NAS CM3061 LoRaWAN BK-G Pulse Reader User Manual

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NAS CM3061 LoRaWAN BK-G Pulse Reader

Features

- Hybrid radio: LoRaWAN® and wM-Bus
- A simple touch touch-to-connect configuration using the NAS Connect Mobile app
- LoRaWAN® ready in wM-Bus mode (automatic switchover) Secure communications
- Monthly, daily, hourly, quarter-hourly metering
- Alerts**:** no usage, tamper
- Simple configuration profiles
- Pre-installed battery with expected life of n/a years
- Device Firmware Update using a phone
- Maintenance free – install and forget
- Durable (IP68 rated)

Quick Start Guide

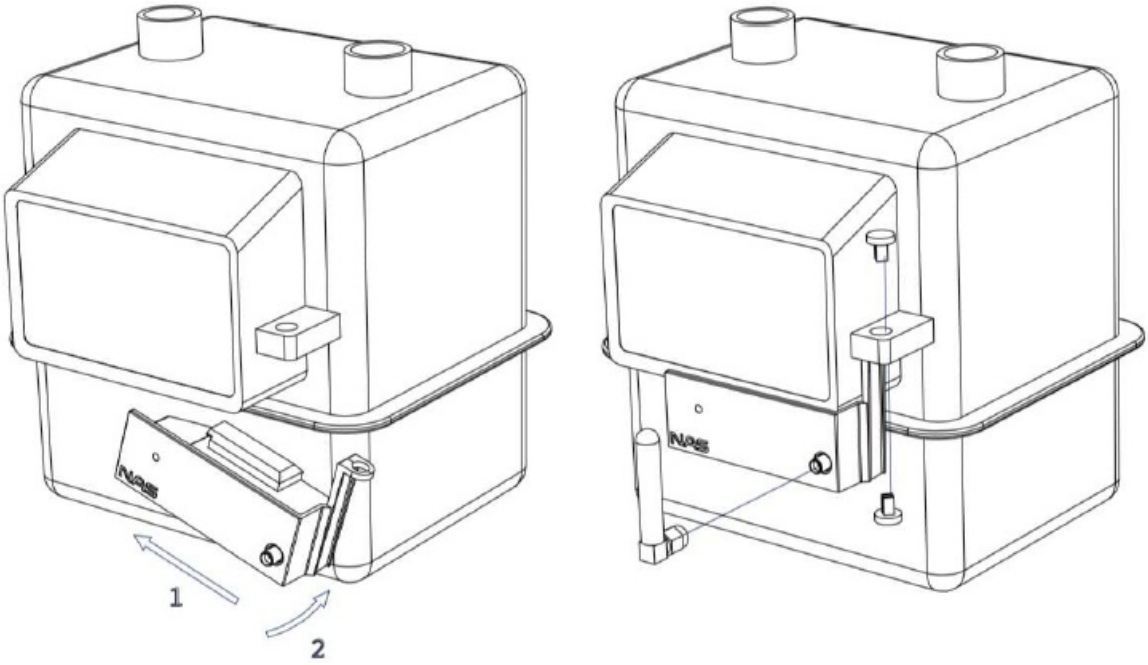
Make sure NAS Connect for iPhone (QR code link on the right) is installed and logged in using **services.nasys.no** account.

Provisioning

Add CM3061 ‘s keys to the available LoRaWAN network server before turning CM3061 on. Necessary keys are DevEUI, JoinEUI (AppEUI) and AppKey (all keys LSB). Device class Class-A, activation join OTAA, LoRaWAN MAC version 1.0.3, regional param rev A. Make sure your account has sufficient rights to access your CM3061 using services.nasys.no

