TeraCode

COMMUNICATION CARD USER MANUAL

TABLE OF CONTENTS

VERSION HISTORY

Developed by TeraCode. The following manual applies to the following devices:

TOTO Communication Card Prototype (V2.5)

VERSION	DATE	AUTHOR	DESCRIPTION
VERSION 1	10/13/23	TeraCode	Initial version
VERSION 2	12/18/23	TeraCode	FCC Label Information
VERSION 3	12/19/23	TeraCode	Revisions for Conformity Report

FCC/IC INFORMATION

Model/Tradename: TCCC024
FCC ID: 2BCX2TCCC024
IC: 31344-TCCC024

This device complies with Part 15 of 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.

Changes or modifications not expressly approved by TeraCode could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

— Reorient or relocate the receiving antenna.
— Increase the separation between the equipment and receiver.
— Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
— Consult the dealer or an experienced radio/TV technician for help.

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.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

1. L'appareil ne doit pas produire de brouillage;

2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement

This radio transmitter IC: 31344-TCCC024 has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Le présent émetteur radio IC: 31344-TCCC024 a été approuvé par Innovation, Sciences et Développement économique Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal. Les types d'antenne non inclus dans cette liste, et dont le gain est supérieur au gain maximal indiqué pour tout type figurant sur la liste, sont strictement interdits pour l'exploitation de l'émetteur.

Dedicated Antenna: Dipole 1.2dBi (50 ohm)

OVERVIEW

PURPOSE

This device allows data access and insight into the operation and current status of TOTO automatic bathroom fixtures. By locally connecting to these devices and forwarding their information wirelessly to the cloud, administrators may gain enhanced insight into device usage patterns that may aid in preventative maintenance and optimization efforts.

DESIGN

This device is designed to be as unobtrusive as possible, easy to clean, and offer powerful data logging capabilities while still maintaining an expected battery life of up to 1 year. To ease battery changing, the device was designed with a "quick swap" battery pack, so maintenance personnel can quickly and easily provide maintenance on these devices. The device also implements BLE connectivity for easy provisioning and troubleshooting, as well as a LoRaWAN radio for IoT telemetry, capable of transmitting data long distances of over 2500 feet.

The device is capable of being powered via several interfaces - it can take power directly from connected devices in the case of the Automatic Soap Dispenser, from an external AC/DC converter via its external DC barrel jack, or can be powered via a quick-swappable internal AA battery pack, with an expected battery life of approximately 1 year

THEORY OF OPERATION

DATA COLLECTION

Raw data is collected from attached TOTO equipment via the black and white cable harness accessible from the back of the device. Once connected, the device is capable of receiving a raw data stream from the equipment that is then logged and stored with a high accuracy timestamp. Data is received and stored in real time as it occurs until either the datalog is full, or 15 minutes has passed, or if high priority data has been received - at which point the data is forwarded on to the cloud via a LoRaWAN network.

CLOUD CONNECTIVITY

Once sent out from the device, data arrives at a nearby LoRaWAN gateway that then retransmits this data over a secure connection to the AWS cloud via either WIFi, LAN, or cellular connection.

VISUALIZATION AND DATA MANAGEMENT

Once received in the cloud, the data is read and interpreted to extract usage information and error information for the purposes of reporting, troubleshooting, and preventative maintenance. TeraCode's AppThing platform offers an easy web portal to access and view this information in an administrator friendly way with both raw information readouts and error info, as well as sophisticated indicators and tools.

SPECIFICATIONS

ELECTRICAL

Max input voltage: 3.3V (3.3V on DC Barrel Input)
Max power draw: 0.33W
Power supplies: DC barrel input, 4x AA battery, 3.3V equipment input
Expected battery life: Approximately 1 year

ENVIRONMENTAL

Operating temperature limit: -10C to 60C
Storage temperature limit: -20C to 70C
Storage/operating humidity: 95% RH or less over storage temperature range
IP Rating: IPX5
Regulatory compliance: FCC, RoHS

