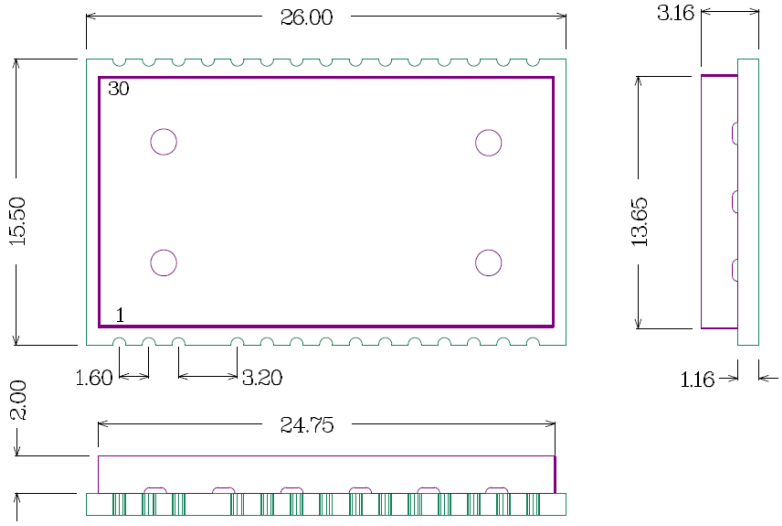
32001353 LoRaWAN 868 MHz band TRX

COMMAND REFERENCE

Product Code: **32001353**

1. PINOUT



ALL DIMENSIONS ARE IN MILLIMETERS
GENERAL TOLERANCE +/-0.1MM

2. PIN DESCRIPTION

Pin	*Name*	*Pin type*	*Description*	*Notes*
1	GND	Supply	Ground (0 V)	
2	RF I/O	A IN/OUT	Tx: output RF Rx: input RF	
3	GND	Supply	Ground (0 V)	
5	NU	NC	Not Used Pin – do not connect	
6	NDATA_INDICATE	D OUT	Data Indicate Pin	
7	NWAKE	D IN	Wake-up Pin	
8	NU	NC	Not Used Pin – do not connect	
9	NU	NC	Not Used Pin – do not connect	
10	NU	NC	Not Used Pin – do not connect	
11	UART TX	D OUT	UART TX Pin	
12	UART RX	D IN	UART RX Pin	
13	NU	NC	Not Used Pin – do not connect	
14	NU	NC	Not Used Pin – do not connect	
15	GND	Supply	Ground (0 V)	
16	GND	Supply	Ground (0 V)	
17	Vcc	Supply	Power supply	
18	SWDAT	NC	Reserved for programming – do not connect	
19	SWCLK	NC	Reserved for programming – do not connect	
20	SWV	NC	Reserved for programming – do not connect	
21	NRST	D IN	Reset. Input Pull-Up	
22	NU	NC	Not Used Pin – do not connect	
23	NU	NC	Not Used Pin – do not connect	
24	NU	NC	Not Used Pin – do not connect	
25	NU	NC	Not Used Pin – do not connect	

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26	NU	NC	Not Used Pin – do not connect
27	NU	NC	Not Used Pin – do not connect
28	NU	NC	Not Used Pin – do not connect
29	NU	NC	Not Used Pin – do not connect
30	GND	Supply	Ground (0 V)

3. UART INTERFACE DATA FRAME FORMAT

UART interface allows Host both to configure the module and to exchange LoRa radio frame data messages.

3.1. Physical Parameters

Default UART configuration is 115200 8n1. Baud rate can be changed configuring an EEPROM parameter.

Used Lines:

Line	Description	Notes
TX UART	Uart Tx pin. Output Push-pull	
RX UART	Uart Rx pin. Input Pull-up	Equivalent Internal Pull-up 40kΩ (Typical Value)
NDATA_INDICATE	Module Digital Output, Indicate Radio Frame Received.	
NWAKE	Module Digital Input. This pin has the function to wake up the module	Equivalent Internal Pull-up 40kΩ (Typical Value)

3.2. Byte Order

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

3.3. Message Structure

The structure of the messages is the following:

HEADER	CMD	LENGTH	Payload (n Bytes)	CheckSum

Where:

HEADER = 0xAA
CMD = Command code to module, see following table.
LENGTH = Payload length
CheckSum = 2's complement of the sum of all preceding bytes

Each command from the host invokes an answer from the module in the same format. The answer to the host has the CMD field equal to host request OR 0x80.

3.4. Detailed Signal Flow

When the module receives a valid command and the checksum is correct, the module sets NDATA_INDICATE LOW, transmits the answer through UART TX pin and then sets NDATA_INDICATE HIGH.

In order to transfer a received radio frame to the host microcontroller, the module has to set NDATA_INDICATE LOW, wait for DATA_INDICATE_TIMEOUT expiration, then send the message on UART TX pin. DATA_INDICATE_TIMEOUT represents the time (in ms) between the instant when NDATA_INDICATE pin goes LOW and the start of transmission on UART TX pin.

The module enters sleep mode as soon as possible therefore, before initiating a UART session, the host shall wake it up by setting the NWAKE pin LOW (pin 7) and then setting it back HIGH at the end of the session.