Installation

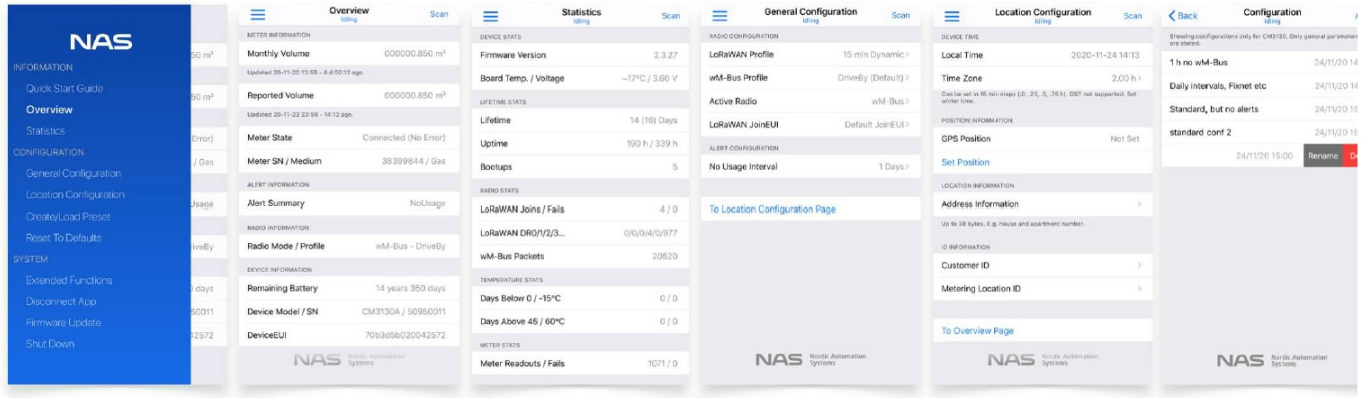
&oo not wake up CM30xx without an external antenna attached, this can damage radio circuitry. Fasten CM3061 tightly, as shown on the figure below. Attach the SMA antenna.



Configuration

Scan CM3061 with the NAS Connect app near the) logo. Configure relevant parameters (app screenshots below). Create Preset. Load Preset on other devices.

Notice: If installed during Summer Time it is recommended to manually set Winter Time by decreasing the Time Zone value by 1 h.



Specifications

Parameter	Typical
Dimensions (LxWxH)	unavailable:DINS:lengthxunavailable:DINS:widthxunavailable:DINS:height mm
Weight	80 g
Enclosure Material	ABS(LG380LK)+engraving add.
IP rating	IP68
ATEX Approved	unavailable:ATEX
Operating Temperature	-5 ‘C … +65’C
Communication range	up to 15 km*
Antenna Connector	SMA
LoRaWAN Device Class	Class A
LoRaWAN Version	1.0.3a
LoRaWAN Activation	OTAA
LoRaWAN Transmit Power	+16 dBm (EIRP)
LoRAWAN Receive Sensitivity	-137 dBm@ SF12, BW 125kHz
wM-Bus Mode	C1 mode-5 encryption
OMS version	4.1.2
Expected battery life	n/a years**
Max. Storage Period	1 year 10’C … 30’C

- Communication range depends on the location of the sensor and the nearest base station, surroundings etc.
- Battery life varies with extreme temperatures. Except if radio_lorawan_profile is lorawan_ 1_h_static or lorawan_ 15_min_static profile.

Metering

Timings

CM3061 is updating meter readouts every 15 minutes. Meter readouts are timed 2 seconds early (xx:59:58,

xx:14:58, xx:29:58, xx:44:58) so that monthly readout would have the date of previous month. meter_actuality_duration_minutes indicates the age of the readout value.

Alerts

Alerts are updated together with timed meter readouts. active_alerts are reported as flags in the next packets. In LoRaWAN mode confirmed us age_with_status_packet clears pending active_alerts flags. In wM-Bus mode active_alerts flags are immediate values and not accumulated. Timed meter readouts to detect alert conditions are performed even in wmbus_privacy and lorawan_24_h_privacy modes.