DEVICE INSTALLATION / STARTUP

Installation for each of the 3 devices is nearly identical. For each device, there will be a small white 1x4 conductor connector attached to either 2 or 3 leads going to the TOTO equipment designed to mate with the communication card's included cable harness.
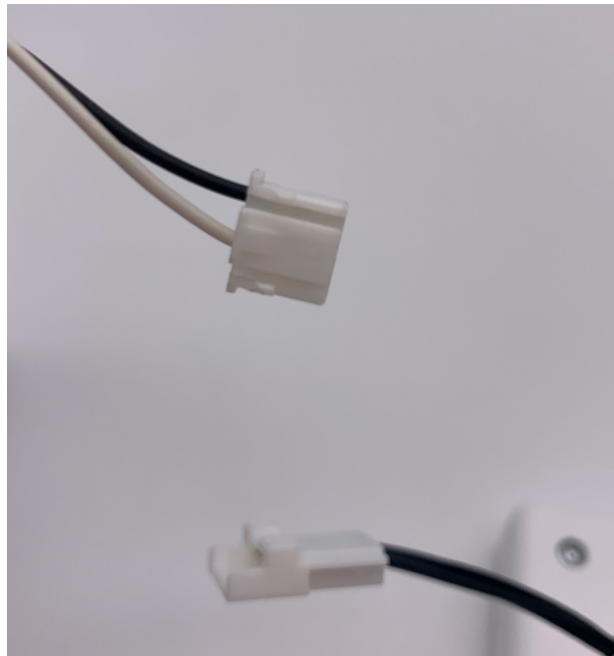
Installation is as easy as connecting this cable, then mounting the communication card to the piece of equipment using the hook feature on the rear of the device. Some devices like the automated flush valve below need to be partially disassembled to allow the hook feature to be "captured" by the equipment's metal or plastic enclosure. Once mounted, the assembly should appear similar to the below image.

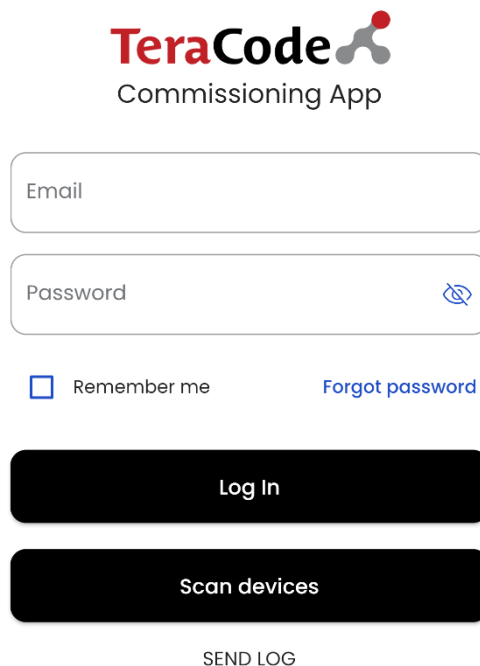On successful power on, green LED will light for 5 seconds.

After the 5s light on period, trigger the TOTO device twice such that the communication card can identify component type and long/short dispense interval (if ASD). If already configured with LoRaWAN credentials, the unit will automatically join the nearby LoRaWAN network, and begin normal operating procedure after approximately 30 seconds.

Note: If the device has been unpowered for a long period of time, it is necessary to update the RTC time of the device, this is done via the mobile app (below)

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COMMISSIONING VIA APP

USING THE COMMISSIONING APP

- Startup the commissioning app and login using your credentials

TeraCode
Commissioning App

Email

Password 👁

☐ Remember me   Forgot password

Log In

Scan devices

SEND LOG

Commissioning App Login Screen

- Once logged in the home screen will load where the user is given the options:
- Tapping the "Commission" Button allows the user to go through the commissioning process
- In order to successfully commission a device, the user must power the board on, and have the devices DevEUI.
- The user can either directly input the DevEUI or they can elect to use a QR Code that contains the DevEUI.
- Once inputted the app connects to the board via bluetooth and begins setting RTC for the board.
- Once successfully set the user is now able to input information pertaining to the type of hardware that'll be connected to the Communication Card as well as the location where the board will be installed.

LED INDICATOR BEHAVIOR

There are 2 LEDs located on the upper portion of the device, a green LED for bootup indication, and a red LED for error state indication.