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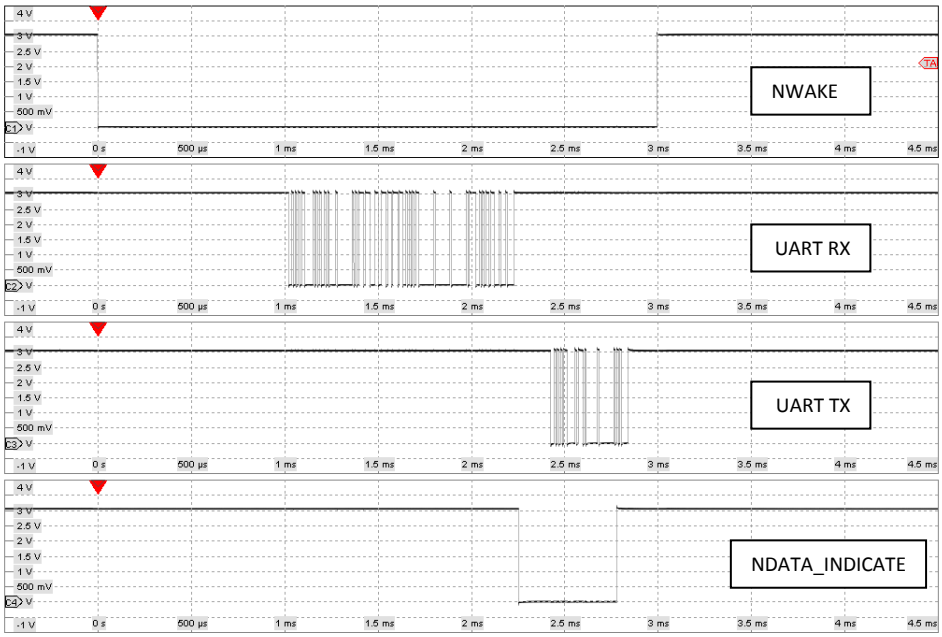
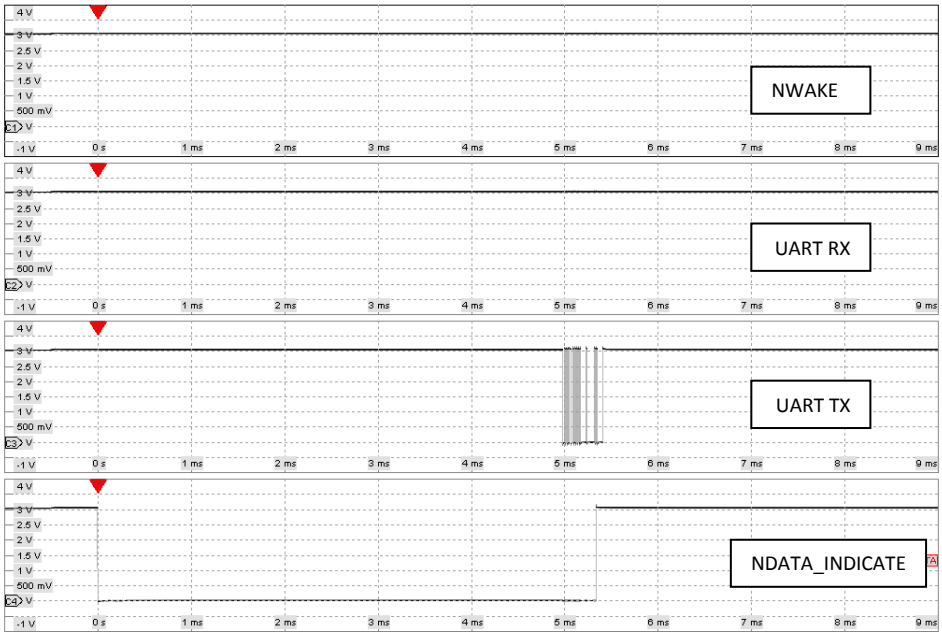
Example of UART command session:



Example of UART RX Command session (DATA_INDICATE_TIMEOUT = 5 ms):



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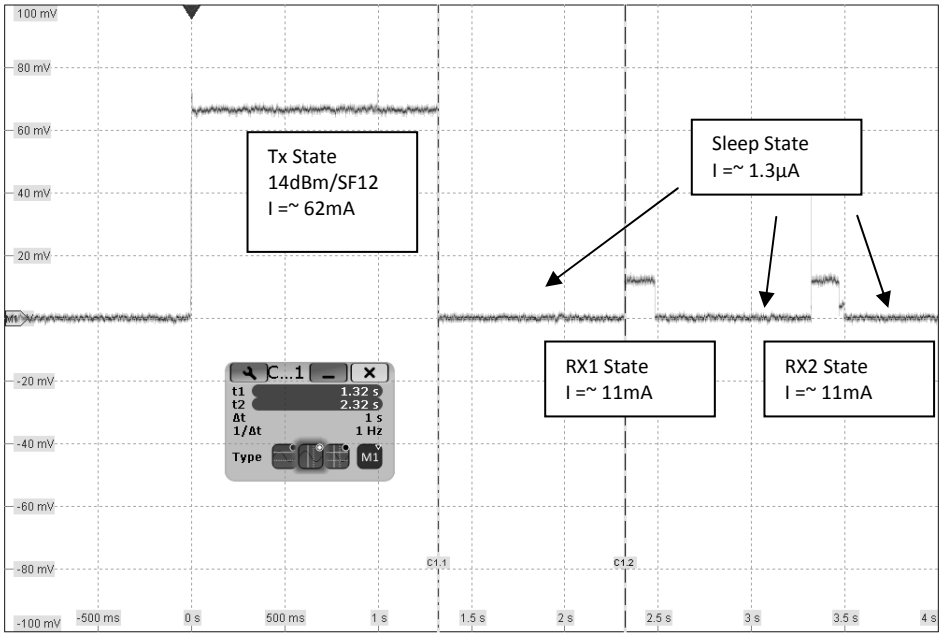
4. SLEEP MODE AND LORA TRANSMISSION CURRENT WAVEFORM

