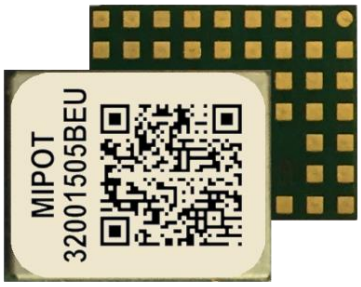
Wireless Protocol Modules MiP Series 3200150X Family

Datasheet



Overview

The 3200150X is a family of transceivers operating in the 868 MHz (EU version) or 915 MHz (US version) SRD Band optimized for very long range, low power applications, suitable for LPWA networks. Based on LoRa® RF Technology and LoRaWAN™ protocol, it provides ultra-long range spread spectrum communication and high interference immunity. Using the (G)FSK modem (EU version), it allows to easily add wM-Bus connectivity for utility meters.

Thanks to its small LGA form factor (11.3 mm x 8.9 mm) and its low current consumption, this module allows the implementation of highly integrated low power solutions for Internet of Things (IoT) applications, security systems, sensor networks, metering, smart buildings, agriculture, and supply chain management.

The 32001505 is a host based module needing an external microcontroller to configure and operate it. Instead, the 32001506 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.

The available radio stacks support a wide range of applications as the wM-Bus standard (3200150XAxx), or accelerating the development of a LoRaWAN application (3200150XBxx) using the LoRa modulation, or performing a local star network using the LoRa Mipot stack (3200150XCxx). Using the LoRa Modem stack (3200150XDxx), it is easy to create point-to-point applications or build a more complex custom stack. The 3200150XFxx can be configured to work either as a LoRaWAN module (as 3200150XBxx) or with the LoRa Modem stack (as 3200150XDxx). The 3200150XGxx can be configured to work either as a LoRaWAN

module (as 3200150XBxx) or with the wM-Bus stack (as 3200150XAxx). The configuration can be changed runtime.

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1. Product Features

Mechanical highlights:

- ✓ Extremely compact dimensions
- ✓ LGA pattern

Low power characteristics:

- ✓ Sleep current consumption 2.2 µA
- ✓ 18 mA in RX mode

Memories:

Only for 32001506

- ✓ 196 Kbyte Flash memory
- ✓ 32 Kbyte RAM
- ✓ 512 byte OTP (One Time Programmable) memory

RF performances:

- ✓ -135 dBm Sensitivity @LoRa®
- ✓ +14 dBm Output Power (EU version)
- ✓ +20 dBm Output Power (US version)

Additional features:

- ✓ Smart serial interface selector (UART, LPUART, SPI, I^2C)
- ✓ Preloaded radio library
- ✓ LoRaWAN™ specifications 1.0.4

Only for 32001506

- ✓ ARM Cortex-M4 CPU
- ✓ Internal communication channel with the radio peripheral
- ✓ Based on STM32WL55J

Multiple Stacks available:

- ✓ wM-Bus
- ✓ LoRaWAN™ specifications 1.0.4
- ✓ LoRa Mipot
- ✓ LoRa Modem
- ✓ LoRa Multistack

Regulatory compliance (EU version):

- ✓ 2014/53/EU (RED)
- ✓ EN 300 220-1 v3.1.1 (2017-02)
- ✓ EN 300 220-2 v3.1.1 (2017-02)
- ✓ EN 301 489-1 v2.2.3 (2019-11)
- ✓ EN 301 489-3 v2.2.0 (2021-11)
- ✓ EN IEC 62311:2020
- ✓ IEC 62321:2008 / IEC 62321-1:2013 / IEC 62321-2:2013 / IEC 62321-3-1:2014
- ✓ EN 62321:2009/ EN 62321-1:2013 / EN 62321-2:2014 / EN 62321-3-1:2014
- ✓ UNE EN 62321:2009 / UNE EN 62321-1:2009 / UNE EN 62321-2:2014 / UNE EN 62321-3-1:2014
- ✓ EN 62368-1:2014 + AC:2015 + AC:2017 + A11:2017
- ✓ IEC 62368-1:2014 + COR1:2015 + COR2:2015
- ✓ UNE-EN 62368-1:2014 + AC1:2015 + AC2:2015 + AC:2017 + A11:2017

Regulatory compliance (US version):

- ✓ 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.