Alert	Condition	Reset at
alert_no_usage	no flow within the *alert_no_usage_interval_days* period	any flow
alert_low_battery	<182 days left of expected CM3061's lifetime	never
alert_tamper	strong external magnetic field	reduced external magnetic field
Alert	Condition	Reset at
alert_no_usage	no flow within the *alert_no_usage_interval_days* period	any flow
alert_low_battery	<182 days left of expected CM3061's lifetime	never
alert_tamper	strong external magnetic field	reduced external magnetic field

Measurement Method

CM3061 reads the volume by sensing a rotating magnet with a reed switch.
This method has some inherent limitations: only relative counting which can introduce error. This method is not guaranteed to ensure Liter-touter precision.
a/ert_tamperdetection is based on a reed switch (detecting an external strong magnetic field) positioned apart from the main reading reed. Meter removal is not detected by CM3061, ii can be verified by the broken seal.

Configuration

meter_accumulated_volume_L – since CM30xx counts revolutions ii has no absolute reference, current meter reading has to be entered meter_serial – serial number of the water meter can be configured, ii is reported in usage_ with_status_packet.

LoRaWAN

CM3061 implements LoRaWAN specification v1 .0.3 class A device. CM3061 listens for downlinks only briefly after uplink. LoRaWAN payloads are all LSB. LoRaWAN parameter NbTrans (formerly NbRep) determines the transmission count of unconfirmed packets, it can be adjusted by the backend (to increase the Quality of Service). CM3061 overrides NbTrans to be 1 at all times to avoid increased battery consumption.

Joining

After boot-up CM3061 performs LoRaWAN Over-the-Air Activation(OTAA) join procedure. The data rates used and the duration of the cycle are region-dependent. In LoRaWAN (except US915, AU915 and AS923 regions) the join cycle consists of 5 join request messages (DR4, DR3, DR2, DR1, ORO). The whole cycle can take up to 3 minutes in total. At successful join CM3061 will decrement DataRate by one when higher DataRates (DR3 —> DR2, DR4 —> DR3).
When using sa channel gateway in AU915 or US915 region with 64 channels, joining is roulette unless joining channel group mask is manually set (see Jorawan_ch_mask_group).

Recovery / Rejoin Mechanisms

LoRaWAN link quality can be assessed after join by looking at DataRate (ORO – worst, DR5 – best). Additionally, the Send Usage With LinkCheck button on the Extended Functions page sends the LoRaWAN LinkCheck MAC command to get the number of gateways and SNR. LoRaWAN connection is daily monitored using usage_with_status_packets confirmations (ACKs).

Mechanism	Mode	Precondition	Reason	Action	Following action
ADR recovery	Hybrid / LoRa only	LoRaWAN joined	No downlink in 48 h	ADR disabled temporarily, data-rate decreased, TX power increased*	no downlink: DR decrease in 48 h downlink received: ADR re-enabled
Network lost rejoin	Hybrid	LoRaWAN joined	No downlink in 7 days	LoRaWAN Rejoin	join failure: fall back to wM-Bus, rejoin after 7 days
	LoRa only	LoRaWAN joined			join failure: rejoin after 24 h
Periodic rejoin	LoRa only	LoRaWAN not joined	Join failed 24 h ago	LoRaWAN Rejoin	join failure: rejoin after 24 h
	Hybrid	wM-Bus active	wM-Bus active for 7 days	LoRaWAN Rejoin	join failure: fall back to wM-Bus, rejoin after 7 days

ADR recovery step decreases DataRate by dividing DataRate index by two (e.g. DR4—> DR2) and increases TX power by dividing power reduction value (relative to max power of region) by two (e.g. 3 dBm—> 9 dBm, 9—> 12, 11 —> 13).

Profile Timings

LoRaWAN timed payloads are transmitted with the specific time offset after meter readout to reduce packet collisions. The time offset is calculated randomly once at boot (system reset) ranging from 30 sec to 14 min 30 sec. Dynamic profiles ensure battery lifetime by lowering transmission interval at lower data rates (which means longer air times). Static profiles do not alter transmission intervals at the expense of reduced battery lifetime. In Jorawan_24_h_privacy (GDPR) mode reported meter readout value is updated once a month to hide the consumption patterns.