When the module transmits a LoRa message module enters sleep mode between transmission and reception states. The following picture shows the current waveform measured across 1 Ω resistor and the typical current values for each state:



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5. COMMANDS DESCRIPTION

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 stored in Module
GET_DEV_EUI	0x36	Get Factory Stored DevEUI
JOIN_CMD	0x40	Network Join Command
JOIN_IND	0x41	Join result indication
GET_ACTIVATION_STATUS_CMD	0x42	Get activation status command
SET_APP_KEY_CMD	0x43	Set Application Key (value stored in EEPROM)
SET_APP_SESSION_KEY_CMD	0x44	Set Application Session Key (value stored in EEPROM)
SET_NWK_SESSION_KEY_CMD	0x45	Set Network Session Key (value stored in EEPROM)
TX_MSG_CMD	0x46	Transmission of LoRa Radio Message
TX_MSG_CONFIRMED_IND	0x47	Indication of LoRa Radio Confirmed Message Transmission
TX_MSG_UNCONFIRMED_IND	0x48	Indication of LoRa Radio Unconfirmed Message Transmission
RX_MSG_IND	0x49	Indicate reception of LoRa Radio Message
GET_SESSION_STATUS_CMD	0x4A	Get the session status
SET_NEXT_DR_CMD	0x4B	Set next datarate command
SET_BATTERY_LVL_CMD	0x50	Set The Battery Level
GET_BATTERY_LVL_CMD	0x51	Get The Battery Level
SET_UPLINK_CNT_CMD	0x52	Set Uplink Counter
GET_UPLINK_CNT_CMD	0x53	Get Uplink Counter
SET_DOWNLINK_CNT_CMD	0x54	Set Downlink Counter
GET_DOWNLINK_CNT_CMD	0x55	Get Downlink Counter
SET_CH_PARAMETERS_CMD	0x57	Set Channel Parameters
GET_CH_PARAMETERS_CMD	0x58	Get Channel Parameters

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5.1. RESET_CMD (0x30)

This command performs a Module Reset. The reset will be performed after about 1s.
When a valid reset request is received, the module starts a timer and replies immediately to the host microcontroller. When the timeout expires the module resets. UART interface will be disabled during the reset procedure.

Host: 0xAA, 0x30, 0x00, 0x26
Reply: 0xAA, 0xB0, 0x00, 0xA6

5.2. FACTORY_RESET_CMD (0x31)

This command performs the recovery of EEPROM default values. This command is allowed only when module is in idle state (network activation has not been performed yet).

Host: 0xAA, 0x31, 0x00, 0x25
Reply: 0xAA, 0xB1, 0x01, Status, cks
Status: 0x00: success
0x02: LoRa Mac not in idle state

5.3. EEPROM_WRITE_CMD(0x32)

This command performs the EEPROM data write. This command is allowed only when module is in idle state (network activation has not been performed yet). For Address and Data table see Module Configuration section.

Host: 0xAA, 0x32, Length, Start Address, <Data>, cks
Reply: 0xAA, 0xB2, 0x01, EEWriteStatus, cks
Note: Data outside allowed range will not be stored in EEPROM and current value will not modified.
If the variable to be updated has the same value of the new one then EEPROM will not be updated in order to minimize memory write cycle operation.
EEWriteStatus: 0x00: Success
0x01: Data address outside range
0x02: LoRaMac not in idle state

5.4. EEPROM_READ_CMD(0x33)

This command performs the EEPROM data read. For Address and Data table see Module Configuration section.

Host: 0xAA, 0x33, 0x02, Start Address, Number of bytes, cks
Reply: 0xAA, 0xB3, Length, Status, Data, cks
Status: 0x00: success, Data contains EEPROM values
0xFF: failure, Data is empty and Length is equal to 1

5.5. GET_FW_VERSION_CMD(0x34)

Get 32bit firmware version.

Host: 0xAA, 0x34, 0x00, 0x22
Reply: 0xAA, 0xB4, 8, FWV0, FWV1, FWV2, FWV3,cks
FWV0, FWV1, FWV2, FWV3: Fw version

5.6. GET_SERIALNO_CMD(0x35)

Get Mipot 32bit Serial Number.

Host: 0xAA, 0x35, 0x00, 0x21
Reply: 0xAA, 0xB5, 0x04, SN0, SN1, SN2, SN3, cks

5.7. GET_DEVEUI_CMD(0x36)

Get DevEUI provided by Mipot.

Host: 0xAA, 0x36, 0x00, 0x20
Reply: 0xAA, 0xB5, 0x08, <DevEUI>, cks

Where DevEUI are the 8 bytes containing Mipot EUI.

