

# Tode-RC

## Users Guide

### Setup and Operation

<http://www.TGit-Tech.com>

Firmware Version: 232H

Last Updated: 2023-02-22



# 1. Contents

## Table of Contents

1. Contents.....	2	4.2 OnOff.....	14
2. Introduction.....	3	4.3 AnaInput.....	14
2.1 Menu Structure.....	5	4.4 AnaOutput.....	15
3. Configure.....	6	4.5 Distance.....	15
3.1 Set Name.....	6	4.6 STSTP3W.....	16
3.2 Radio Settings.....	7	5. Automation (Logic).....	16
3.2.1 Requirements.....	7	5.1 SetPoint.....	16
3.2.2 Per-Digit Setting.....	7	5.2 Math.....	17
3.2.3 Value Setting.....	8	6. System.....	18
3.3 IO HDW Setting.....	9	7. MQTT Control.....	19
3.4 Adding Devices.....	10	7.1 Tode Setup.....	19
3.5 Device Control.....	11	7.2 IoT-Server Setup.....	19
3.6 Add Tode (Remote).....	12	7.2.1 Openhabian.....	19
3.7 Deleting.....	13	7.2.2 Putty.....	19
3.7.1 Deleting Devices.....	13	7.2.3 MQTT Broker & Client.....	20
3.7.2 Deleting Remote Todes.....	13	7.2.4 Serial2MQTT.....	20
3.7.3 Factory Reset.....	13	7.2.5 OpenHab.....	21
4. IO Devices.....	14	A. MQTT /get Value Update.....	22
4.1 Common Settings.....	14		

## 2. Introduction

- ✓ The Tode Project is a Universal Platform of...
  - User Inter-Face Options
  - Back-plane Models optional Radio & Arduino Micro-Controller
  - Extensions - IO Interfaces, Battery Trays

### User Inter-face Options

Model	Components	Resources
#TFT18KB6	1.8" TFT LCD Color Screen + (6) Key keypad	Design Files @ <a href="https://github.com/TGit-Tech/Tode-RC">https://github.com/TGit-Tech/Tode-RC</a>
#COVER	A Cover Only	<i>Not available at this time</i>

### Tode Models (post-fix RC=Remote/Radio Control equipped)

Model	Components
Tode #AMP	Arduino Mega Pro (AtMega2560)
Tode-RC #AMPE32T30	Arduino Mega Pro (AtMega2560) Ebyte E32-433T30D Radio (1W/30dbm)
Tode-RC #AMPE32T20	Arduino Mega Pro (AtMega2560) Ebyte E32-433T20D Radio (250mW/20dbm)
Tode-RC #AMPXBEE	Arduino Mega Pro (AtMega2560) Digi Xbee Radio

### SIO Stations ( Input/Output by Todes Side-IO [SIO] plug )

Model	Components	Resources
#SIOST	Screw Terminals	Design Files <a href="https://github.com/TGit-Tech/Tode-SIOST">https://github.com/TGit-Tech/Tode-SIOST</a>
#SIOAP	Aviation Plugs	<i>Not available at this time</i>



The Tode System is licensed under the MIT License. It's hosted on Github.com at:  
<https://github.com/TGit-Tech/Tode-RC>



2.1 Menu Structure

✓ **Top-Level Menu Structure** ( Introduced at Power-ON )

- Multiple Todes make-up a remote-control-network of Individual Todes.
  - The particular Tode in subject is self-described as **This-Tode**.
- Every Tode has (2) Top-Level Display Screens
  - 1<sup>st</sup> Screen is **This-Tode IO-Control Screen** ( 1<sup>st</sup> screen on Power-ON )
  - 2<sup>nd</sup> Screen is **This-Tode SETUP Screen**
  - 3<sup>rd</sup>, 4<sup>th</sup>, etc.... Screens are Remote Controllable Todes (i.e. Not This-Tode)