LoRaWAN Profile	LoRaWAN packet interval	Metering value update interval	Internal meter readout interval	Reduced lifetime
lorawan_24_h_privacy	24 h	monthly	15 min	no
/orawan_24_h	24 h	24 h	15 min	no
lorawan_ 12_h	12 h	12 h	15 min	no
/orawan_ 1_h_dynamic	1 h / 2 h (DRO)	1 h / 2 h (DRO)	15 min	no
lorawan_ 15_min_ dynamic	15 min/ 1 h (DR1, DR2) / 2 h (DRO)	15 min/ 1 h (DR1, DR2) / 2 h (DRO)	15 min	no
lorawan_ 1_h_static	1 h	1 h	15 min	yes
lorawan_ 15_min_ static	15 min	15 min	15 min	yes

Packets Overview

CM3061 sends out usage_packets on configured intervals with the exception of midnight and noon when usage_with_status_packetis sent instead. This payload contains everything that is needed for billing purposes. usage_with_status_packet differs from usage_packetonly by added device_status block. After every LoRaWAN join, CM3061 sends out a boot_packet. If any configuration parameter is changed (via app or LoRaWAN downlink) or configuration restored at boot, CM30xx sends out the corresponding configuration packet.

Packet	fPort	Condition for sending	Confirmed, retries	Direction	Contains
usage_packet	25	timed, 1 - 94 times per day,	no	up	*active_alerts*, *meter_actuality_duration__minutes* , *meter_accumulated_volume__L*
usage_with_status_packet		*device_status* block added at 00:00 and 12:00	yes, 0		*usage_packet* + *meter_serial*, *battery_*, *temperature_* and *radio_* parameters
boot_packet	99	first packet after a successful join.	yes, 1	up	*device_serial*, *device_firmware_version*, wakeup_*info* etc
shutdown_packet	99	right before shutdown or switch from LoRaWAN to wM-Bus	yes, 1	up	*shutdown_reason*, full *usage_with_status_packet*
general_configuration_packet	50	*general_configuration_request* or any contained configuration changed	no	both	*radio_lorawan_profile*, *radio_wmbus_profile*, *meter_* and *alert_* configurations
location_configuration_packet	50	*location_configuration_request* or any contained configuration changed	no	both	*gps_position_*, *time_zone*, *address*, *id_customer*, *id_location*
configuration_request	49	-	-	down	either request for *general_configuration_packet* or *location_configuration_packet*
enter_dfu_command	60	-	-	down	-
local_time_request	60	-	-	down	-
local_time_response	60	response for *local_time_request*	no	up	*device_local_time__s*
faulty_downlink_packet	99	when any configuration or command packet has an error	no	up	*packet_fport*, *packet_error_reason*

Note: LoRaWAN DeviceTimeReq MAC command is added to bootpacket and usage_with_status_packets once every 96h to synchronise CM30xx time. This usage_with_status_packets has been reported to be hidden in certain networks (e.g. TTN) due to added MAC command, in that case please contact the service provider.

wM-Bus

- wM-Bus operates in C1 mode, using mode-5 encryption. wM-Bus is only available on CM3061A (LoRaWAN EU868 region), disabled in all other regions.
- wM-Bus Serial is the second half of CM3061 DevEUI (e.g. 70b3d5b020042593—, 20042593).

Profile Timings

In wmbus_privacy (GDPR) mode reported meter readout value is updated once a month to hide the consumption patterns.

wM-Bus Profile	Internal meter readout interval	Metering value update interval	wM-Bus packet interval	Battery life ensured
wmbus_privacy	15 min	monthly	17 s	yes
wmbus_driveby	15 min	24 h	17 s	yes
wmbus_fixnet	15 min	15min	60 s	yes

Reported Parameters List

Details about the parameters contained in wM-Bus frame.

