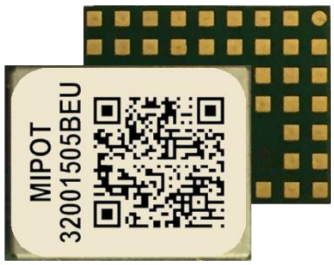
Wireless Protocol Modules MiP Series 3200150xDxx

LoRa™ Modem

Command Reference



Description

This document provides list of commands that the 3200150xDxx implement and the description of their use.

Contents

1. Communication protocol

1.1. Byte Order

Multiple byte values are transmitted in little endian order with least significant byte first (LSB).

1.2. Message Structure

The structure of the messages is the following:

HEADER	CMD	LENGTH	PAYLOAD (n Bytes)	CHECKSUM

Where:

HEADER = 0xAA

CMD = Command code to the module (32001505Dxx) / to the radio stack (32001506Dxx) , see the following table

LENGTH = Payload length

CHECKSUM = 2's complement on one byte of the sum of all preceding bytes

Each command from the host invokes an answer from the module (32001505Dxx)/from the radio stack (32001506Dxx) in the same format.

The answer to the host has the CMD field equal to host request OR 0x80.

1.3. Message Types

There are three types of messages:

Commands: sent from the host to the module to request an information or an action (32001505Dxx case).

sent from the user application running on the M4 core to the radio stack running on the M0+ core to request an information or an action (32001506Dxx case).

Replies: sent from the module to the host as direct reply to a command, their command code is equal to the host request (<cmd> OR 0x80) (32001505Dxx case).

sent from the radio stack to the user application as direct reply to a command, their command code is equal to the host request (<cmd> OR 0x80) (32001506Dxx case).

Indications: messages sent from the module to the host that are sent without prior action from the host, triggered by events on the radio interface. (e.g.: a received transmission) (32001505Dxx case).

messages sent from the radio stack to the user application that are sent without prior action from the host, triggered by events on the radio interface. (E.g.: a received transmission) (32001506Dxx case).

2. Command Set Description

List of the implemented command:

Command (CMD)	Value	Description
RESET_CMD	0x30	Module software reset
FACTORY_RESET_CMD	0x31	Restore EEPROM to factory default values
EEPROM_WRITE_CMD	0x32	Write EEPROM parameter
EEPROM_READ_CMD	0x33	Read EEPROM parameter
GET_FW_VERSION_CMD	0x34	Get firmware version
GET_SERIALNO_CMD	0x35	Get serial number
TX_MSG_CMD	0x50	Transmission of radio message
TX_MSG_IND	0x52	Indication of radio message transmission
RX_MSG_IND	0x53	Indicate radio message reception
SET_AES_KEY_CMD	0x58	Write EEPROM parameter AES encryption key
SET_IV_CMD	0x59	Write EEPROM parameter IV for encryption

2.1. RESET_CMD (0x30)

This command performs a module Reset.

When a valid reset request is received, the module replies immediately to the host microcontroller.

All communication interfaces will be disabled during the reset procedure.

Host: 0xAA, 0x30, 0x00, 0x26

Reply: 0xAA, 0xB0, 0x00, 0xA6

2.2. FACTORY_RESET_CMD (0x31)

This command restores EEPROM factory default values.

Host: 0xAA, 0x31, 0x00, 0x25

Reply: 0xAA, 0xB1, 0x01, Status, checksum

Status: 0x00 = Success

A value different from 0: error

2.3. EEPROM_WRITE_CMD (0x32)

This command performs an EEPROM data write. For Addresses and Data values see “Module Configuration” section.

Host: 0xAA, 0x32, Length, Start Address, <Data>, checksum

Reply: 0xAA, 0xB2, 0x01, EEWriteStatus, checksum

EEWriteStatus:

0x00 = Success

0x01 = Invalid address

Note: Data outside allowed range will not be stored in EEPROM and the current value will not be modified. If the variable to be updated has the same value of the new one then the EEPROM will not be updated in order to minimize memory write cycles.

2.4. EEPROM_READ_CMD (0x33)

This command reads EEPROM data. For Addresses and Data values see “Module Configuration” section.

Host: 0xAA, 0x33, 0x02, Start Address, Number of bytes, checksum

Reply: 0xAA, 0xB3, Length, Status, Data, checksum

Status: 0x00 = Success, Data contains EEPROM values

0xFF = failure, Data is empty and Length is equal to 1

2.5. GET_FW_VERSION_CMD (0x34)

Get 32-bit firmware version.