<p>1<sup>st</sup> Screen <b>This-Todes IO-Control Screen</b></p> <p>On initial Power-ON this screen is blank because This-Tode hasn't been configured yet.</p> <p>Press Right ➡</p> 	<p>2<sup>nd</sup> Screen <b>This-Todes SETUP Screen</b></p> <p>Where all configuration is done</p> <p>Press Right ➡</p> 	<p>3<sup>rd</sup> , 4<sup>th</sup> , etc. Screens <b>Remote-Todes IO-Control</b></p> <p>Remote Todes</p> <p>On Initial Power-ON the SETUP Screen doesn't change because there are NO other Remote Todes added at this Time.</p>
--	--	---




✓ **Sub-Level Menu Screens** ( From This-Todes **SETUP** Screen )

- Selecting Radio and **GET** will produce Sub-Level Radio Settings.
- Selecting Add Device and **GET** will produce Add a Device Screen.
- Selecting Del Tode and **GET** will produce List of Todes.
- To Exit a Sub-Level Screen press the ⬅ button.

3. Configure

3.1 Set Name

1. Enter a Name for **This-Tode**

<p><b>SETUP</b></p> <p>Press ↵ to the blank [NAME] field. Press SET</p> 	<p><b>SETUP, 'Set Name'</b></p> <p>On 'Set Name' Screen Press ↵</p> 	<p><b>SETUP, 'Set Name'</b></p> <p>Text Entry Field highlights (Blue)</p> 
---	---	--

**Text Entry Field** is Red when not selected else Blue when Selected by ↵↵.  
Once Selected (BLUE) Character Position (WHITE) can be Selected by ⇐⇒

<p><b>SETUP</b></p> <p><b>'Set Name'</b></p> <p>Entering a Name</p> 	<p><b>SETUP</b></p> <p><b>'Set Name'</b></p> <p>Saving &amp; Exiting</p> 	<p><b>SETUP</b></p> 
--	---	---

To Edit or Clear a Character Position; Highlight the Text Field (BLUE) and select the character to replace (WHITE) then choose the replacement character press SET. The BLANK character is directly under the "EXIT".



3.2 Radio Settings

3.2.1 Requirements

- ✓ Radio Settings that **must be identical** for Tode Communication.
- SecNet

Security Code selected by you that prevents unauthorized access to your Tode network.
- (Range 01-7F)
- Frequency

The radio frequency (channel) for Tode Communication.
- (410 to 441)MHz
- ✓ Radio Setting that **must be Unique**
- Address

A radio address to identify each Tode uniquely decided upon by you.
- (Range 0000-FFFE)
- ✓ Other Radio Settings
- Tx Power

Sets the (Tx) Transmitting Power of the Radio.
- (21,24,27,30)dBm

Lower saves power, Higher transmits farther.
- PC Connex

When set to On it ties the radio terminal to the USB Port.
- (On -or- Off)

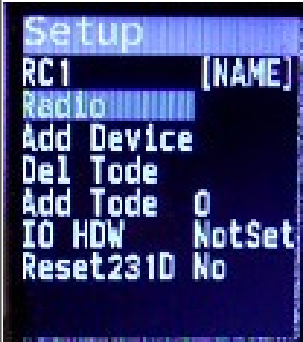
This a special function generally ignored by users.

3.2.2 Per-Digit Setting

1. Choose any **SecNet** Value between 01 to 7F and Set that Value.


SETUP

↓ to select **Radio**.  
Press **GET**




SETUP  
RADIO

↓ to select **SecNet**  
↔ to select **Value**



SETUP  
RADIO (Per-Digit Set)

Press **SET** to change.  
Press **SET** again to set.




**SecNet** and **Address** use **Per-Digit Set** where each digit is changed at a time. The WHITE background indicates the selected digit. Use **↔** to change the selected digit and **↑↓** to change the digits value. Going **↔** beyond the number of select-able digits will exit setting without saving changes.

