Amazon ACK HMCU
On NuMaker-M032SE

www.nuvoton.com
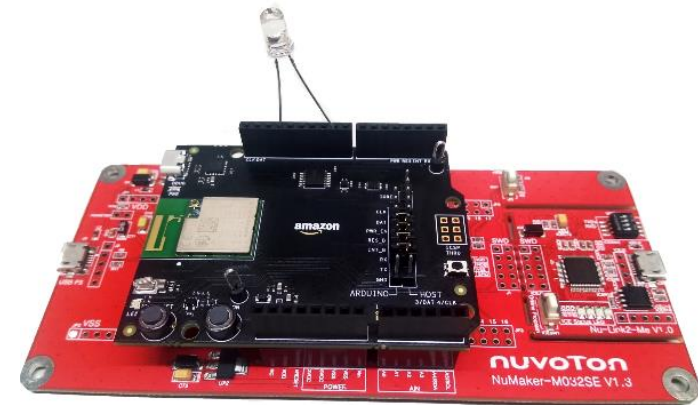
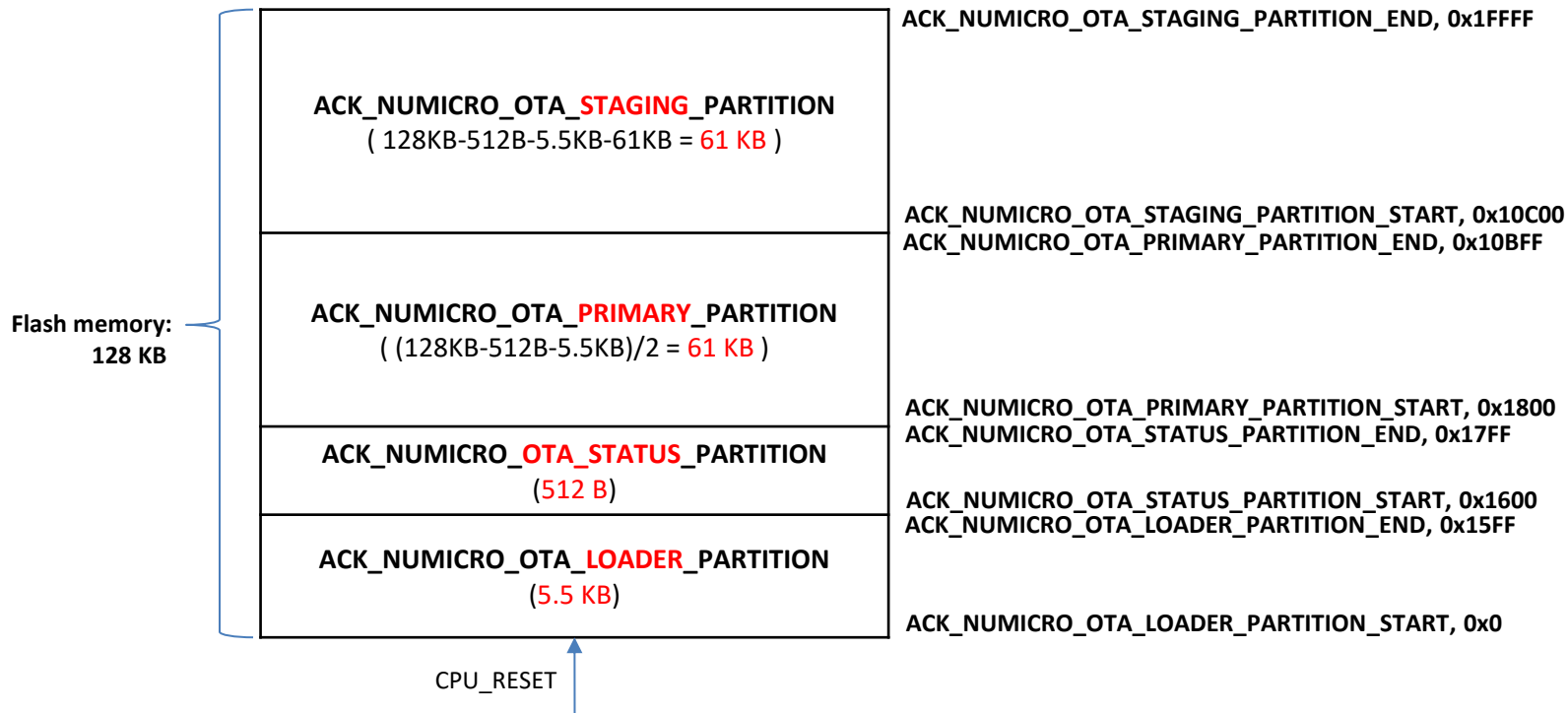**MS70 Wayne Lin**