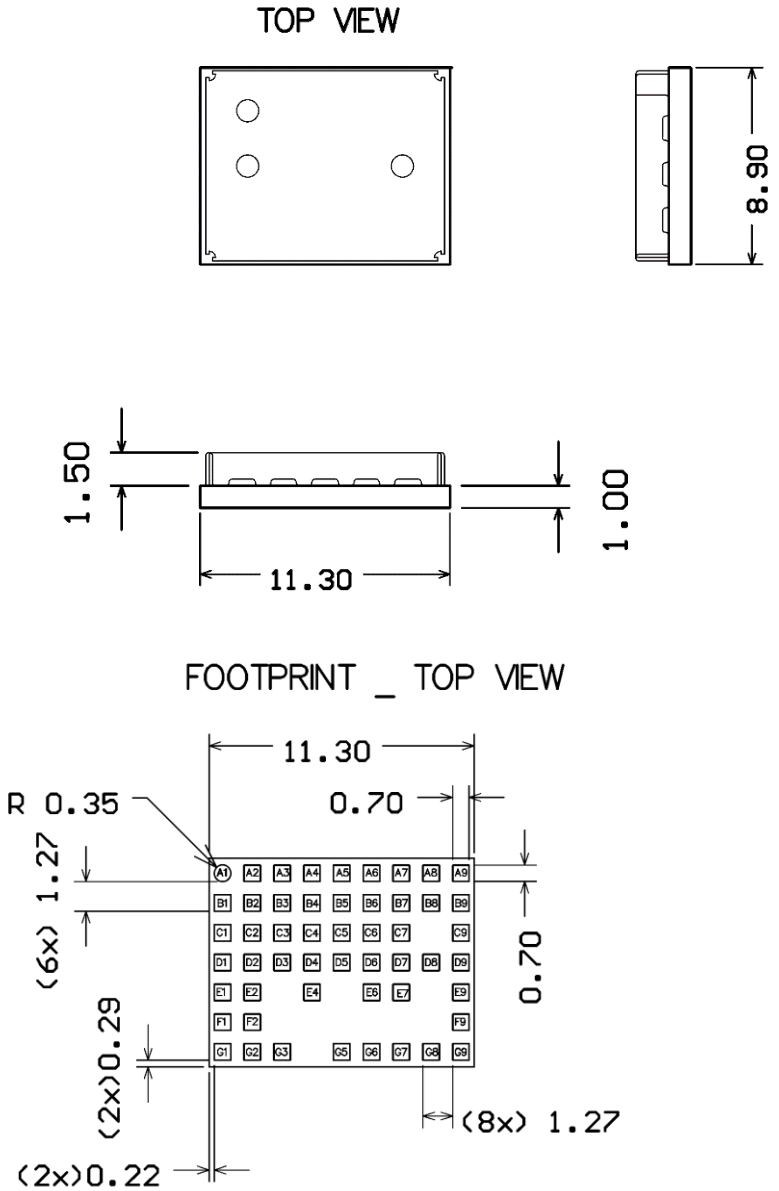
Only 32001505-BUS:

- ✓ 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)

Emission designator :