3.2.2 Configure :: Radio Settings :: Per-Digit Setting Page -7-

- Choose any **\*Unique\* Address** Value for this Tode between 0001 and FFFE and set that Value the same way Per-Digit Set as done to set SecNet.
  - In this example Address is set to 1112.

3.2.3 Value Setting

- Choose any **Frequency** between 410MHz and 441MHz (default is 433MHz).
  - The chosen frequency must be identical on all Todes expected to communicate with each other.




<p><b>SETUP RADIO</b></p> <p>↵ to <b>Frequency</b></p> 	<p><b>SETUP RADIO</b></p> <p>➡ to select <b>Value</b></p> 	<p><b>SETUP RADIO (Value Set)</b></p> <p>Press <b>SET</b> to change.</p> 
<p>⬆ to Increment Value ⬇ to Decrement Value</p> 	<p>Press <b>SET</b> to save Value. ⬅ to <b>Frequency</b></p> 	<p>⬅ again to <b>SETUP</b></p> 

- Choose the lowest **Tx Power** level that will sustain communications.

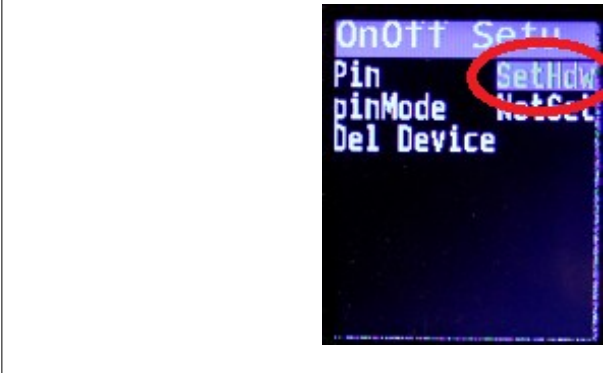


3.3 IO HDW Setting

1. A Tode that has connected devices must know what **IO HDW** is used to connect the devices. If the Tode will be used only as a hand-held control device, then setting the **IO HDW** is not needed.
- a) At the time of this writing the only option for connecting devices is a **SideIO Plug** (SIOST stands for SideIO with Screw Terminals).







<p><b>SETUP</b></p> <p>⇩ to <b>IO HDW</b></p> 	<p><b>SETUP</b></p> <p>⇨ to select <b>Value</b> (I.e. 'NotSet' in picture)</p> 	<p><b>SETUP</b></p> <p>SET then ↑ or ⇩ select <b>SideIO</b> SET to set the value</p> 
---	--	---

2. **NOTICE:** If the **IO HDW** has not been set before trying to set a device **PIN** the Tode will notify you with **SetHDW** as shown below.



3.4 Adding Devices


See 5.1 Section for more information on Device Support and Setup.



<p><b>SETUP</b></p> <p>↑ or ↓ select <b>Add Device</b> Press <b>GET</b></p> 	<p><b>SETUP</b> <b>Add Device</b></p> <p>↑ or ↓ Select Device to Add. Press <b>GET</b></p> 	<p><b>This-Tode</b></p> <p>The added device appears as <b>?NAME?</b> <i>0 is the Device Index #</i></p> 
<p><b>This-Tode</b> <b>Select Device</b></p> <p>↓ select 0?NAME?</p> 	<p><b>Selected Device</b> <b>SET=Device Set Name</b></p> <p>Press <b>SET</b> enter Set Name for the Device. <i>Same routine as setting a Tode <u>name</u>.</i></p> 	<p><b>Selected Device</b> <b>GET=Device Setup</b></p> <p>Re-Select Device. Press <b>GET</b> enter Setup <i>Enter Device specific Setup Settings (Ex. Only)</i></p> 
		<p><b>Note: OLOff</b> <b>Output Low, when Off</b></p>

### 3.5 Device Control

Below shows an example of how to change an Output Device's State.