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5.8. JOIN_CMD(0x40)

This command performs the join network command.
There are two types of activation:
OTAA (Over The Air Activation): End devices must follow a join procedure before exchanging data within network. This procedure requires that the device must be personalized with Application identifier (AppEUI), Application Key (AppKey), and end-device identifier (DevEUI). After Activation the following information will be stored in end-device: End-device Address (DevAddr), Network Session Key (NwkSKey), and Application Session Key (AppSKey).
ABP (Activation by personalization): End-device Address (DevAddr), Network Session Key (NwkSKey), and Application Session Key (AppSKey) are known before and End-devices are personalized with this fields.
For details see LoRaWAN Specification.

Host: 0xAA, 0x40, 0x01, mode, cks
Reply: 0xAA, 0xC0, 0x01, Status, cks
Mode: 0 = Activation by personalization (ABP)
1 = Over the air activation (OTAA)
Status: 0x00: success
0x01: invalid parameter
0x02: busy

5.9. JOIN_IND(0x41)

This command indicates the result of OTAA join procedure.
Module: 0xAA, 0x41, 0x01, Status, cks

Status: 0x00 = success
A value different from zero means that an error has occurred

5.10. GET_ACTIVATION_STATUS_CMD(0x42)

This command gets the module activation status.
Host: 0xAA, 0x42, 0x00, 0x14
Reply: 0xAA, 0xC2, 0x01, status, cks

Status: 0x00 = Not activated
0x01 = Joining
0x02 = JOINED
0x03 = MAC ERROR

5.11. SET_APP_KEY_CMD(0x43)

This command performs the EEPROM data write.
Host: 0xAA, 0x43, 0x10, <AppKey>, cks
Reply: 0xAA, 0xC3, 0x00, cks
AppKey: 16 byte in Little Endian Order. Needed for OTAA procedure.

5.12. SET_APP_SESSION_KEY_CMD(0x44)

This command performs the EEPROM data write.
Host: 0xAA, 0x44, 0x10, <AppSKey>, cks
Reply: 0xAA, 0xC4, 0x00, cks
AppSKey: 16 byte in Little Endian Order. Needed for APB procedure.

5.13. SET_NWK_SESSION_KEY_CMD(0x45)

This command performs the EEPROM data write.
Host: 0xAA, 0x45, 0x10, <NwkSKey>, cks
Reply: 0xAA, 0xC5, 0x00, cks
NwkSKey: 16 byte in Little Endian Order. Needed for APB procedure.

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5.14. TX_MSG_CMD(0x46)

This command performs the transmission of radio frame.
In case of Reliable data Transmission (Confirmed Frames) if the module doesn't receive an acknowledgment it will perform a datarate adaptation according to the LoRaWAN Specification V1.0.1, chapter 19.4, according to the following table:

Transmission Number	Data Rate
1 (first)	DR
2	DR
3	max(DR-1,0)
4	max(DR-1,0)
5	max(DR-2,0)
6	max(DR-2,0)
7	max(DR-3,0)
8	max(DR-3,0)

In case of Unreliable data Transmission (Unconfirmed Frames) the module will transmit the frames N times in according to "Unconfirmed TX Repetition Number" EEPROM parameter.

Host: 0xAA, 0x46, Length, Options, Port, <MsgPayload>, cks
Reply: 0xAA, 0xC6, 0x01, Status, cks

Options: 0bxxxxxxx0 = Unreliable Data Transmission
0bxxxxxxx1 = Reliable Data Transmission
Port: Port Number, from 1 to 223
MsgPayload: Data to transmit. The maximum allowed data length depends upon set data rate.

Status: 0x00: success
0x01: Device busy
0x02: Device not Activated
0x03: Channel Blocked by duty-cycle
0x04: Port number not supported
0x05: Length not supported
0x06: End Node in silent state
0x07: Error

5.15. TX_MSG_CONFIRMED_IND (0x47)

This command indicates the transmission of radio frame.
Module: 0xAA, 0x47, 0x05, Status, DataRate, TxPower, AckReceived, NbRetries, cks
Status: 0x00 = success
A value different from zero means that an error has occurred.
DataRate: 0 = SF12/125KHz
1 = SF11/125KHz
2 = SF10/125KHz
3 = SF9/125KHz
4 = SF8/125KHz
5 = SF7/125KHz
6 = SF7/250KHz
7 = FSK
TxPower: 0 = 20dBm
1 = 14dBm
2 = 11dBm
3 = 8dBm
4 = 5dBm
5 = 2dBm
AckReceived: 0 = No Ack received
1 = Ack received
NbRetries: Number of transmissions.

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5.16. TX_MSG_UNCONFIRMED_IND (0x48)

This command indicates the transmission of radio frame.
Module: 0xAA, 0x48, 0x03, Status, DataRate, TxPower, cks

Status: 0x00 = success
A value different from zero means that an error has occurred.

DataRate: 0 = SF12/125KHz
1 = SF11/125KHz
2 = SF10/125KHz
3 = SF9/125KHz
4 = SF8/125KHz
5 = SF7/125KHz
6 = SF7/250KHz
7 = FSK

TxPower: 0 = 20dBm
1 = 14dBm
2 = 11dBm
3 = 8dBm
4 = 5dBm
5 = 2dBm

5.17. RX_MSG_IND(0x49)

This command indicates the reception of radio frame.
Module: 0xAA, 0x49, Length, Status, MsgType, MulticastFlag, RxDataRate, RxSlot, FramePending, AckReceived, RxData, RssiLSB, RssiMSB, SNR, Port, Payload, cks

Status: 0x00 = success
A value different from zero means that an error has occurred.