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

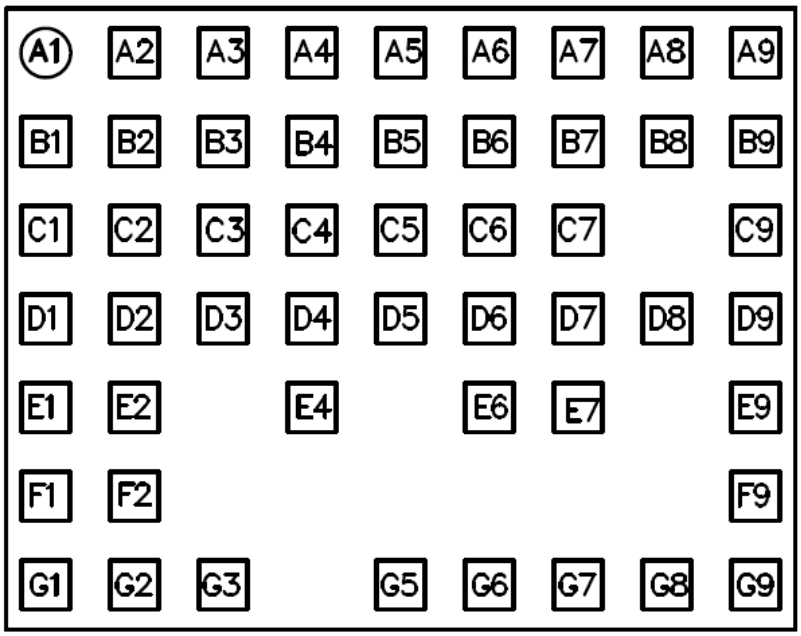
2. Mechanical Dimensions



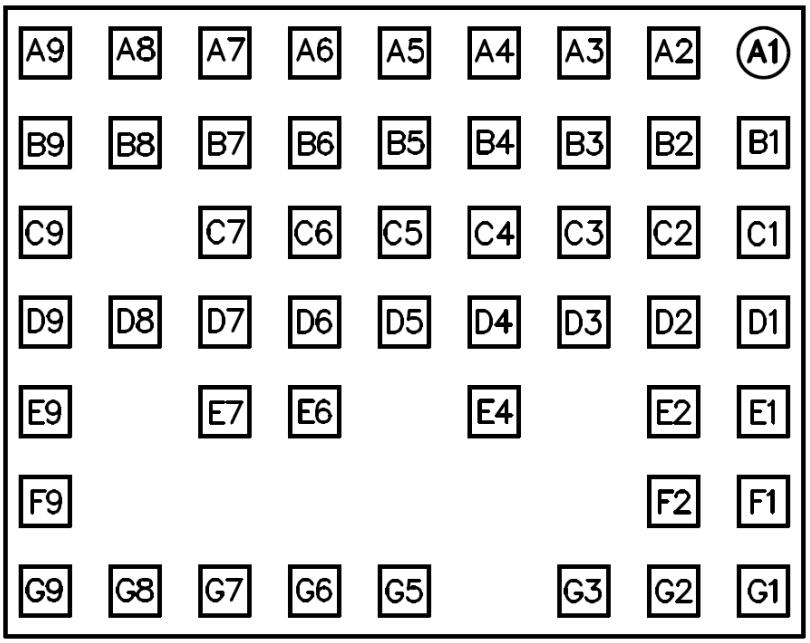
Note: Dimension in mm. General tolerance ±0.1mm. The tolerance is not cumulative

3. Pin Definition

Top View



Bottom View



	32001505		32001506
PAD	**NAME**	**TYPE**	**STM32WL PIN**
A1	SPI1_MISO	I/O	PA6
A2	SPI1_SCK	I/O	PA5
A3	SPI1_NSS	I/O	PA4
A4	LPUART1_TX	I/O	PC0
A5	LPUART1_RX	I/O	PC1
A6	SPI1_MOSI	I/O	PB5
A7	I2C1_SCL	I/O	PB8
A8	I2C1_SDA	I/O	PB9
A9	VDD	S	VDD
B1	NWAKE	I	PA7
B2	NDATA_INDICATE	O	PC6
B3	USART2_TX	I/O	PA2
B4	USART2_RX	I/O	PA3
B5	USART1_TX	I/O	PB6
B6	USART1_RX	I/O	PB7
B7	NC	-	PA15
B8	VDDA	S	VDDA
B9	VDD	S	VDD
C1	BOOT0	I/O	PH3-BOOT0
C2	NC	-	PA8
C3	NC	-	PA1
C4	GND	S	GND
C5	NC	-	PA0
C6	NC	-	PB4
C7	VREF+	S	VREF+
C9	GND	S	GND

	32001505		32001506
PAD	**NAME**	**TYPE**	**STM32WL PIN**
D1	GND	S	GND
D2	NC	-	PB10
D3	NC	-	PB11
D4	GND	S	GND
D5	NC	-	PB14
D6	NC	-	PA10
D7	VBAT	S	VBAT
D8	NC	-	PB13
D9	SPI2_MISO	I/O	PC2
E1	GND	S	GND
E2	GND	S	GND
E4	NC	-	PB1
E6	NC	-	PB2
E7	NC	-	PA12
E9	SPI2_MOSI	I/O	PC3
F1	ANT	RF I/O	ANT
F2	GND	S	GND
F9	SPI2_NSS	I/O	PB12
G1	GND	S	GND
G2	GND	S	GND
G3	GND	S	GND
G5	NRST	I	NRST
G6	NC	-	SWDIO
G7	NC	-	SWCLK
G8	NC	-	SWO
G9	SPI2_SCK	I/O	PA9

Note:

- Regarding the characteristics and its alternate functions of the STM32WL's pins refer to the STM32WL55xx datasheet.
- NC means "do not connect", leave the pin floating.