Parameter	Updated	Data Record Header	Total length
meter_actuality_duration_s	always (for *volume)*	0x02 0x74	5
meter_accumulated_volume_L	*wmbus_fixnet*- 15 min, *wmbus_driveby*- 24 h, *wmbus_privacy* – n/a	0x04 0x1x	6
meter_key_date_accumulated_volume_L	monthly	0x44 0x1x	6
meter_key_date	monthly	0x42 0x6C	4
remaining_battery	always	0x02 0xFD 0x74	5
manufacturer_specific (Alerts and *battery_remaining_semesters)*	always	0x0F 0x01	4

Configuration

CM3061 can be configured using NAS Connect app at installation and in case of need also remotely via LoRaWAN. Changes of parameters in the App will trigger a LoRaWAN uplink packet with the corresponding configuration right after leaving the corresponding page in the app. Common settings can be stored in the NAS Connect app using the “Create/Load Preset” button so that specific presets can be easily loaded onto other CM3061 devices. Creating a preset store the current configuration as a preset, so apply desired configurations first. The “Reset To Defaults” button in app resets all the configurations to factory defaults.
configuration downlink packet over LoRaWAN will either respond with the new configuration packet if parsing was successful or with an error code. Device configuration can be requested, see Configuration Request. All configurations are divided into two categories: General Configuration and Location Configuration. There is a separate LoRaWAN configuration packet and separate page in NAS Connect app for each of these categories. Changing a parameter using the NAS Connect app sets the corresponding LoRaWAN configuration packet pending, the packet is sent after leaving the corresponding configuration page in the app.

Genera/_configuration_packet Parameters
Configures radio_ profiles, meter_ and alert_ parameters.

Parameter	Config via App/LoRaWAN	Part of Preset	Availability	Default	Comments
radio_lorawan_profile	yes/yes	yes		*lorawan_1_h_dynamic*	determines packet (and metering readout) interval. Options: *lorawan_disabled* , *lorawan_24_h_privacy* .... *lorawan_15_min_static*
radio_wmbus_profile	yes/yes	yes		*wmbus_driveby*	determines packet (and metering readout) interval. Options: *wmbus_disabled* , *wmbus_privacy* , *wmbus_driveby* , *wmbus_fixnet*
lorawan_joineui	yes/no	yes	not if *lorawan_disabled*	Distributed JoinEUI	not reset with Reset To Defaults button
lorawan_ch_mask_group	yes/no	yes	only in US915 and AU915 regions	all channels	pre-select channel mask to make join procedure faster, button disabled after joining
meter_serial	yes/yes	no		*not_set*	
meter_accumulated_volume__L	yes/yes	no		0	
meter_accumulated_volume_offset__L	yes/yes	no		0	
meter_multiplier	yes/yes	yes		1	
alert_no_usage_interval__days	yes/yes	yes	not with gas meters	*disabled*	
alert_tamper	yes/yes	yes		*enabled*	

Location_configuration_packet Parameters

Configures optional meta information that is stored inside CM3061 and reported over LoRaWAN when added and can be requested at any time over LoRaWAN. id_customerand id_location can be used as customer EiC and metering EiC. All text fields are UTF-8 compatible strings (not nullterminated).

Notice: all the lengths of the text fields are in bytes, not symbols (UTF-8 symbols can take multiple bytes). The content may be sent in two portions if all the fields are filled and the available payload length is insufficient.

Parameter	Config via App/LoRaWAN	Part of Preset	Availability	Comments
gps_position	yes/yes	no	not if *lorawan_disabled*	phone's coordinates, stored only on manual button press, adjustments on map allowed
address	yes/yes	no		up to 38 bytes utf-8
id_customer	yes/yes	no		Customer ID, 16 bytes of utf-8
id_location	yes/yes	no		Metering Location ID, 16 bytes of utf-8
time_zone	yes/yes	yes		automatically set by App

Functionality Description

Hybrid Radio Mode

CM3061 has two radio stacks: wM-Bus and LoRaWAN and it can automatically switch back and forth between them on specific conditions, preferring the LoRaWAN network if available. Modes are determined by the combination of radio_/orawan_profile and radio_wmbus_profile. CM30xx operates in regular single radio mode if the other profile is _ disabled.

