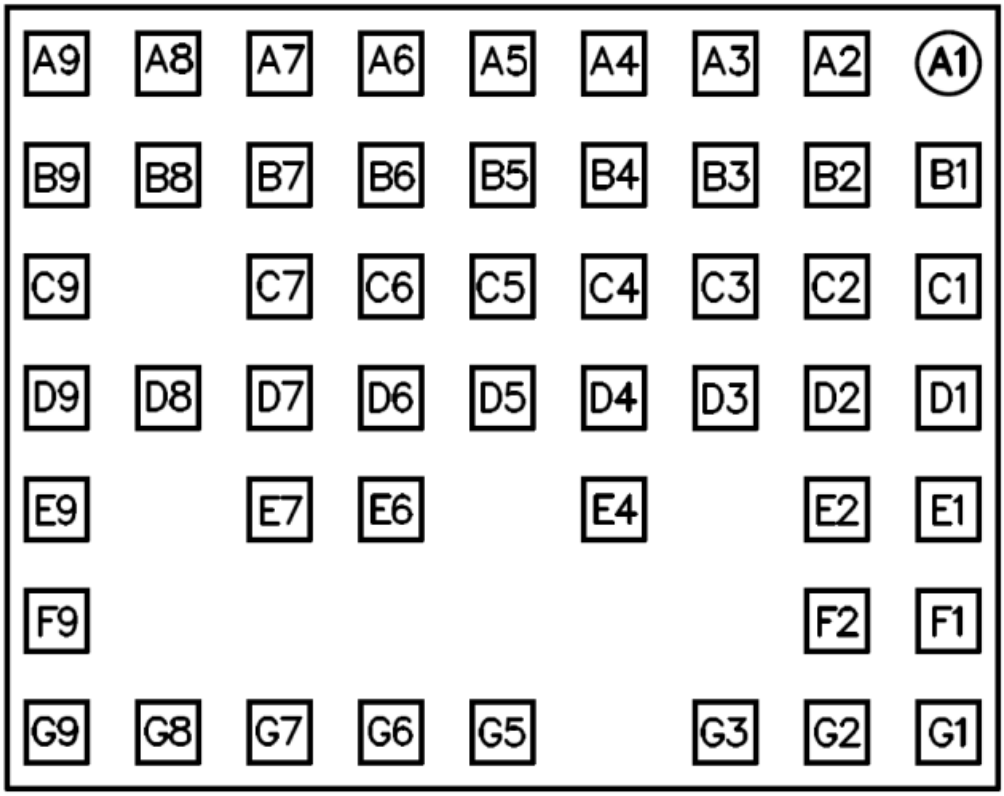
Note: Dimension in mm. General tolerance ±0.1mm. The tolerance is not cumulative.