GREEN LED

The green LED will turn on during initial bootup, and will remain on if powered by an external power source other than the battery supply.

RED LED

The red LED will light to indicate errors. The errors indicated by the red LED are:
- 1 flash: Low Battery
- 2 flashes: Invalid LoRaWAN Credentials
- 3 Flashes: Invalid LoRaWAN Data
- 4 Flashes: RTC not set

# LORAWAN GATEWAY SETUP

For gateway user manual, please see this link:
http://wiki.dragino.com/xwiki/bin/view/Main/User%20Manual%20for%20All%20Gateway%20models/LPS8N%20-%20LoRaWAN%20Gateway%20User%20Manual/

Ensure that the firmware used in the device is lgw-5.4.1655274924, to confirm, go to System tab > System Overview. If the device is an older version, see user manual above for instructions on how to upgrade the firmware.

Gateway configuration:
Follow the instruction manual above to connect to the gateway, either via its LAN port or via WLAN when attached to the same WiFi network as the device.

Go to the LoRa tab:
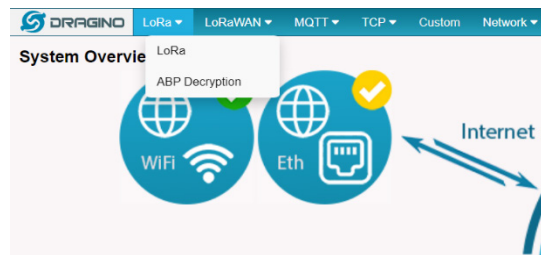
Change the frequency to AS923-1 Asia 923MHz (920~923),TTN AS1. And hit Save&Apply.

Go to the LoRaWAN > LoRaWAN Basic Station tab.

Enter the CUPS URI endpoint URL in the CUPS URI field. Then, choose and upload each of the CUPS trust, Private Key, and Cert pem files as indicated in the screenshot below.

NOTE: ensure Ga

Hit Save&Apply.

AppThing CUPS URI/URL: https://A18SB17XOS4H6A.cups.lorawan.us-east-1.amazonaws.com:443

TROUBLESHOOTING/ERRATA

To troubleshoot the device, it is recommended to use BLE and access the real time log while connected to the device. If an error or other strange behavior occurs, please download the log and submit it to TeraCode for further review.

TROUBLESHOOTING INFORMATION

- Communication Card advertises for 2 minutes after initial boot up
- Device Name is the board's devEUI (devEUI is present on the enclosure information label)
- Bluetooth Characteristics

Name	UUID	Read	Write	Notify	Characteristic Length [Bytes]	Description
AppEUI	0x9f75	X	X		8	8-byte application identifier for LoRa, EUI-64, which is unique enough to be considered globally unique. Example: 0xAE432J4554569874
AppKey	0x9f76	X	X		16	16-byte application key for LoRa device. Example: 0x4568456812311231786456877845
RTC	0x9f77	X	X	X	4	32-bit RTC (real-time clock) for Communication Card Device in epoch (UNIX/POSIX Time) format. Example: 1684778463 (0x646BADDF) for Mon May 22 2023 11:01:03 GMT-0700 (Pacific Daylight Time)
Output Uplink Protocol Version	0x9f78	X			3	Outputs Uplink Protocol Version. The communication card outputs the current Uplink Protocol Version to the App. App calls for read operation by calling 0x9f78. Example is 0x010004 for version 1.0.4. A value of 0x01 signifies an error obtaining the version number.
Output Log	0x9f80	X	X	X	20	The Communication Card Device outputs log information to this characteristic. Log information is the current data in the TOTO UART RX Buffer as received from the connected TOTO device. Writing any value to this characteristic starts notification of the current buffer in 20 byte chunks until the complete buffer is transmitted. Output is the entirety of the TOTO UART RX Buffer. Example: 0x43 23 43 50 69 90 50 69 89 30 4P
LoRaMac Region	0x9f81	X	X		1	Sets the LoRaMac Region. The Communication Card Device outputs the current LoRaMac Region to the App. App calls for read operation by calling 0x9f81. User submits a 1 byte value pertaining to a region in accordance to the table in section "LoRaMac Regions". An example input is 0x08 for region US915.

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