2021/10/18

- **Introduction**
- **Partition layout, Boot flow & OTA upgrading**
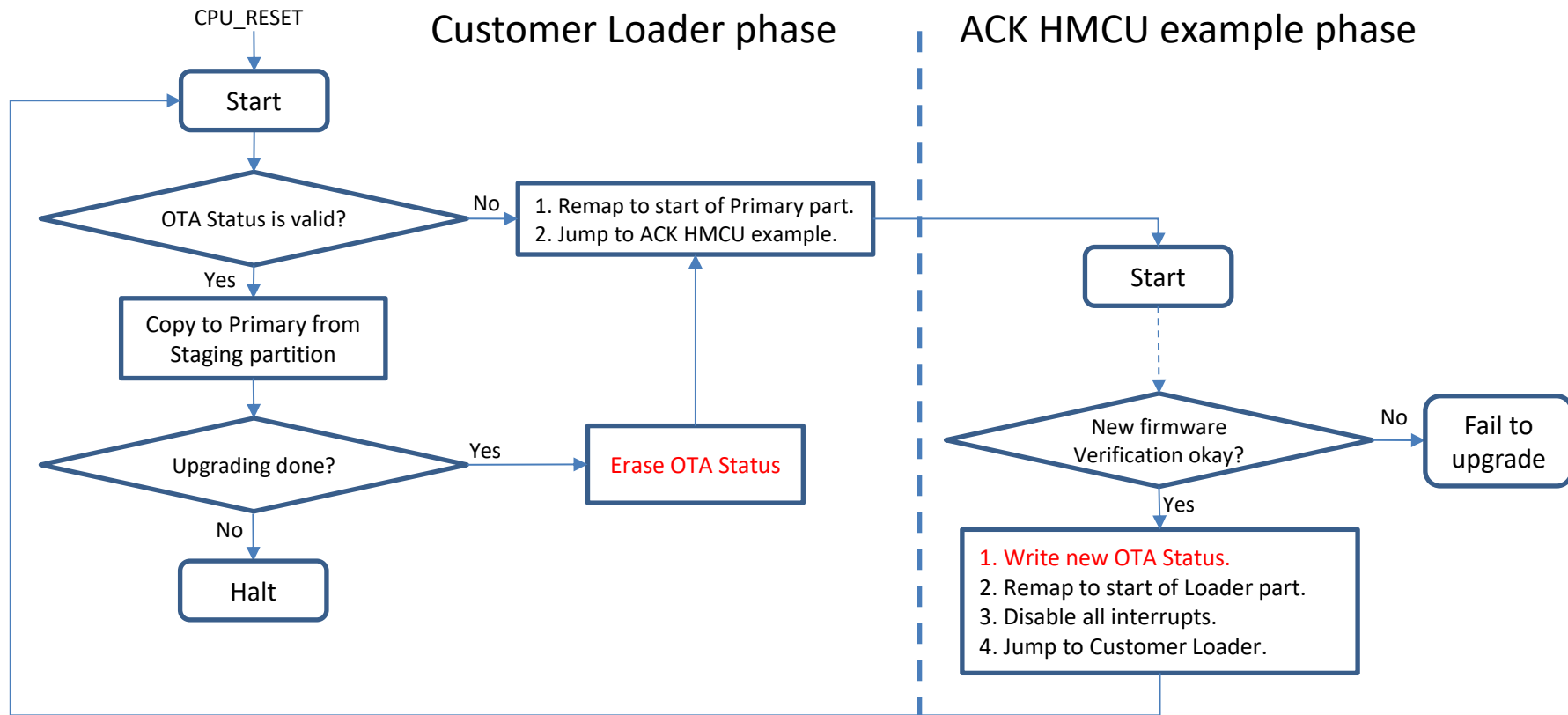- **Demo**
- **Some notes**

Introduction

- **ACK – Alexa Connect Kit**
- **An Amazon-managed solution that makes it simpler, faster, and more economical to create and manage Alexa-controlled, Wi-Fi-enabled smart devices.**