Pin Definition

Top View



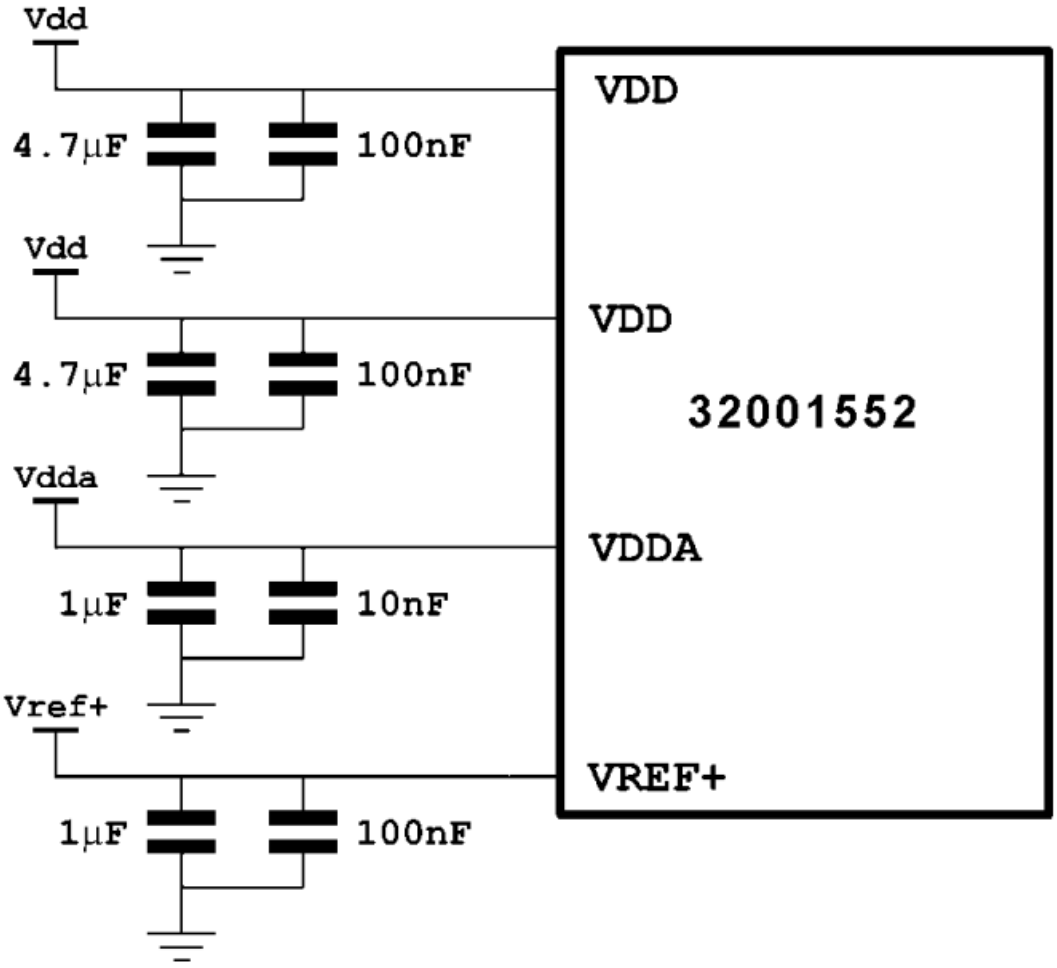
Bottom View



32001552DUS LGA PAD	STM32WL BGA B ALL		32001552DUS LGA PAD	STM32WL BGA B ALL
A1	PA6		D1	GND
A2	PA5		D2	PB10
A3	PA4		D3	PB11
A4	PC0		D4	GND
A5	PC1		D5	PB14
A6	PB5		D6	PA10
A7	PB8		D7	VBAT
A8	PB9		D8	PB13
A9	VDD		D9	PC2
B1	PA7		E1	GND
B2	PC6		E2	GND
B3	PA2		E4	PB1
B4	PA3		E6	PB2
B5	PB6		E7	PA12
B6	PB7		E9	PC3
B7	PA15		F1	ANT
B8	VDDA		F2	GND
B9	VDD		F9	PB12
C1	PH3-BOOT0		G1	GND
C2	PA8		G2	GND
C3	PA1		G3	GND
C4	GND		G5	NRST
C5	PA0		G6	SWDIO
C6	PB4		G7	SWCLK
C7	VREF+		G8	SWO
C9	GND		G9	PA9

Hardware integration

Decoupling capacitors
Each power supply pin must be decoupled with capacitors with the values suggested in the figure.



Layout guidelines
For better noise rejection, put the decoupling capacitors as close as possible to the power pins of the module, giving precedence to the low-value ones. The trace connecting to the RF pin must have an impedance of 50 Ω. For better performance, connect the GND pads around the RF pin without thermals.

Electrical Characteristics
Absolute Maximum Ratings

Parameter	**Max.**	**Unit**
Supply Voltage (VDD)	3.9	V
Radio Frequency Input Level, pin F1	0	dBm
Voltage Standing Wave Radio (VSWR) at RF Input, ANT, pad F1	10:1	
I/O Pin voltage	VDD + 0.3	V
Storage Temperature	-40 ÷ 100	°C
Operating Temperature	-40 ÷ 85	°C

Operating Condition
Note: All RF parameters are measured with input (pad F1, ANT) connected to a 50 Ω impedance signal source or load.

GENERAL ELECTRICAL CHARACTERISTICS 25 °C

Parameter	Min.	Typ.	Max.	Unit	Notes
Supply Voltage (VDD)	1.9	3.0	3.6	V	
VDDA	0	–	3.6	V	
VBAT	1.55	–	3.6	V	
VIN	-0.3	–	VDD+0.3	V	
Sleep DC Current	–	2.2	3.0	µA	
Data Rate 2-FSK	–	–	48	kbit/s	
Data Rate LoRa®	0.98	–	21.9	kbit/s	

RECEIVER ELECTRICAL CHARACTERISTICS 25 °C

Parameter	Min.	Typ.	Max.	Unit	Notes
DC Current Drain	–	–	11	mA	6
Operating Frequency	902.0	–	928.0	MHz	
Channel Frequency Precision	–	±15	–	kHz	
Sensitivity, 2-FSK	–	-115	–	dBm	2,3,5
Sensitivity, LoRa®	–	-135	–	dBm	2,4,5
Spurious radiated level	–	–	-57	dBm	
Output Logic Low	GND	–	0.05	V	
Output Logic High	VDD – 0.2	–	VDD	V	