Host: 0xAA, 0x34, 0x00, 0x22

Reply: 0xAA, 0xB4, 0x04, FWV0, FWV1, FWV2, FWV3, checksum

FWV0, FWV1, FWV2, FWV3:
Firmware version

2.6. GET_SERIALNO_CMD (0x35)

Get unique 32-bit Serial Number.

Host: 0xAA, 0x35, 0x00, 0x21

Reply: 0xAA, 0xB5, 0x04, SN0, SN1, SN2, SN3, checksum

SN0, SN1, SN2, SN3:
32-bit Mipot Serial Number.

2.7. TX_MSG_CMD (0x50)

This command performs the transmission of a radio frame.

Host: 0xAA, 0x50, Length, <MsgPayload>, checksum

Reply: 0xAA, 0xD0, 0x01, Status, checksum

MsgPayload: Data to be transmitted. Maximum allowed payload size is 240 bytes.
With AES encryption enabled the number of byes to be transmitted shall be a multiple of 16.

Status: 0x00 = Success
0x01 = Device busy
0x03 = Payload error

NOTE:

The module does not manage automatically duty cycle restrictions. Host application must handle the duty cycle requirements in order to assure compliance with the harmonized standard limits.

The following table shows time-on-air for a single frame as a function of the number of transmitted bytes at 4/5 coding rate.

Spreading Factor	Number of bytes	Time on Air (ms)	
		BW = 125 kHz	BW = 250 kHz
7	10	46	23
	120	271	135
	240	517	258
8	10	82	41
	120	461	230
	240	870	435
9	10	164	82
	120	799	399
	240	1496	748
10	10	288	144
	120	1435	717
	240	2664	1332
11	10	577	288
	120	2543	1271
	240	4755	2377
12	10	991	495
	120	4595	2297
	240	8527	4263

2.8. TX_MSG_IND (0x52)

This command indicates the end of a transmission session.

Module: 0xAA, 0x52, 0x05, Status, Time1, Time2, Time3, Time4, checksum

Status: 0x00 = success

A value different from zero means that an error has occurred.

Time1, Time2, Time3, Time4:

Time on Air, total time needed for the transmission, in ms.

2.9. RX_MSG_IND (0x53)

This command indicates the reception of radio frames.

Module: 0xAA, 0x53, Length, Status, RssiLSB, RssiMSB, SNR, <Payload>, checksum

Status: 0x00 = success
Values different from zero are reserved.

RssiLSB/MSB: 16-bit Rssi Value expressed in dBm

SNR: 8-bit Signal-to-Noise Ratio

Payload: Data Message

2.10. SET_AES_KEY_CMD (0x58)

This command performs an EEPROM data write.

Host: 0xAA, 0x58, 0x10, <AESKey>, checksum

Reply: 0xAA, 0xD8, 0x01, Status, checksum

AESKey: 16 bytes in Little Endian Order. Needed for Application encryption customization.
This key is used only when AppEnAES parameter is set to 1.

Status: 0x00 = success
Values different from zero are reserved.

2.11. SET_IV_CMD (0x59)

This command performs an EEPROM data write.

Host: 0xAA, 0x59, 0x10, <InitVector>, checksum

Reply: 0xAA, 0xD9, 0x01, Status, checksum

InitVector: 16 bytes in Little Endian Order. Needed for Application encryption customization. This key is used only when AppEnAES parameter is set to 1.

Status: 0x00 = success
Values different from zero are reserved.

3. Module Configuration

Multiple byte values are expressed in little endian order with least significant byte first (LSB).

3.1. Internal DATA (Read Only)

The module implements on-board network AES encryption with an internal key (not accessible to the host microcontroller). If the host microcontroller needs to customize the encryption at application level, it has to enable this feature by setting AppEnAES parameter to 1 and write AESKey through SET_AES_KEY_CMD (0x58).