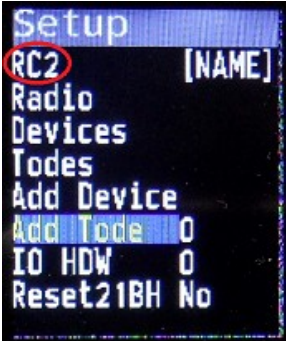


This can be done on LOCAL (This-Tode) devices or devices on Remote Todes.  
To add a Remote Tode see [3.6.Add Tode \(Remote\)](#)

NOTE: Remote Tode Devices will show a value of '?' until the readings are requesting by pressing .

<p><b>This-Tode</b></p> <p>↓ select <b>RELAY1</b> → to select <b>Value</b> Value 'Off' Press <b>SET</b></p> 	<p><b>This-Tode</b></p> <p><b>SET</b> to set a new value. ↑ ↓ change <b>Value</b> <b>SET</b> to set the value</p> 	<p><b>This-Tode</b></p> <p>Once set to 'On' Relay1 on pin 33 should activate.</p>
---	---	---

3.6 Add Tode (Remote)

- ✓ To Remotely Control another Tode's Devices.
  - The "Remote" Tode (RC1 with RELAY1:IO-Device used this far)
  - is added to a new Tode (RC2)
- ✓ Obtain a 2<sup>nd</sup> Tode
  - Repeat Steps [3.1.Set Name](#) and Name the 2<sup>nd</sup> Tode **RC2**
  - Assign a \*Unique\* Radio Address to RC2

RC2 Radio Settings	Required	RC1 Radio Settings
	<p><b>SecNet</b> has to Match.</p> <p><b>Address</b> must be different / unique.</p> <p><b>Frequency</b> has to Match.</p>	
On Tode RC2		
<p>↩ select <b>Add Tode</b></p> 	<p>add <b>RC1</b> by <b>Address</b></p> <p>↩ to select <b>Value</b></p> <p><b>SET</b> to set RC1-Address</p> 	<p>Check for an <b>RC1</b> "remote" Tode Screen.</p> <p><b>SET</b> Again to load RC1</p> <p>↩ RC1 remote Screen</p> 
<p>Now the Devices on RC1 can be controlled by RC2.</p> <p>If the "remote" Tode RC1 failed to show up; try again closer to the unit.</p>		

3.7 Deleting

3.7.1 Deleting Devices




To Delete a Device enter the Device Setup Screen as shown in [3.4.Adding Devices](#) and select **Del Device** and press **GET**.

3.7.2 Deleting Remote Todes

To Delete a Remote Tode control screen. Select **Del Tode** on the SETUP menu and then select the Remote Tode by Name on the list and press **GET**.

3.7.3 Factory Reset

Preforming a factory reset deletes the Tode Name and all Devices and Remote Todes. Radio Setting are preserved. To preform this operation...


<div>↵ select <b>Reset????</b></div> <div><b>Note:</b> The 4-Digit after Reset is the Firmware Version Loaded.</div> <div>Firmware 231D</div>	<div>⇨ to select <b>Value</b></div> <div>SET  to set</div> <div>↵ to set <b>Yes</b></div> <div>SET  again to apply.</div>	<div>The Tode will automatically Reboot and the blank Tode screen will show.</div>
		


4. IO Devices

4.1 Common Settings

- ✓ Every Device Setup has a **Del Device** option.
- ✓ Every **Pin** has a corresponding **pinMode** option.
  - **OLoOff** = Output Low, when Off – Active High
  - **OHiOff** = Output High, when Off – Active Low
  - **InHigh** = Input Pull-Up(High) – Active Low
  - **InLow** = Input Low – Active High (Default Setting)


4.2 OnOff



On Off Device Setup Screen	
Pin	Can be any Pin Selectable
pinMode	See pinMode options in <a href="#">#4.1.Common Settings</a>
Del Device	Select and  to delete this device

4.3 AnalInput


The equation for Value = (Pin-Reading + PreAdd) \* (MultNum/MultDen) + Add.  
MultDen cannot be 0 so 0 equivocates to 10K (10,000)



On Off Device Setup Screen	
Pin	The Pin to read from (must be an 'A' pin)
pinMode	
PreAdd	1 <sup>st</sup> Add this amount to the Pin reading.
MultNum	2 <sup>nd</sup> Multiplv by fraction (Fraction Numerator)
MultDen	(Fraction Denominator)
Add	3 <sup>rd</sup> Add after fraction multiply (i.e. offset value)
Samples	Number of reading to qather and average for value.