Mode	Description	Case
Hybrid mode (w M Bus active)	CM3061 transmits wM-Bus packets and tries to join to LoRaWAN weekly	Plans of installing LoRaW AN network in the future
Hybrid mode (L oRaWAN active)	CM3061 transmits LoRaWAN packets, if packet confirmations ar e missing for a week, try to rejoin. If join fails, enter wM-Bus	Falls back to wM-Bus if the LoRaWAN network f ails

Battery Lifetime

battery_remaining_years is reported in usage_with_status_packet and wM-Bus packet. All profiles except /orawan_ 1_h_static and /orawan_ 15_min_static are calculated to ensure a specified battery lifetime. Operating CM3061 for more than 10 days in one of these static modes invalidates the remaining battery estimations. active_alerts.low_battery means that less than 182 days of battery is left. The flag remains on until the end of life. Battery lifetime estimations are based Medium Zone temperature profile as seen below.

-20°C	-10°C	0°C	10°c	20°c	30°c	40°c	50°C
1%	**2%**	**12%**	**20%**	**21%**	**20%**	**16%**	**8%**

CM3061 Local Time

A correct device clock is needed to take e.g. hourly readings at the right time. The two methods to synchronise the CM3061 clock are:

1. NAS Connect app – time is automatically synced if the logged-in user has configurator rights for the device.
2. LoRaWAN DeviceTimeReq – synchronises after successful join (with booLpacket) and regularly with 4-day intervals (with usage_wit h _ status packet).

CM3061 is time zone aware (knows it offset from UTC), but not Summer Time aware. If installed during Summer Time it is recommended to manually set Winter Time by decreasing the time_zone value by 1 h. CM3061 ‘s local time can be requested for troubleshooting purposes over LoRAWAN using /ocaltime_request

Boot-up Behaviour

At boot-up, CM3061 runs a self-check routine. If there is some internal failure, CM3061 will shut down immediately except when the NAS Connect app is connected for the user to see the issue (shutdown will still be pending). At the very end of battery life CM3061 falls into a reset loop due to dropping battery voltage. After 4 sequent unfinished wake-ups, CM3061 sleeps for 4 hours and then reboots to retry again 4 times and so on. This 4-hour waiting can be cancelled by scanning CM3061 with NAS Connect app.

Shutdown Behaviour

In LoRaWAN mode a shutdown_packetsending is attempted within 5 seconds (LoRaWAN might be duty-cycle locked). shutdown_packetco ntains shutdown reason and last usage_with_status_packet. Shutdown does not erase settings.

LED Indications

Mode	Indication	Duration
Wakeup	red blinks once a second	5 sec
Shutdown	red blinks twice a second, end with a long pulse	5 sec
NAS Connect app connected	blue blinks with 2-second interval	while app connected
Magnet switch active	blue blinks with 1 second interval	while magnet switch active

DFU
CM3061 firmware can be updated using free nRF Toolbox App. DFU mode can be activated via LoRaWAN or using the NAS Connect app. The downgrade is not possible, nor LoRaWAN region change. CM3061 retains its configurations. All readouts (monthly etc) are reset to boot moment.

NAS Connect App
CM3061 can be conveniently configured using the NAS Connect App featuring:

- Touch (scan NFC) to connect
- Real-time parameters, states, modes Convenient configuration
- Preset storage (create and load preset) CM3061 Quick start guide easily accessible Triggering DFU of CM3061
- Setting CM3061 GPS coordinates with phone Secure communication

The app consists of pages that can be navigated from the left sidebar. Additionally, some system functions of CM3061 can be accessed on the sidebar. CM3061 can only be turned on and shut down using the NAS Connect App. It can be configured either using NAS Connect app or over LoRaWAN.

Privacy

NAS Connect does not store anything inside the phone except the login token in a secure cell and stored configuration presets. NAS Connect App needs a user to have a services.nasys.no account and Internet connection to access the device above guest_Jevel. The device challenges the server and the server provides user_right_level. This request is only to authenticate NAS Connect app access to CM30xx. The authentication request (after scanning CM30xx) is logged on the server side, log containing the username, timestamp, user right level, and device DevEUI. No parameter visible/configurable in the app is stored/logged/forwarded. Optional meta parameters like gps_position_, address, id_customer, id_location etc are only stored in CM30xx, they are transmitted over LoRaWAN once after setting them. If user has rights above guest_level NAS Connect app updates CM30xx time at every connection.