MsgType: Message type:
0 = UNCONFIRMED
1 = CONFIRMED
2 = MULTICAST (Reserved for future usage)
3 = PROPRIETARY

MulticastFlag: (Reserved for future usage)
0 = No Multicast
1 = Multicast message

RxDataRate: 0 = SF12/125KHz
1 = SF11/125KHz
2 = SF10/125KHz
3 = SF9/125KHz
4 = SF8/125KHz
5 = SF7/125KHz
6 = SF7/250KHz
7 = FSK

RxSlot: RxSlotValue
0 = Rx window 1
1 = Rx window 2

FramePending: Frame Pending status:
0 = no downlink Frame Pending
1 = downlink Frame Pending

AckReceived: Indicates if an Ack is received:
0 = No Ack received
1 = Ack Received

RxData: Indicates if data is available:
0 = No data available

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1 = Data available
Rssi: 16-bit Rssi Value expressed in dBm
SNR: 8-bit Signal-to-Noise Ratio (for FSK SNR = 0)
Port: Port Number, from 1 to 223
Payload: Data Message

Port and Payload are optional: if module receives an Ack from server after a reliable data transmission, module will transmit a RX_MSG_IND command without Port and Payload fields.

5.18. GET_SESSION_STATUS_CMD(0x4A)

This command gets the module current status.
Host: 0xAA, 0x4A, 0x00, cks
Reply: 0xAA, 0xCA, 0x01, status, cks
Status: 0x00 = Idle
0x01 = Busy (LoRa session sunning)
0x02 = Device not activated
0x03 = Delayed (LoRa session paused due to Duty-cycle)

5.19. SET_NEXT_DR_CMD(0x4B)

This command will set next transmission DR. The value is stored in RAM memory.

Host: 0xAA, 0x4B, 0x01, DataRate, cks
Reply: 0xAA, 0xCB, Status, cks

DataRate: 0 = SF12/125KHz
1 = SF11/125KHz
2 = SF10/125KHz
3 = SF9/125KHz
4 = SF8/125KHz
5 = SF7/125KHz
6 = SF7/250KHz
7 = FSK
Status: 0x00 = success
A value different from zero means that an error has occurred.

5.20. SET_BATTERY_LEVEL_CMD(0x50)

This command will set the battery level required for *DevStatusReq* frame used in LoRaWAN class A protocol. The value is stored in RAM memory.
Host: 0xAA, 0x50, 0x01, BatteryLevel, cks
Reply: 0xAA, 0xD0, 0x00, 0x86

where BatteryLevel has the following values:
0 = The end-device is connected to an external power source
1…254 = The battery level, 1 being at minimum and 254 being at maximum
255 = The end-device was not able to measure battery level.

5.21. GET_BATTERY_LVL_CMD (0x51)

This command will get the battery level value.
Host: 0xAA, 0x51, 0x00, 0x05
Reply: 0xAA, 0xD1, 0x01, BatteryLevel, cks

Where BatteryLevel has the following values:
0 = The end-device is connected to an external power source
1…254 = The battery level, 1 being at minimum and 254 being at maximum

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5.22. SET_UPLINK_CNT_CMD(0x52)

This command will set the uplink counter in RAM memory.

Host: 0xAA, 0x52, 0x04, UplinkCnt0, UplinkCnt1, UplinkCnt2, UplinkCnt3, cks
Reply: 0xAA, 0xD2, 0x00, 0x84

Where UplinkCnt is the 32-bit Uplink Counter.

5.23. GET_UPLINK_CNT_CMD(0x53)

This command will get the uplink counter from RAM memory.

Host: 0xAA, 0x53, 0x00, 0x03
Reply: 0xAA, 0xD3, 0x04, UplinkCnt0, UplinkCnt1, UplinkCnt2, UplinkCnt3, cks

Where UplinkCnt is the 32-bit Uplink Counter.

5.24. SET_DOWNLINK_CNT_CMD(0x54)

This command will set the downlink counter in RAM memory.

Host: 0xAA, 0x54, 0x04, DownlinkCnt0, DownlinkCnt1, DownlinkCnt2, DownlinkCnt3, cks
Reply: 0xAA, 0xD4, 0x00, 0x82

Where DownlinkCnt is the 32-bit Downlink Counter.

5.25. GET_DOWNLINK_CNT_CMD(0x55)

This command will get the downlink counter from RAM memory.

Host: 0xAA, 0x55, 0x00, 0x01
Reply: 0xAA, 0xD5, 0x04, DownlinkCnt0, DownlinkCnt1, DownlinkCnt2, DownlinkCnt3, cks

Where DownlinkCnt is the 32-bit Downlink Counter.

5.26. SET_CH_PARAMETERS _CMD(0x57)

This command will set channel parameters and enable/disable optional channels. These settings will be stored in **RAM memory**. Ch0, Ch1, Ch2 are the three default Channels (see LoRaWAN specification table 12) and they couldn't be modified. Channels from 3 to 15 are customizable by the user and are disabled in default configuration.