4. Firmware development (only for 32001506)

4.1. Overview

The 32001506 family module is based on the STM32WL55J and embeds the necessary circuitry for the RF subsystem in the 868 MHz band (EU version) or 915 MHz band (US version). The MCU employs an asymmetrical dual core CPU comprised of an ARM Cortex-M4 and an ARM Cortex-M0+.

The Cortex-M0+ core is reserved for the RF stack while the user code runs on the Cortex-M4. The communication between the cores is done using the Inter-Processor Communication Controller (IPCC).

The RF stack is preloaded in the module and uses the same set of commands of the host based version.

For details about the MCU, please refer to STM32WL55J data sheet (DS13293) and reference manual (RM0453).

4.2. Memory organization

The memory available for the user code depend on the model because of different memory requirements of the different stacks, and is shown in the following tables.

4.2.1. Available memory for 32001506Axx

Start address	End Address	Length	Description
0x0800 0000	0x08031FFF	204800	User Flash Memory
0x2000 0000	0x2000 7FFF	32768	User RAM
0x2000 8000	0x2000 83FF	1024	IPCC RAM
0x1FFF 7200	0x1FFF 73FF	512	User OTP Memory

4.2.2. Available memory for 32001506Bxx

Start address	End Address	Length	Description
0x0800 0000	0x08026FFF	159744	User Flash Memory
0x2000 0000	0x2000 7FFF	32768	User RAM
0x2000 8000	0x2000 83FF	1024	IPCC RAM
0x1FFF 7200	0x1FFF 73FF	512	User OTP Memory

4.2.3. Available memory for 32001506Cxx

Start address	End Address	Length	Description
0x0800 0000	0x0802B7FF	178176	User Flash Memory
0x2000 0000	0x2000 7FFF	32768	User RAM
0x2000 8000	0x2000 83FF	1024	IPCC RAM
0x1FFF 7200	0x1FFF 73FF	512	User OTP Memory

4.2.4. Available memory for 32001506Dxx

Start address	End Address	Length	Description
0x0800 0000	0x0802 F7FF	194560	User Flash Memory
0x2000 0000	0x2000 7FFF	32768	User RAM
0x2000 8000	0x2000 83FF	1024	IPCC RAM
0x1FFF 7200	0x1FFF 73FF	512	User OTP Memory

4.2.5. Available memory for 32001506Fxx

Start address	End Address	Length	Description
0x0800 0000	0x08021FFF	139264	User Flash Memory
0x2000 0000	0x2000 7FFF	32768	User RAM
0x2000 8000	0x2000 83FF	1024	IPCC RAM
0x1FFF 7200	0x1FFF 73FF	512	User OTP Memory

4.3. Reserved Pins

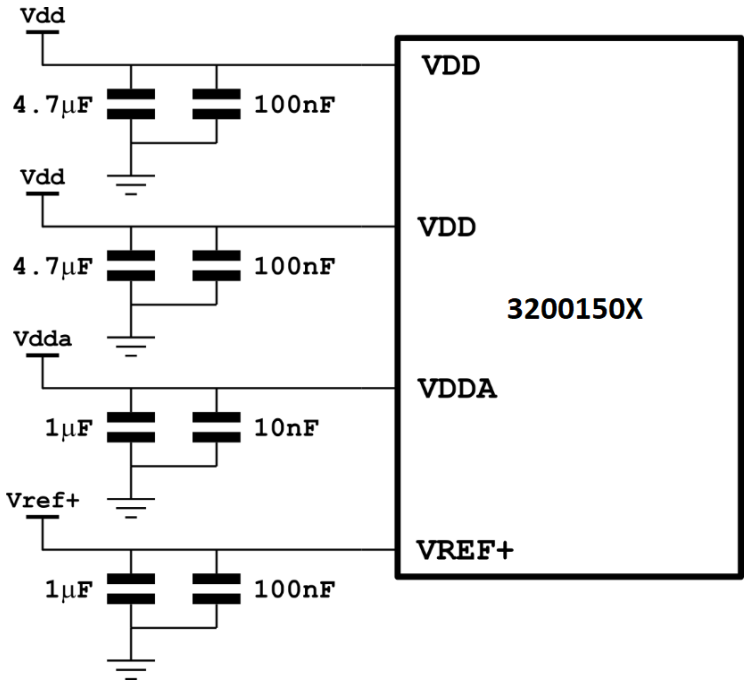
Some Pins of the STM32WL55J are reserved for internal use, so those are not available for the user application and must be not modified in any way.