  - ACK module

  - High-reliability/Low-latency device control cloud

  - ACK Management Console

  - Extensibility APIs

  - Dash Replenishment Service

Partition layout

ACK_NUMICRO_OTA_STAGING_PARTITION_END, 0x1FFFF

ACK_NUMICRO_OTA_STAGING_PARTITION
(128KB-512B-5.5KB-61KB = 61 KB)

ACK_NUMICRO_OTA_STAGING_PARTITION_START, 0x10C00
ACK_NUMICRO_OTA_PRIMARY_PARTITION_END, 0x10BFF

**Flash memory:
128 KB**

ACK_NUMICRO_OTA_PRIMARY_PARTITION
((128KB-512B-5.5KB)/2 = 61 KB)

ACK_NUMICRO_OTA_PRIMARY_PARTITION_START, 0x1800
ACK_NUMICRO_OTA_STATUS_PARTITION_END, 0x17FF

ACK_NUMICRO_OTA_STATUS_PARTITION
(512 B)

ACK_NUMICRO_OTA_STATUS_PARTITION_START, 0x1600
ACK_NUMICRO_OTA_LOADER_PARTITION_END, 0x15FF

ACK_NUMICRO_OTA_LOADER_PARTITION
(5.5 KB)

ACK_NUMICRO_OTA_LOADER_PARTITION_START, 0x0

CPU_RESET

Boot flow & OTA upgrading

Customer Loader phase ┊ **ACK HMCU example phase**

CPU_RESET

Start

OTA Status is valid? — No → 1. Remap to start of Primary part. / 2. Jump to ACK HMCU example.

Yes

Copy to Primary from Staging partition

Upgrading done? — Yes → Erase OTA Status

No

Halt

Start

New firmware Verification okay? — No → Fail to upgrade

Yes

1. Write new OTA Status.
2. Remap to start of Loader part.
3. Disable all interrupts.
4. Jump to Customer Loader.

Demo

- **Requirements**
- **Driver Installation**
- **Build Steps**
- **HMCU Board Setting**
- **ACK HMCU Firmware Installation**
- **ACK HMCU Boot Option Configuration**

Requirements

- **Hardware**

  - An ACK module board (USI MT7697H development kit)

  - An development board for ACK HMCU (NuMaker-M032SE board)

  - An internet-accessible **2.4G** Wi-Fi router

  - A mobile phone with Alexa APP

  - A LED, a dupont line and an USB Micro line

- **Software/Drivers**

  - Keil MDK 5.26

  - Latest Nu-Link Keil drivers

  - Python-3.8 environment

Driver Installation

- **Install "Nu-Link Driver for Keil" on Window platform**

  - Nuvoton provides installshield wizard to help user to install these utilities for keil.

  - It also includes a Nu-Link USB Driver. Please install it for MDK-ARM debugger and Nuvoton virtual COM(VCOM) function.
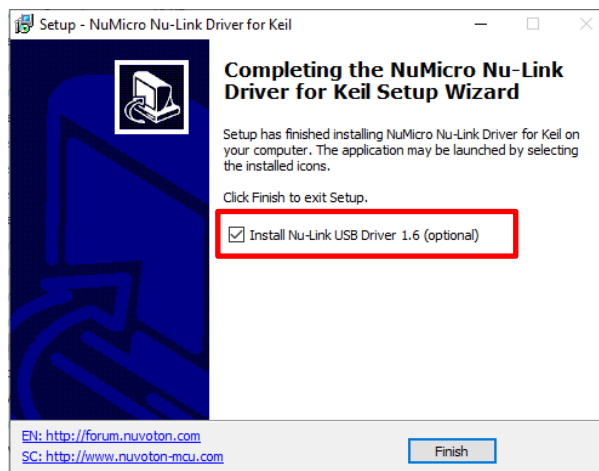
Build Steps