Frequently Asked Questions

- Q: Where do I get the LoRaWAN keys (AppKey etc) for CM3061?
- A: The keys are distributed by the seller at purchase.
- Q: CM3061 is not joining to LoRAWAN network?
- A: Make sure there is a working LoRaWAN gateway nearby. Make sure the device is properly provisioned. In case of poor LoRAWAN signal (e.g. inside basement), first try to join in better conditions (e.g. outside) to rule out network problems (correct keys, gateway etc) and then rejoin in a real location. US915, AU915 and AS923 LoRAWAN region specifications define 64 channels and gateways have mostly 8 channels, so joining is a roulette. It can be accelerated (and battery saved) by choosing LoRaWAN Ch. Mask Group from app. In case of testing in multiple overlapping LoRaWAN networks make sure the keys are deleted from all other network

servers.

- Q: CM3061 needs to be transferred to another LoRaWAN network, how to rejoin?
- A: Make sure the keys are only present in the desired network. If the CM3061 can be accessed with NAS Connect app, rejoin can be immediately triggered. If CM3061 is inaccessible, CM3061 will automatically attempt to rejoin in 7 days from last successful ACK.
- Q: The packet comes from the correct form but bytes do not match with the payload structures document.
- A: The payloads may be encrypted when length and fPort are correct but bytes seem totally random. The packets have to originate from the application server (decrypted) not the network server.
- Q: “Could not connect to NAS device” message in NAS Connect app?
- A: Try to scan CM3061 again. NFC reading is sensitive to distance and minimises motion during NFC scanning. Due to continuous NFC scanning on newer phones, NFC tag is hidden after each scan for 2 seconds to avoid new connection. Is iPhone Settings-> Privacy-> Bluetooth -> NAS Connect enabled?
- Q: NFC of CM3061 not scanning at all?
- A: Try again to find optimal position between the CM3061 NFC antenna and the phone.
- Try to scan with some other NFC app, if that works try again with NAS Connect App. Swipe the reed with magnet to reset the NFC tag. If nothing helps, try to rescan after an hour.
- Q: Can the CM3061 battery be replaced?
- A: No, CM30xx is potted in to achieve {nas:erp:meta: INPR} rating.
- Q: Why NAS Connect app show only a few pages on CM3061?
- A: Reduced functionality means guest access. To achieve a higher access level, make sure:
  - the phone has an Internet connection while connecting to CM3061 (no offline configuration at this point)
  - in the NAS Connect app, the user has to be logged in using the **services.nasys.no** account
  - user account must have desired rights for the device in **services.nasys.no**

Ordering Information

Example ordering code CM3061 A#0001 EU consists of following:

Product	Article region		Package quantity	SKU region
CM3061	A	#	0001	EU

Article region	SKU region	LoRAWAN band
A	EU	EU868
B	AU	AU915
C	us	US915
D	AS	AS923
F	KR	KR920
	IN	IN865
J	RU	RU864

Packaging

CM3061s are shipped either in a single or bulk package depending on order code package quantity. Single package each CM3061 has a separate unavailable:SPDM (mm) cardboard box. Bulk package reduces waste by packing up to unavailable:BPNP CM3061s into larger unavailable: BPDM (mm) cardboard box. Minimum bulk order quantity is unavailable: MOQ.

CM3061 package includes

- n x CM3061 Module
- n x External SMA antenna
- 1 x Printed Quick Start Guide
- n x QR LoRaWAN/wM-Bus keys on a removable sticker (samples only)

Contact

- Nordic Automation Systems AS
- www.nasys.no
- info@nasys.no

Revision History

First version

Documents / Resources

	NAS CM3061 LoRaWAN BK-G Pulse Reader [pdf] User Manual NAS_CM3061, CM3061 LoRaWAN BK-G Pulse Reader, CM3061, LoRaWAN BK-G Pulse Reader, BK-G Pulse Reader, Pulse Reader, Reader

References

- User Manual