- PA11
- PB0
- PC4
- PC5
- PC13
- PC15

5. Hardware Integration

5.1. Decoupling capacitors

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



5.2. 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.

6. Electrical Characteristics

6.1. 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, pin F1	10:1	
I/O Pin voltage	VDD + 0.3	V
Storage Temperature	-40 ÷ 100	°C
Operating Temperature	-40 ÷ 85	°C

6.2. Operating Condition

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

6.2.1. GENERAL ELECTRICAL CHARACTERISTICS @ 25 °C

EU version:

Parameter	1505	1506	Min.	Typ.	Max.	Unit	Notes
Supply Voltage (VDD)	x	-	2.1	3.0	3.6	V	
	-	x	1.9	3.0	3.6		
VDDA	x	x	0	-	3.6	V	
VBAT	x	x	1.55	-	3.6	V	
VIN	x	x	-0.3	-	VDD + 0.3	V	
Sleep DC Current	x	-	-	2.2	3.7	µA	
	-	x	-	2.2	10.8		
Data Rate 2-FSK	x	x	-	-	50	kbit/s	
Data Rate LoRa®	x	x	0.25	-	11	kbit/s	

US version:

Parameter	1505	1506	Min.	Typ.	Max.	Unit	Notes
Supply Voltage (VDD)	x	-	2.1	3.0	3.6	V	
	-	x	1.9	3.0	3.6		
VDDA	x	x	0	-	3.6	V	
VBAT	x	x	1.55	-	3.6	V	
VIN	x	x	-0.3	-	VDD + 0.3	V	
Sleep DC Current	x	x	-	2.5	3.7	µA	
Data Rate 2-FSK	x	x	-	-	48	kbit/s	
Data Rate LoRa®	x	x	0.98	-	21.9	kbit/s	

6.2.2. RECEIVER ELECTRICAL CHARACTERISTICS @ 25 °C

EU version:

Parameter	1505	1506	Min.	Typ.	Max.	Unit	Notes
DC Current Drain	x	-	-	-	20	mA	6
	-	x	-	-	22		
Operating Frequency	x	-	868.1	-	869.525	MHz	
	-	x	868.0	-	868.6		
Channel Frequency Precision	x	x	-	±15	-	kHz	
Sensitivity, 2-FSK	x	x	-	-115	-	dBm	2,3,5
Sensitivity, LoRa®	x	x	-	-135	-	dBm	2,4,5
Sensitivity, wM-Bus mode S	x	x	-	-107	-	dBm	9
Sensitivity, wM-Bus mode T	x	x	-	-106	-	dBm	9
Sensitivity, wM-Bus mode R	x	x	-	-115	-	dBm	9
Sensitivity, wM-Bus mode C	x	x	-	-106	-	dBm	9
Image Frequency Rejection	x	x	-	54	-	dB	7
Spurious radiated level	x	x	-	-	-57	dBm	
Output Logic Low	x	x	GND	-	0.05	V	
Output Logic High	x	x	VDD – 0.2	-	VDD	V	

US version:

Parameter	1505	1506	Min.	Typ.	Max.	Unit	Notes
DC Current Drain	x	x	-	-	20	mA	6
Operating Frequency	x	x	902.0	-	928.0	MHz	
Channel Frequency Precision	x	x	-	±15	-	kHz	
Sensitivity, 2-FSK	x	x	-	-115	-	dBm	2,3,5
Sensitivity, LoRa®	x	x	-	-135	-	dBm	2,4,5
Spurious radiated level	x	x	-	-	-57	dBm	
Output Logic Low	x	x	GND	-	0.05	V	
Output Logic High	x	x	VDD - 0.2	-	VDD	V	

6.2.3. TRANSMITTER ELECTRICAL CHARACTERISTICS @ 25 °C

EU version:

Parameter	1505	1506	Min.	Typ.	Max.	Unit	Notes
Current Drain (CW @14dBm)	X	X	-	103	-	mA	1,2
Current Drain (FSK @14 dBm)	X	-	-	-	128	mA	1,2
	-	X	-	-	120		
Operating frequency	X	-	868.0	-	869.6	MHz	
	-	X	868.0	-	868.6		
Occupied Bandwidth 2-FSK	X	X	-	125	-	kHz	
Occupied Bandwidth LoRa®	X	X	125		250	kHz	
Operating Channel Width 2-FSK	X	X	-	200	-	kHz	
Operating Channel Width LoRa®	X	X	200	-	300	kHz	
Maximum Output power (50 Ω load)	X	X	-	14	-	dBm	1,2,8
RF Output Impedance	X	X	-	50	-	Ω	
Input Logic Low	X	X	GND	-	0.05	V	
Input Logic High	X	X	VDD - 0.2	-	VDD	V	