TRANSMITTER ELECTRICAL CHARACTERISTICS 25 °C

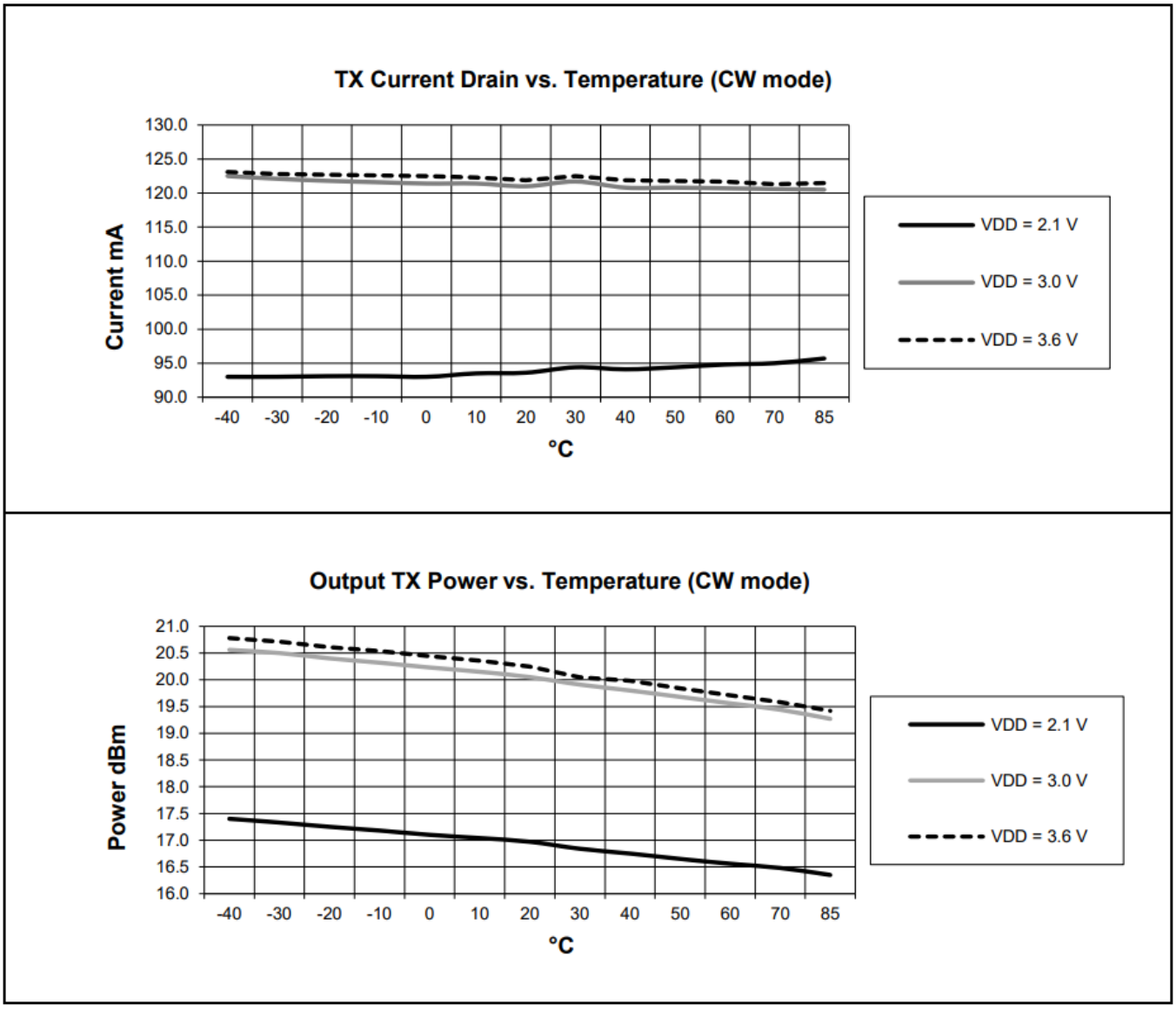
Parameter	Min.	Typ.	Max.	Unit	Notes
Current Drain (CW @20 dBm)	–	138	–	mA	1,2
Operating frequency	902.0	–	928.0	MHz	
Occupied Bandwidth LoRa® DTS	500	–	–	kHz	
Occupied Bandwidth LoRa® FHSS	–	125	–	kHz	8
Operating Channel Width LoRa®	–	600	–	kHz	
Operating Channel Width LoRa® FHSS	–	200	–	kHz	8
Maximum Output power (50 Ω load)	–	20	–	dBm	1,2,7
RF Output Impedance	–	50	–	Ω	
Input Logic Low	GND	–	0.05	V	
Input Logic High	VDD – 0.2	–	VDD	V	

Notes

1. VDD = 3.6 V.
2. All RF parameters are measured with input (pin F1, ANT) connected to a 50 Ω impedance signal source or load.
3. Pseudo-random code NRZ, 2-FSK BER (bit error rate) = 0.1 % or better, 2-level FSK modulation without pre-filtering, Bit Rate = 4.8 kbit/s, frequency deviation = 5 kHz, filter bandwidth = 20 kHz.
4. LoRa® PER (packet error rate) = 1 %, a packet of 64 bytes, preamble of 8 bytes, error correction code CR = 4/5, CRC on payload enabled, no reduced encoding, no implicit header.
5. Sensitivities are given using the highest LNA gain step.
6. Power consumption was measured with a -140 dBm signal and AGC ON.
7. In order not to exceed the maximum power permitted by the FCC PART 15 regulation, choose an appropriate antenna system and power supply.
8. Single hop OBW and OCW.