Host: 0xAA, 0x57, 0x07, ChIdx, Freq0, Freq1, Freq2, Freq3, DrRange, ChStatus, cks
Reply: 0xAA, 0xB7, 0x01, Status, cks

ChIdx: Channel index from 3 to 15.
Freqx: Frequency expressed in Hz, where Freq0 is LSB and Freq3 is MSB. For example 867500000 Hz = 0x33B4FFE0, Freq0 = 0xE0, Freq1 = 0xFF, Freq2 = 0xB4, Freq3 = 0x33.
DrRange: Data Rate range. Data Rate Max is most significant nibble, and Data Rate min in less significant nibble.
DR_MAX: from 0 to 7
DR_MIN: from 0 to 7
ChStatus: 0x00 = Disabled
0x01 = Enabled
Status: 0x00: success,
0xF0: failure, ChannelIdx Out of Range
0xF1: failure, DrRange Out of Range
0xF2: failure, Frequency Out of Range
0xF3: failure, DrRange and Frequency Out of Range
0xF4: failure, MAC Busy

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5.27. GET_CH_PARAMETERS_CMD(0x58)

This command will get channel parameters.

Host: 0xAA, 0x58, 0x01, ChIdx, cks

Reply: 0xAA, 0xD8, 0x06, Freq0, Freq1, Freq2, Freq3, DrRange, ChStatus, cks

ChIdx: Channel index from 0 to 15.

Freqx: Frequency expressed in Hz, where Freq0 is LSB and Freq3 is MSB. For example 867500000 Hz = 0x33B4FFE0, Freq0 = 0xE0, Freq1 = 0xFF, Freq2 = 0xB4, Freq3 = 0x33.

DrRange: Data Rate range. Data Rate Max is most significant nibble, and Data Rate min in less significant nibble.
DR_MAX: from 0 to 7
DR_MIN: from 0 to 7

ChStatus: 0x00 = Disabled
0x01 = Enabled

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6. MODULE CONFIGURATION

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

Parameter	Description	Values Range	Default	Notes
AppKey	Application Key	0-255 for all 16 bytes	0 for all 16 bytes	**Used in OTAA (Write Only Variable)**
NwkSKey	Network Session Key	0-255 for all 16 bytes	0 for all 16 bytes	**Used in ABP (Write Only Variable)**
AppSKey	Application Session Key	0-255 for all 16 bytes	0 for all 16 bytes	**Used in ABP (Write Only Variable)**

6.1. LoRa Stack Parameters

Parameter	Description	Address	Values Range	Default	Notes
CustomerDevEUI	Customer 64 bit -Extended Unique Identifier	0x00 – 0x07	0-255 for all 8 bytes	0 for all 8 bytes	
AppEUI	64 bit Application Extended Unique Identifier	0x08-0x0F	0-255 for all 8 bytes	0 for all 8 bytes	Used in OTAA
DevAddr	Device Address	0x10-0x13	0-255 for all 4 bytes	0 for all 4 bytes	Used in ABP
Class	LoRaWAN Class	0x20	0 = Class A 1 = Class C	0	
DR/SF	LoRA datarate / Spreading Factor setting	0x21	0 = SF12/125KHz 1 = SF11/125KHz 2 = SF10/125KHz 3 = SF9/125KHz 4 = SF8/125KHz 5 = SF7/125KHz	0	Value used for next uplink transmission. This value may change automatically Indicative bit rate (bit/s): 0 = 250 1 = 440 2 = 980 3 = 1760 4 = 3125 5 = 5470
Tx Power	Tx Power Level	0x22	1 = 14dBm 2 = 11dBm 3 = 8dBm 4 = 5dBm 5 = 2dBm	1	Value used for next uplink transmission. This value may change automatically
ADR	Enable/Disable adaptive data rate	0x23	0-1	1	Automatic data rate adaption allowed.
Duty Cycle Control	Enable/Disable duty cycle control.	0x24	0-1	1	Should be disabled only for test purpose.
Unconfirmed TX Repetition	Define the Number of	0x25	1-15	1	

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Number	uplink messages repetitions (unconfirmed messages only)				
Enable Customer EUI	Enable/Disable Customer EUI.	0x26	0 = Internal DevEUI 1 = Customer DevEUI	0	
RX2 Data Rate	Rx2 Window Data Rate	0x27	From 0 to 7: 0 = SF12/125KHz 1 = SF11/125KHz 2 = SF10/125KHz 3 = SF9/125KHz 4 = SF8/125KHz 5 = SF7/125KHz 6 = SF7/250KHz 7 = FSK	0	
RX2 Frequency	Rx2 Window Frequency	0x28-0x2B	From 863000000 to 870000000	869525000	
LinkCheckTimeout	RESERVED	0x2C-0x2D	0	0	Reserved. Must be set to 0.
PublicNtwEn	Enable public network sync word	0x2E	0 = Private Network 1= Public Network	1	0 => Sync = 0x12 1 => Sync = 0x34

6.2. Module Parameters

Parameter	Description	Address	Range	Default	Notes
DataIndicateTimeout	Timeout in ms	0x80	1-255	5	Expressed in ms
UartBaudrate	Uart baudrate selection	0x81	0 – 5	4	0 = 9600 1 = 19200 2 = 38400 3 = 57600 4 = 115200

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6.3. Internal DATA (Read Only)

Parameter	Description	Notes
SerialNumber0	Byte 0 SN	Serialization at 32 bit
SerialNumber1	Byte 1 SN	
SerialNumber2	Byte 2 SN	
SerialNumber3	Byte 3 SN	
FwVersion0	Byte 0 FW Version	Fw Version
FwVersion1	Byte 1 FW Version	
FwVersion2	Byte 2 FW Version	
FwVersion3	Byte 3 FW Version	
DevEUI0	Byte 0 Dev EUI	64 bit -Extended Unique Identifier
DevEUI1	Byte 1 Dev EUI	
DevEUI2	Byte 2 Dev EUI	
DevEUI3	Byte 3 Dev EUI	
DevEUI4	Byte 4 Dev EUI	
DevEUI5	Byte 5 Dev EUI	
DevEUI6	Byte 6 Dev EUI	
DevEUI7	Byte 7 Dev EUI	

7. EXAMPLES

This section describes some examples for network configuration and message exchange.