4.4 AnaOutput

	<b>AnaOutput is the PWM output operation</b>	
	Pin	Analoq Output is Always on PIN #45


4.5 Distance

This is used for Sonic Distance Sensors with a Trigger & Echo Pins.

	<b>Distance Device Setup Screen</b>	
	Triq	The Triqqer Pin
		The Triqqer Pins pinMode
	Echo	The Echo Pin
	EchoPMode	Echo Pins pinMode
	Samples	Number of Samples to Average for Value

4.6 STSTP3W

This is used for panels with a START and STOP momentary push buttons.

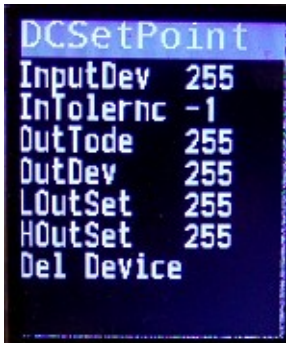
	<b>3-Wire On/Off Momentary (3-second) Switch</b>	
	StartPin	OUTPUT hat triqqers to initiate a START button.
	StartPMode	StartPin pinMode Setting
	StopPin	The Pin that triqqers to initiate a STOP button.
	StopPMode	StopPin pinMode Setting
	Status	INPUT; Pin that determines current state.
	StatPMode	Status Pins pinMode
	Del Device	Select and <b>(GET)</b> to delete this device

5. Automation (Logic)

5.1 SetPoint


Compares an Input Device reading to a User SetPoint and if the Input reading is outside the boundaries (+/- Tolerance) then it sets an Output Device respectively.

For example; A tank of water with a level sensor can maintain it's water level by switching ON or OFF a pump that feeds the tank.

	<b>On Off Device Setup Screen</b>	
	InputDev	The Device Index to read a value from
	InTolernc	The (+/-) tolerance allowed from setpoint
	OutTode	The Tode Index of Out Device (optional) or 0-local
	OutDev	The Device Index to SET the value on (optional)
	LOutSet	SET value on OutDev when Input is < setpoint
	HOutSet	SET value on OutDev when Input is > setpoint
		SET value can be ON or OFF
		Or INCR/DECR where Difference between setpoint

5.2 Math


Implements Mathematical Operation on TWO input readings and (Optionally) sends the computed value to an output device if the value breaks tolerance (+/-) boundaries (i.e. Value changes significantly).

	<b>On Off Device Setup Screen</b>	
	In1Dev	The Device Index to read a value from
	Operator	(+)(-)(x)(/) plus, minus, times, divide or AVE-average
	In2Dev	The Device Index to read a value from
	Tolerenc	+/- Change Tolerance before setting Output
	OutTode	The Tode Index of Out Device (optional) or 0-local
	OutDev	The Device Index to SET the value on (optional)

Note: When OutTode is a Remote Tode; values are only sent every 14s when the In-Value passes +/- Tolerance of the last sent value.

# 6. System

The System menu allows one to do factory resets, enable MQTT, Soft Reset the unit and lookup the firmware version loaded. Pressing the Okay button on the FWver-???? entry causes the Soft Reset.

	System Sub-menu	
	USBSerial	What the Top USB plug is used for (auto-reboots)
	Factory RST	Factory Reset
	Pub ADiscv	Publish homie MQTT data for Auto-Discovery
	SRFWv-????	Soft Reset. Displays current Firmware version.