- **Open ack.uvmpw Keil multiple project file using MDK 5.26.**
  - Path: <Path-to-ACK_Device_SDK>\user\platform\numicro_m031\numaker-m032se\ack.uvmpw
- **Press "Batch rebuild" to build all examples.**
- **Finally, execute "ack_hmcu_fw_merge.bat" to merge customer_loader and example into a hex file.**
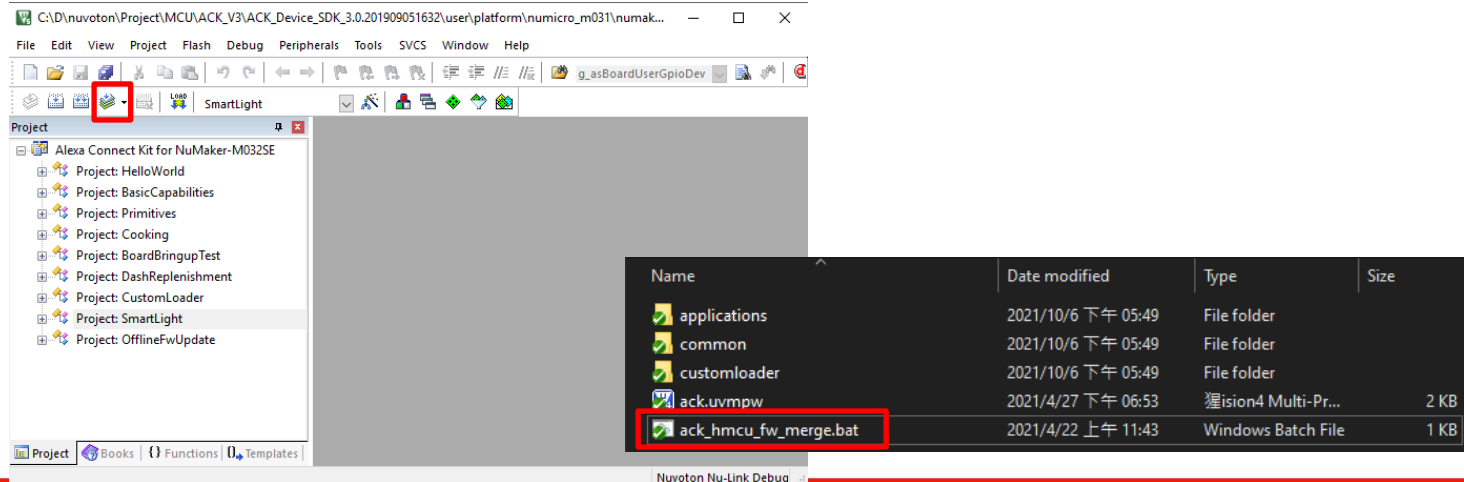
Python Installation

- **Python 3.8** or later is required, with the following optional modules (install with pip): intelhex, protobuf, pyserial.

    - Download: https://www.python.org/ftp/python/3.8.6/python-3.8.6-amd64.exe

    - The **intelhex** is *MUST* before you executing the **m031_merge.bat** script.

    - To execute '**pip install intelhex**' in command line window.

    - Remember to add python execution to **PATH** variable.

ack_hmcu_fw_merge.bat

- **This is batch script for window platform. Help user to get all merged firmwares for programming, just a double-click step.**

- **It invokes some python utilities Amazon provided**

  - For producing a merged firmware for NuMicro MCU.

  - **For OTA upgrading file for publishing on Amazon Cloud.**

    - **Please remember to modify the device type for yours.**

HMCU board Setting

- **Switch Pin 1 and pin 2 of VCOM(ICESW2) on Nu-Link2-Me to "ON" position.**

- **Bridge USB micro line between Nu-Link2-Me and PC.**

- **After that, PC will show a "NuMicro MCU" disk on Window file manager.**
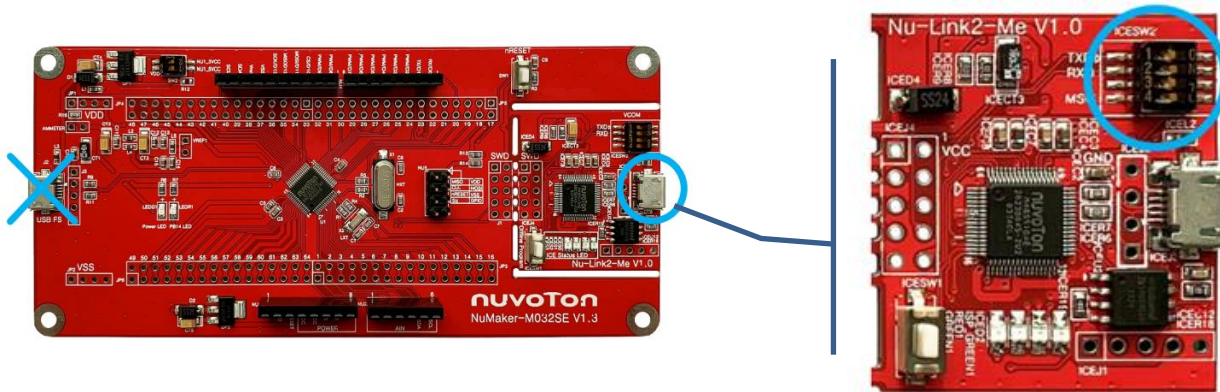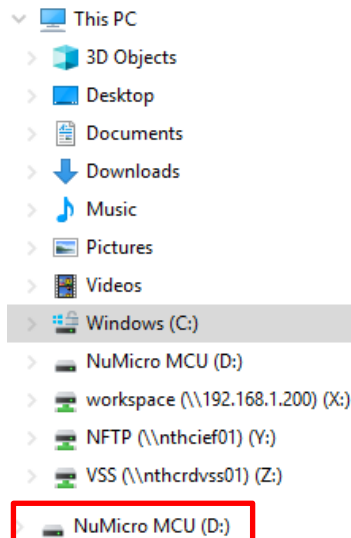