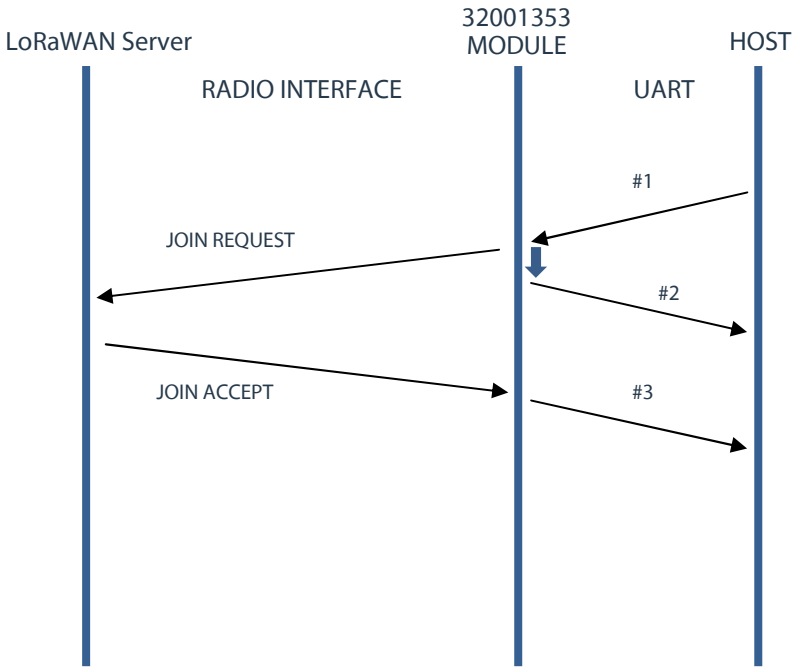
7.1. END NODE OTAA (Over The Air Activation)

This procedure performs the over the air end node activation. This procedure requires that the device must be personalized with Application identifier (AppEUI), Application Key (AppKey), and end-device identifier (DevEUI).

Host command: 0xAA, 0x40, 0x01, 0x01, 0x14 (#1)
Module Answer: 0xAA, 0xC0, 0x01, 0x00, 0x95 (#2)

When the activation procedure succeeds, an indicate message will be transmitted by module:

Module Indicate: 0xAA, 0x41, 0x01, 0x00, 0x14 (#3)



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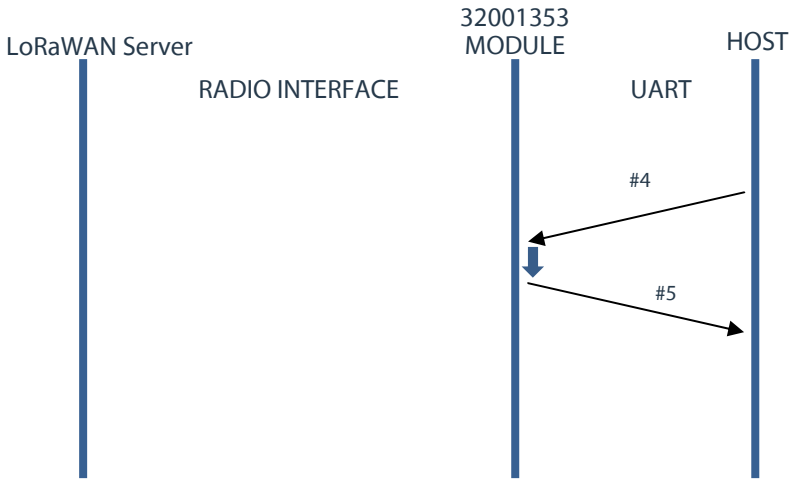
7.2. END NODE ABP (Activation by personalization)

End-device Address (DevAddr), Network Session Key (NwkSKey), and Application Session Key (AppSKey) are known in advance and End-devices are personalized with this fields.

Host command: 0xAA, 0x40, 0x01, 0x00, 0x15 (#4)
Module Answer: 0xAA, 0xC0, 0x01, 0x00, 0x95 (#5)

No radio message is exchanged through this procedure.