Parameter	Description	Values Range	Default	Notes
AESKey	16 bytes AES key	0-255 for all 16 bytes	0 for all 16 bytes	**Used at application level (Write Only Variable)**
InitVect	16 bytes initialization vector	0-255 for all 16 bytes	0 for all 16 bytes	**Used at application level (Write Only Variable)**

Parameter	Description	Notes
SerialNumber0	Byte 0 SN	Serialization at 32 bits
SerialNumber1	Byte 1 SN	
SerialNumber2	Byte 2 SN	
SerialNumber3	Byte 3 SN	
FwVersion0	Byte 0 FW Version	Firmware version
FwVersion1	Byte 1 FW Version	
FwVersion2	Byte 2 FW Version	
FwVersion3	Byte 3 FW Version	

3.2. Radio physical parameters

Parameter	Description	Address	Range	Default	Notes
Power	Power expressed in dBm	0x00	2 – 14 (EU) # – # (US)	14 (EU) # (US)	Power expressed in dBm
Frequency	Channel frequency selection	0x01	0 - 74	2	Check frequency index table
Bandwidth	TX bandwidth	0x02	0 - 2	0	0 = 125 kHz 1 = 250 kHz 2 = 500 kHz
Spreading Factor	Spreading factor expressed in chips	0x03	6 – 12 (EU) # - # (US)	10 (EU) # (US)	6 = 64 chips 7 = 128 chips 8 = 256 chips 9 = 512 chips 10 = 1024 chips 11 = 2048 chips 12 = 4096 chips
Code Rate	Code rate	0x04	1 - 4	1	1 = 4/5 2 = 4/6 3 = 4/7 4 = 4/8

3.3. Frequency index table

EU Version

Index	Freq [MHz]	Index	Freq [MHz]	Index	Freq [MHz]	Index	Freq [MHz]
0	868.075	20	868.575	40	869.075	60	869.575
1	868.100	21	868.600	41	869.100	61	869.600
2	868.125	22	868.625	42	869.125	62	869.625
3	868.150	23	868.650	43	869.150	63	869.650
4	868.175	24	868.675	44	869.175	64	869.675
5	868.200	25	868.700	45	869.200	65	869.700
6	868.225	26	868.725	46	869.225	66	869.725
7	868.250	27	868.750	47	869.250	67	869.750
8	868.275	28	868.775	48	869.275	68	869.775
9	868.300	29	868.800	49	869.300	69	869.800
10	868.325	30	868.825	50	869.325	70	869.825
11	868.350	31	868.850	51	869.350	71	869.850
12	868.375	32	868.875	52	869.375	72	869.875
13	868.400	33	868.900	53	869.400	73	869.900
14	868.425	34	868.925	54	869.425	74	869.925
15	868.450	35	868.950	55	869.450		
16	868.475	36	868.975	56	869.475		
17	868.500	37	869.000	57	869.500		
18	868.525	38	869.025	58	869.525		
19	868.550	39	869.050	59	869.550		

US Version

Index	Freq [MHz]	Index	Freq [MHz]	Index	Freq [MHz]	Index	Freq [MHz]
0	903.000	20	905.500	40	908.000	60	910.500
1	903.125	21	905.625	41	908.125	61	910.625
2	903.250	22	905.750	42	908.250	62	910.750
3	903.375	23	905.875	43	908.375	63	910.875
4	903.500	24	906.000	44	908.500	64	911.000
5	903.625	25	906.125	45	908.625	65	911.125
6	903.750	26	906.250	46	908.750	66	911.250
7	903.875	27	906.375	47	908.875	67	911.375
8	904.000	28	906.500	48	909.000	68	911.500
9	904.125	29	906.625	49	909.125	69	911.625
10	904.250	30	906.750	50	909.250	70	911.750
11	904.375	31	906.875	51	909.375	71	911.875
12	904.500	32	907.000	52	909.500	72	912.000
13	904.625	33	907.125	53	909.625	73	912.125
14	904.750	34	907.250	54	909.750	74	912.250
15	904.875	35	907.375	55	909.875		
16	905.000	36	907.500	56	910.000		
17	905.125	37	907.625	57	910.125		
18	905.250	38	907.750	58	910.250		
19	905.375	39	907.875	59	910.375		

3.4. Module parameters

Parameter	Description	Address	Range	Default	Notes
DataIndicate Timeout	Interval between data indicate low and data transmission	0x05	1-255	5	Expressed in ms
Uart Baudrate	Serial communication baud rate	0x06	0 - 4	0	0: 9600 1: 19200 2: 38400 3: 57600 4: 115200
AppEnAES	Application AES key enable / disable	0x07	0 - 1	0	0 = disabled 1 = enabled

4. Revision History

Revision	Date	Description
0.1	22.01.2025	First version