- ✓ **USBSerial** allows (3)options
  - **NOTICE:** *Changing the USB-Serial use causes an auto-reboot to occur.*
    - **None** = There is no USB Serial Usage (option for debugging)
    - **MQTT** = Tode uses USB Serial to communicate with MQTT Server.
    - **KBC** = Keyboard Control by Serial Input. (For Automated Testing)
      - 8=up                      9=Set
      - 4=left, 6=right
      - 2=down                  3=Get
- ✓ **Factory RST** erases all Todes and Devices and User-Settings.
- ✓ **Pub ADiscv** publishes 'homie' auto-discovery MQTT on-demand.
  - only works when USBSerial=MQTT.
- ✓ **SRFWv** preforms a soft (no-erase) reset on-demand and also displays the loaded firmware version. It can be used to reset without power-cycling after making a new setting for USBSerial or any reason to do just a soft-reset.

## 7. MQTT Control

Tode-RC firmware ver.232D+ has support for 'homieMQTT' Internet of Things(IoT) control using the Serial plug to connect a Tode to a Raspberry Pi IoT server.

### 7.1 Tode Setup

In SETUP→System→USBSerial set to 'MQTT'.

See [6.System](#) for details.



### 7.2 OpenHab Server Setup

#### 7.2.1 Openhabian

Download Raspberry-Pi Imager at <https://www.raspberrypi.com/software/>

When you run it; It'll ask for...

1. Operating System: scroll down and click "Other specific-purpose OS"
  - Pick & Click "Home assistants and home automation"
  - Pick & Click "openHAB"
    - Pick 32-bit as OpenHAB states use 32-bit; works best.
    - Storage: Choose the Flash-Card Target.
2. Insert Card into Raspberry-Pi and attach an Ethernet Cable
  - Power the Raspberry Pi and wait a while for boot up process.
  - Connect to the openHAB UI at <http://openhabian:8080>

- This may take up to 45-Minutes to become available
- May have to use MS-DOS ">arp -a" command to find it's IP-Address
- Enter an administrator Username and Password on Startup.
- Connect to the openHAB Log Viewer (frontail): <http://openhabian:9001>

## 7.2.2 Putty

### 3. Install PuttySSH Terminal on a Home PC.

- See: <https://putty.org/>
- Run the Putty terminal
  - Click on Connection Type: **SSH**
  - Enter Host Name: **openhabian**
  - click **open**.
- Login
  - Username: openhabian
  - Password: openhabian

## 7.2.3 MQTT Broker & Client

### 1. Login to the Server computer (Raspberry Pi) using 'Putty' terminal.

- Install the MQTT Broker (Mosquitto) on the Raspberry Pi.
  - See: <https://community.openhab.org/t/oh3-mqtt-setup-and-configuration/111494>

```
openhabian:~$ sudo apt install mosquitto
openhabian:~$ sudo systemctl start mosquitto
openhabian:~$ sudo systemctl daemon-reload
openhabian:~$ sudo systemctl enable mosquitto
```
- Also install MQTT Client (mosquitto-clients) on the Raspberry Pi.
 

```
Openhabian:~$ sudo apt-get install mosquitto-clients
```
- Visit the above link for enabling outside IP connections if desired.

### 2. Test the MQTT broker setup with mosquitto-clients.

- Login with a 2<sup>nd</sup> putty terminal and enter
 

```
openhabian:~$ mosquitto_sub -v -t 'test/topic'
```



b) On the 1<sup>st</sup> putty terminal send an MQTT publish  
`openhbian:~$ mosquitto_pub -t 'test/topic' -m 'helloWorld'`

verify that the (-m)message 'helloWorld' appears on the 2nd terminal.

✓ Online Instructions for installing an MQTT broker on Raspberry Pi.