Temperature Range Curves

Note: All RF parameters measured d with input (pad F1) connected to a 50 Ω impedance signal source or load.



Exposure assessment

A conservative evaluation distance of 20 cm has been used to perform the assessment. The Maximum Gain to meet FCC Radiofrequency radiation exposure limits is:

Technology/Mode	Band	Frequency (MHz)	Distance (c m)	FCC General Population Limit (m W/cm^2)	Maximum Gain to com ply with RF Exposure Limits (dBi)
LoRa	ISM (USA)	902 – 928	20	0.60	16.10

Antenna details
To perform the assessments the following antenna has been used as a reference:

Antenna model	2J0B15 – C885G		
Parameters	868/915 MHz ISM Antenna		
Standards	ZigBee, ISM, SIGFOX, LoRa		
Band (MHz)	868		915
Frequency (MHz)	863 – 870		902 – 928
Return Loss (dB)	~ -7.8		-8.0
VSWR	2.4:1		2.4:1
Efficiency (%)	66.1		75.2
Peak Gain (dBi)	2.7		3.3
Average Gain (dB)	-1.8		-1.2
Impedance (Ω)		50	
Polarization		Linear	
Radiation Pattern		Omni-Directional	
Max. Input Power (W)		25	

Application Notes

Title	Description	Doc
Command Reference Manual	Description of commands for the wM-Bus stack	32001551AUS_Com_Ref
Command Reference Manual	Description of commands for the LoRaWAN stack	32001551BUS_Com_Ref
Command Reference Manual	Description of commands for the LoRa Mipot stack	32001551CUS_Com_Ref
Command Reference Manual	Description of commands for the LoRa Modem stack	32001551DUS_Com_Ref
Command Reference Manual	Description of commands for the multi-stack module	32001551FUS_Com_Ref
Manufacturing Process Information for LGA MiP Series Modules	Packaging information, Tape& Reel Specification, Reflow soldering information	AN_MNF002
STM32WLE5J data sheet	Overview of the MCU and its peripherals	DS13293 (from ST)
STM32WLE5J reference manual	Detailed description of the MCU and its peripherals	RM0453 (from ST)

Ordering Information

Title	Description	DoC
32001551AUS	MiP-Wm-1C128S-US	United States
32001551BUS	MiP-Lw-1C128S-US	United States
32001551CUS	MiP-LoMi-1C128S-US	United States
32001551DUS	MiP-LoMo-1C128S-US	United States
32001551FUS	MiP-LwMo-1C128S-US	United States

Regulatory Approvals
Models: 32001551AUS, 32001551BUS, 32001551CUS, 32001551DUS, 32001551FUS
The U.S. FCC ID: 2AQJP-MIP

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

CANADA
IC: 28566-MIP
HVIN: 32M01514A

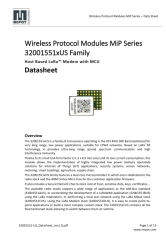
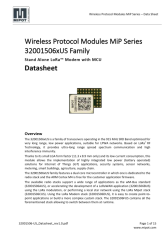
PMN:	32001551AUS, 32001551BUS, 32001551CUS, 32001551DUS, 32001551FUS	HVIN:	32M01514A
HMN:	–	FVIN:	–

Doc	Title	Description
DoI	32001505BUS_DoI	Declaration of Identity

Revision History

Revision	Date	Description
0.0	07.06.2023	First emission
1.0	03.11.2023	Added regulatory approvals labels, exposure assessment and antenna details

Documents / Resources

	MIPOT MiP Series Wireless Protocol Modules [pdf] Owner's Manual 32001551AUS, 32001551BUS, 32001551CUS, 32001551DUS, 32001551FUS, MiP Series Wireless Protocol Modules, MiP Series, Wireless Protocol Modules, Protocol Modules, Modules
	MIPOT MiP Series Wireless Protocol Modules [pdf] Owner's Manual 32001506AUS, 32001506BUS, 32001506CUS, 32001506DUS, 32001506FUS, MiP Series Wireless Protocol Modules, MiP Series, Wireless Protocol Modules, Protocol Modules, Modules

References

- User Manual