US version:

Parameter	1505	1506	Min.	Typ.	Max.	Unit	Notes
Current Drain (CW @20 dBm)	X	X	-	138	-	mA	1,2
Operating frequency	X	X	902.0	-	928.0	MHz	
Occupied Bandwidth LoRa® DTS	X	X	500	-	-	kHz	
Occupied Bandwidth LoRa® FHSS	X	X	-	125	-	kHz	8
Operating Channel Width LoRa® DTS	X	X	-	600	-	kHz	
Operating Channel Width LoRa® FHSS	X	X	-	200	-	kHz	8
Maximum Output power (50 Ω load)	X	X	-	20	-	dBm	1,2,7
RF Output Impedance	X	X	-	50	-	Ω	
Input Logic Low	X	X	GND	-	0.05	V	
Input Logic High	X	X	VDD - 0.2	-	VDD	V	

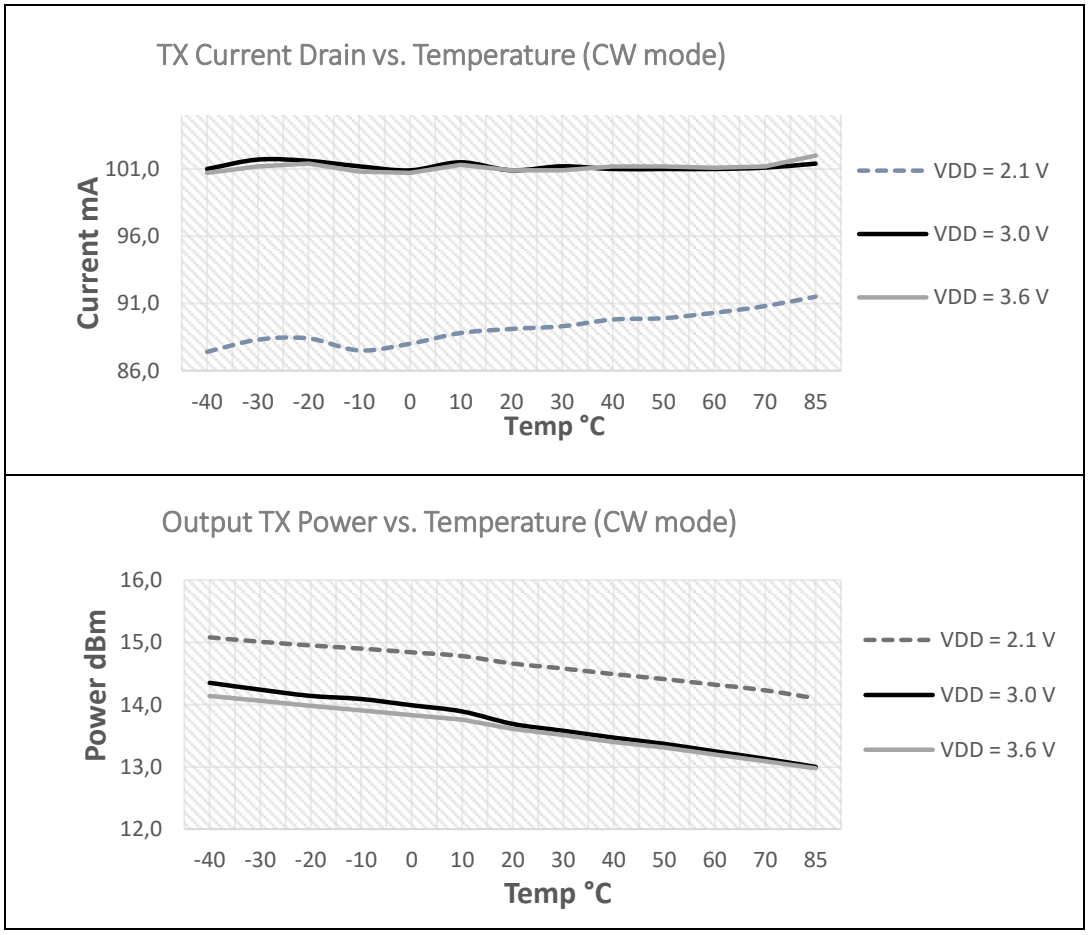
Notes:

1) VDD = 3.6 V.
2) All RF parameters measured with input (pin F1, ANT) connected to 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 %, 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 given using highest LNA gain step.
6) Power consumption measured with -140 dBm signal and AGC ON.
7) Blocking immunity, ACR and co-channel rejection, given for a single tone interferer and referenced to sensitivity +6 dB, blocking tests performed with unmodulated signal measured as per ETSI 300 220-1.
8) In order to not exceed the maximum power permitted by the ETSI EN 300 220 regulation, choose an appropriate antenna system and power supply.
9) According to EN 13757-4, measured @ PER < 0.8 with frame characteristics reported in the paragraphs 5/6/7/8 (mode S, T, R, C).

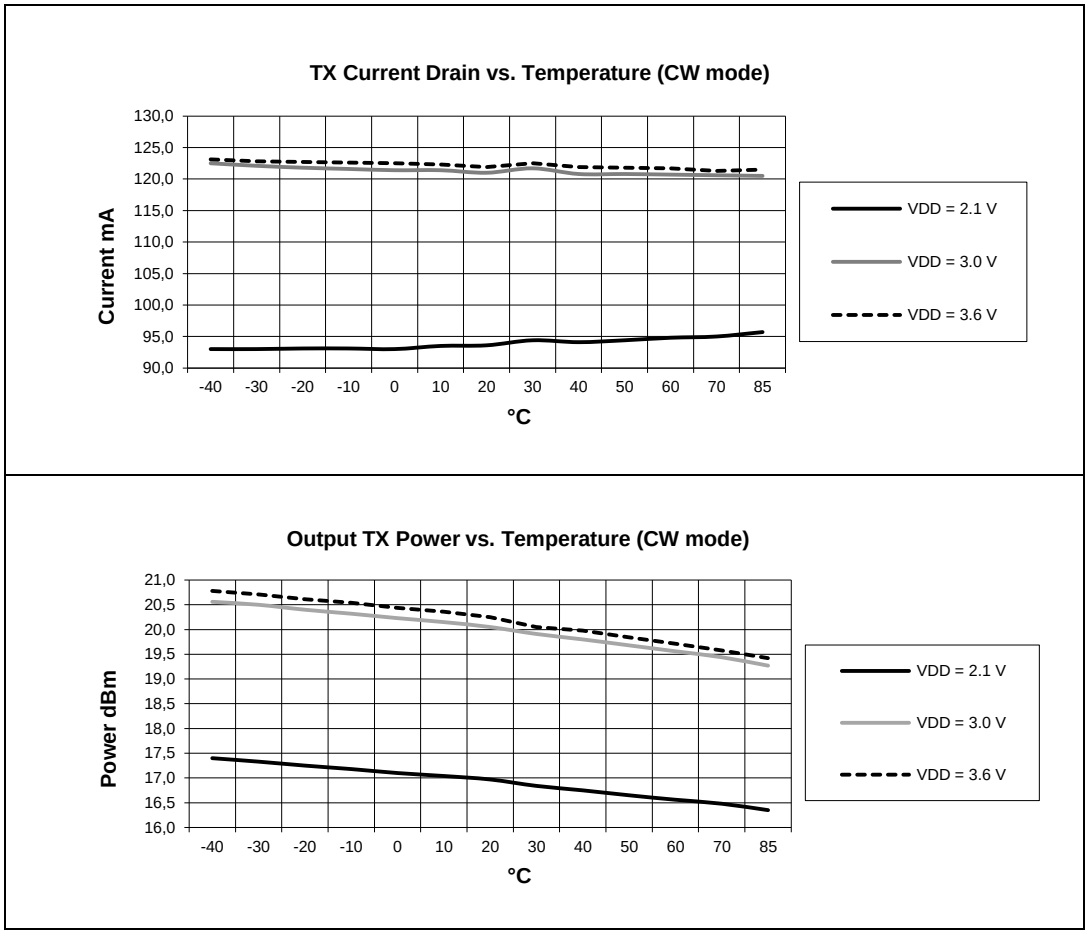
7. Temperature Range Curves

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

EU version:



US version:



8. Safety note

To meet safety requirements, the module must be powered by an external power source that meets limits of ES1 and PS1 according to IEC 62368-1.