- **Nu-Link2-Me firmware upgrade guiding**

    - Please find out Chapter 5 of 'NuMicro Cortex-M Keil ICE driver user manual.pdf' in installed Nu-Link_Keil driver folder - C:\Program Files (x86)\Nuvoton Tools\Nu-Link_Keil\.
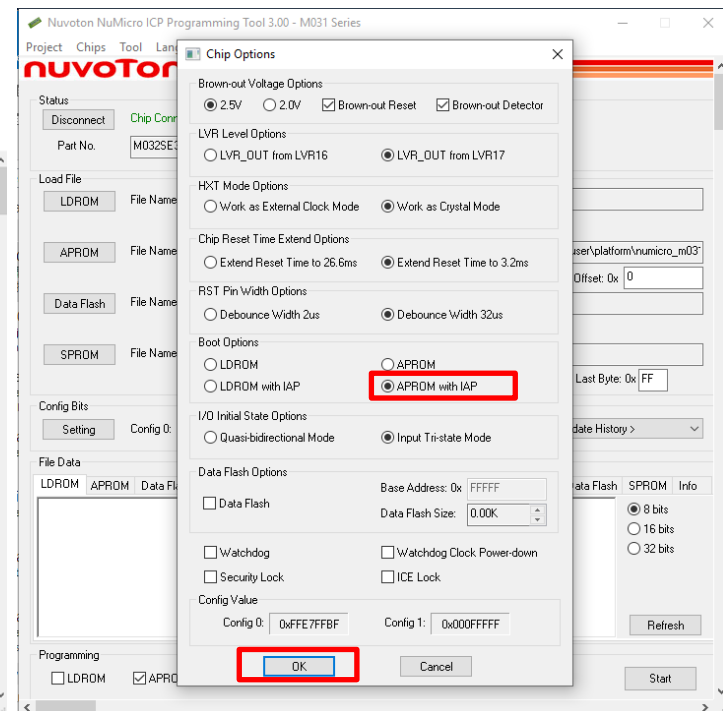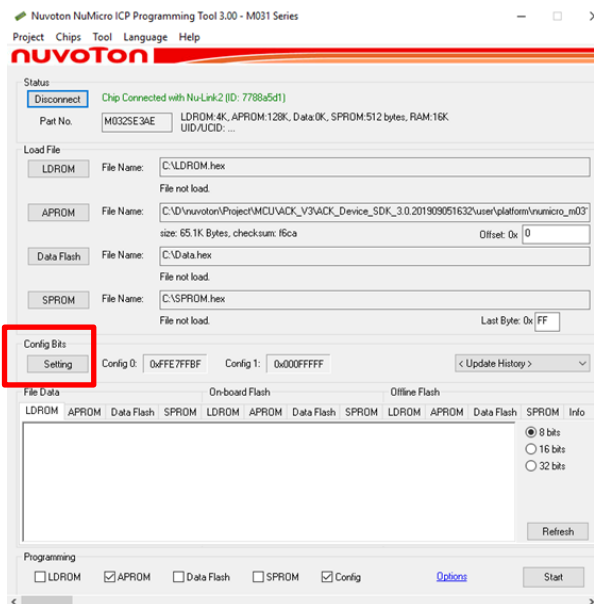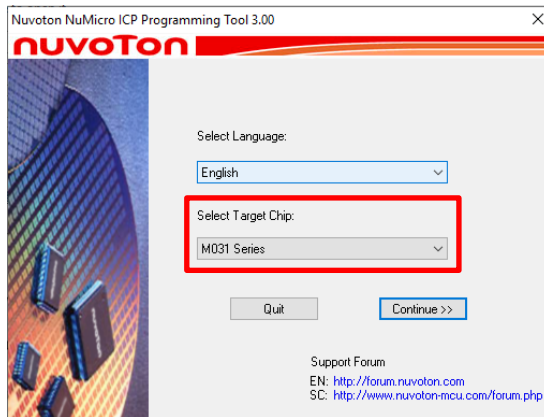
ACK HMCU Firmware Installation