7.3. MESSAGE UNCONFIRMED TRANSMISSION SESSION

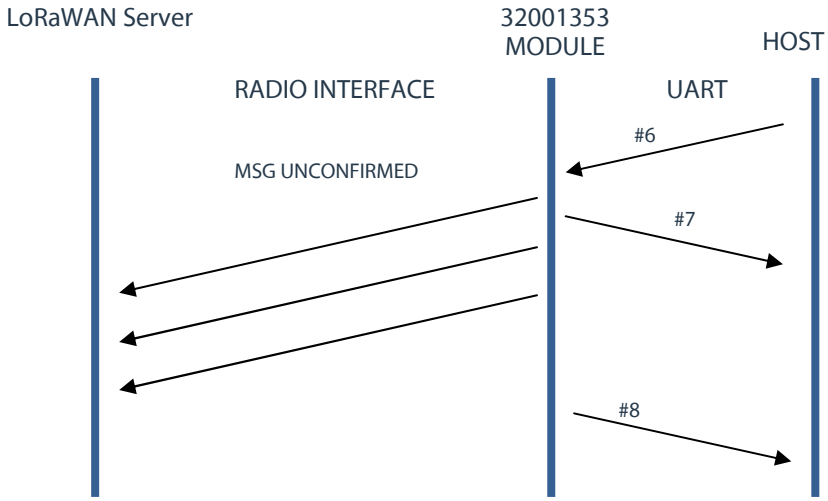
This example shows how to send an unconfirmed message. Here assume Unconfirmed TX Repetition Number equal to 3. To send a PAYLOAD equal to {0xAA, 0xBB, 0xCC, 0xDD, 0xEE, 0xFF} to port 10:

Host command: 0xAA, 0x46, 0x08, 0x00, 0x0A, 0xAA, 0xBB, 0xCC, 0xDD, 0xEE, 0xFF, 0x03 (#6)
Module Answer: 0xAA, 0xC6, 0x01, 0x00, 0x8F (#7)

When the session ends, module sends back to the host an indication message containing the transmission power and transmission datarate:

Module Indicate: 0xAA, 0x48, 0x03, 0x00, 0x05, 0x01, 0x05 (#8)

In this example the node has transmitted one frame at 14dBm SF7/125kHz.



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7.4. MESSAGE CONFIRMED TRANSMISSION SESSION

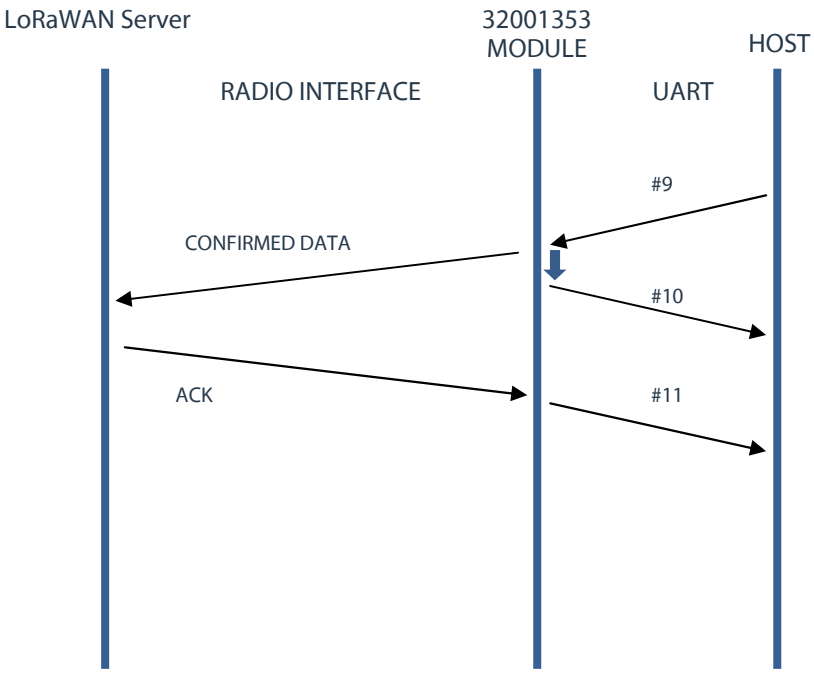
This example shows how to send a confirmed message. To send a PAYLOAD equal to {0xAA, 0xBB, 0xCC, 0xDD, 0xEE, 0xFF} to port 10:

Host Cmd: 0xAA, 0x46, 0x08, 0x01, 0x0A, **0xAA, 0xBB, 0xCC, 0xDD, 0xEE, 0xFF**, 0x02 (#9)
Module Answer: 0xAA, 0xC6, 0x01, 0x00, 0x8F (#10)

When the session ends, module sends back to the host an indication message containing the transmission power, transmission datarate, a confirm of Ack reception, and the number of transmitted messages:

Module Indicate: 0xAA, 0x47, 0x05, 0x00, 0x05, 0x01, 0x01, 0x01, 0x02 (#11)

In this example node has transmitted one frame at 14dBm SF7/125kHz and it has received an ack by server.



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8. GLOSSARY

ABP = Activation by personalization
OTAA = Over The Air Activation
SN = Serial Number
FW = Firmware
EUI = Extended Unique Identifier
LSB = Least significant byte
MSB = Most significant byte
Cks = Checksum

9. REFERENCES

[1] LoRaWAN Specification V1.0.1
[2] Sx1272 Datasheet

10. CERTIFICATIONS

The module has been certified according to Radio Equipment **Directive (RED) 2014/53/EU**.

Compliant with **ReACH** and **ROHS** directives.

11. REVISION HISTORY

Revision	Date	Description
0.1	03-08-2016	Preliminary
0.2	13-10-2016	Changed UART data interface description
0.3	31-03-2017	Added examples.
0.4	24-07-2017	Removed Class C EEPROM configuration
0.5	27-04-2018	Restored Class C EEPROM configuration
1.0	27-08-2019	Final release

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