9. Exposure assessment (only for US version)

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 (cm)	FCC General Population Limit (mW/cm^2)	Maximum Gain to comply with RF Exposure Limits (dBi)
LoRa	ISM (USA)	902 - 928	20	0.60	16.10

This device must be kept at a safety distance of at least 20 cm from the human body while in use to comply with the Radiofrequency exposure limits.

10. Antenna details

To perform the assessments the following antenna has been used as 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	

11. Supporting Documentation

Title	Description	Doc	Notes
Command Reference Manual	Description of commands for the wM-Bus stack	3200150xAxx_Com_Ref	
Command Reference Manual	Description of commands for the LoRaWAN stack	3200150xBxx_Com_Ref	
Command Reference Manual	Description of commands for the LoRa Mipot stack	3200150xCxx_Com_Ref	
Command Reference Manual	Description of commands for the LoRa Modem stack	3200150xDxx_Com_Ref	
Command Reference Manual	Description of commands for the multi-stack module	3200150xDSM_Com_Ref	
Manufacturing Process Information for LGA MiP Series	Packaging information, Tape& Reel Specification, Reflow soldering information	AN_MNF002	
STM32WL55J data sheet	Overview of the MCU and its peripherals	DS13293 (from ST)	1
STM32WL55J reference manual	Detailed description of the MCU and its peripherals	RM0453 (from ST)	1

Notes:

1) Only for 32001506

12. Ordering Information

Title	Description	DoC
32001505AEU	MiP-Wm-1C128N-EU	Europe
32001505BEU	MiP-Lw-1C128N-EU	Europe
32001505CEU	MiP-LoMi-1C128N-EU	Europe
32001505DEU	MiP-LoMo-1C128N-EU	Europe
32001505FEU	MiP-LwMo-1C128N-EU	Europe
32001505GEU	MiP-WmLw-1C128N-EU	Europe

Title	Description	DoC
32001506AEU	MiP-Wm-2C256N-EU	Europe
32001506BEU	MiP-Lw-2C256N-EU	Europe
32001506CEU	MiP-LoMi-2C256N-EU	Europe
32001506DEU	MiP-LoMo-2C256N-EU	Europe
32001506FEU	MiP-LwMo-2C256N-EU	Europe
32001506GEU	MiP-WmLw-2C256N-EU	Europe

Title	Description	DoC
32001505AUS	MiP-Wm-1C128N-US	United States
32001505BUS	MiP-Lw-1C128N-US	United States
32001505CUS	MiP-LoMi-1C128N-US	United States
32001505DUS	MiP-LoMo-1C128N-US	United States
32001505FUS	MiP-LwMo-1C128N-US	United States
32001505GUS	MiP-WmLw-1C128N-US	United States

Title	Description	DoC
32001506AUS	MiP-Wm-2C256N-US	United States
32001506BUS	MiP-Lw-2C256N-US	United States
32001506CUS	MiP-LoMi-2C256N-US	United States
32001506DUS	MiP-LoMo-2C256N-US	United States
32001506FUS	MiP-LwMo-2C256N-US	United States
32001506GUS	MiP-WmLw-2C256N-US	United States

Example 3200150 5 A EU

Core

5 = Single core module

6 = Dual core module

Stack Radio

A = wM-Bus

B = LoRaWAN

C = LoRa Mipot

D = LoRa Modem

F = LoRaWAN + LoRa Modem

G = wM-Bus + LoRaWAN

Region

EU = Europe (UE)

US = United States/Canada

13. Regulatory Approvals

EU version:

Doc	Title	Description
DoC	32001505BEU_DoC	Declaration of Conformity
DoI	32001505BEU_DoI	Declaration of Identity

US version:

Models: 32001505AUS, 32001505BUS, 32001505CUS, 32001505DUS, 32001505FUS,
32001506AUS, 32001506BUS, 32001506CUS, 32001506DUS, 32001506FUS

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.

Doc	Title	Description
DoI	32001505xUS_DoI	Declaration of Identity

CANADA

IC: 28566-MIP

HVIN: 32M01514A

PMN:	32001505BUS	HVIN:	32M01514A
HMN:	-	FVIN:	-

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference.
2. This device must accept any interference, including interference that may cause undesired operation of the device.

14. Revision History

Revision	Date	Description
0.0	19.03.2025	Preliminary - Draft
0.1	20.11.2025	Added sensitivity values for wM-Bus (EU version)