○ <https://www.openhab.org/addons/bindings/mqtt/>

## 7.2.4 Serial2MQTT

### 1. Install serial2mqtt

○ See: [https://github.com/TGit-Tech/Tode-RC-Firmware/tree/main/serial2mqtt\\_build](https://github.com/TGit-Tech/Tode-RC-Firmware/tree/main/serial2mqtt_build)

```
openhbian:~$ wget https://raw.githubusercontent.com/TGit-Tech/Tode-RC-Firmware/main/serial2mqtt_build/serial2mqtt.arch.zip
```

```
openhbian:~$ wget https://raw.githubusercontent.com/TGit-Tech/Tode-RC-Firmware/main/serial2mqtt_build/serial2mqtt.json
```

```
openhbian:~$ unzip serial2mqtt.arch.zip
openhbian:~$ mv Debug/serial2mqtt.arch serial2mqtt
```

### 2. Setup crontab to auto-run serial2mqtt at start-up

○ Start the crontab editor

```
openhbian:~$ crontab -e
```

○ Edit the file adding the following line at the bottom of the file.

```
@reboot /home/openhabian/serial2mqtt
```

be sure to save / write changes to file.

### 3. Check operation

a) Reboot (Power-Cycle) the Raspberry Pi Server.

b) Make sure 'serial2mqtt' starts after Raspberry Pi reboot

```
openhbian:~$ ps -x
```

PID	TTY	STAT	TIME	COMMAND
347	?	Ss	0:00	/bin/sh -c /home/openhabian/serial2mqtt
348	?	Sl	0:01	/home/openhabian/serial2mqtt

c) View the 'serial2mqtt' logfile

```
openhbian:~$ tail -f log.serial2mqtt.0.log
```

d) For debugging; you can launch 'serial2mqtt' from the command line.

```
openhbian:~$ ~/serial2mqtt
```

e) Attach Tode to the Raspberry Pi by USB cable.

- Watch the 'serial2mqtt' log file as it connects and publishes data.

## 7.2.5 OpenHab

Inside OpenHab you can now add the MQTT binding which also requires an MQTT thing. Once the Tode publishes it's 'homie' MQTT data the first time a 'tode' thing will show up in the 'inbox' feature.

However; due to OpenHab bugs after a 'tode' thing has been added one must instruct the Tode to send the 'homie' data a second time. Go to Tode's SETUP menu, to 'System' menu and select 'Pub ADiscv' (stands for Publish Auto-Discovery data) and push the Okay button.

Only after OpenHab has received the 'homie' data a second time will the 'channels' show up. The rest of OpenHab setup should be instructed in the OpenHab guide.

The Tode publishes MQTT in the form of homie/tode/todename/devicename (gets) + /set for (sets).

It also publishes MQTT in the form of homie/tode/tstodename/tsdevicename where the 'ts' prefix stands for timestamped status. 'ts' channels are for (gets) only and appends a hexadecimal millisecond timestamp to the gotten value. ( example; ON-2fe3a1). Using OpenHab label card to show this (gotten) value ensures that the sets are preformed correctly. Watch that the timestamp changes after setting a new value.

### A. MQTT /get Value Update

Once Widgets are setup to turn things on and off.

Using a Label Card to display "ts" values.

1. Get the UID of the MQTT Broker by clicking the 'Copy UID' symbol.

2 things

Alphabetical

By binding

M

MQTT Broker

Copy UID

ONLINE >

mqtt:broker:58b97f2f4b

T

tode

ERROR: COMM >

mqtt:homie300:58b97f2f4b:tode

## 2. Create New script named mqttGet

a) Use 'ECMAScript'

b) actions.get("mqtt","mqtt:broker:58b97f2f4b").publishMQTT("homie/tode/1com6/get","")

c) Paste your MQTT Broker UID in second get() parameter. And adjust the publish MQTT for the 'TodeName' for the /get.

## 3. Setup the Label Widget to run the 'GetScript' when clicked.

a) Under Action choose 'Run rule'

b) Click Rule and select 'mqttGet' for the 'script name'.