- **Drag-and-drop firmware into "NuMicro MCU" disk.**

  - The firmware includes a bootloader and an ACK example in a .hex file is merged by hexmerge.py.

 - After copying finished, firmware installation is done.

ACK HMCU Boot Option Configuration

- **Configure "Boot Options" is in "APROM with IAP" mode using ICP programming Tool.**
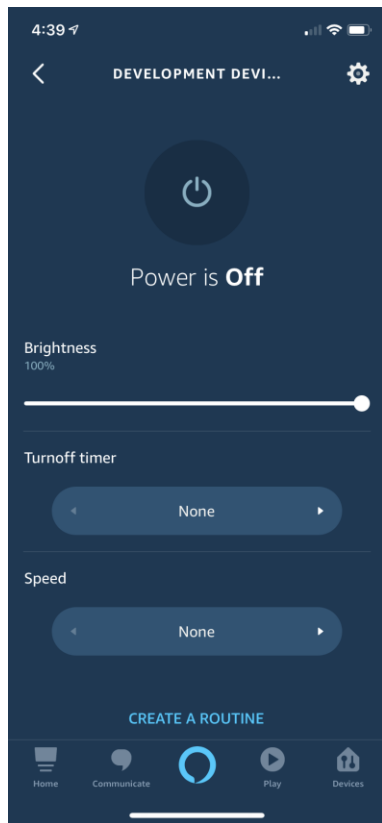
Wiring and Alexa APP

- **Mount ACK connectivity board on Arduino shield of NuMaker board.**
- **Connect a LED to D9(+) and GND(-).**
- **Use terminal utility to see Log**
  - Open window device manager to get Nuvoton VCOM COM port number.
  - UART communication setting is **115200N81**.
- **Associate with an Internet-accessible Wi-Fi router**
- **Install Amazon Alexa APP in your mobile device**
  - Got an Amazon account to login.
  - Make sure the APP version number is latest.

GND(-)   D9(+)
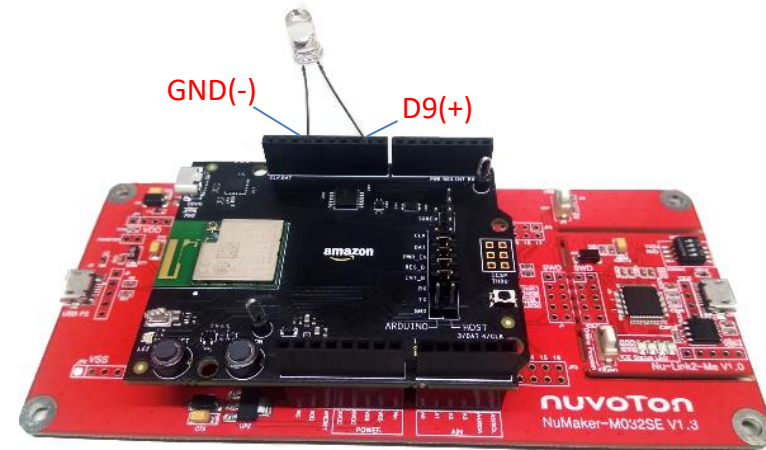
Alexa APP controlling

- **You can use Alexa APP to set smart-light functions**

  - **Press Turn-on/off button**

    - LED will be turn-on/off.

  - **Slide brightness bar to [1-100] percent.**

    - LED light brightness will be adjusted.

  - **Select speed option to none/low/medium/high.**

    - LED blink speed will changed to none/low/medium/high.

  - **Select Turnoff timer option to none/5mins/10mins/1hours.**

   - LED will be turn be after specified time.

Speech controlling

- **Golden utterances**

  - https://developer.amazon.com/zh/docs/device-apis/alexa-brightnesscontroller.html

- **You also can talk to Alexa APP below commands.**

  (Renamed development board to light)

  - **Alexa, turn-on light**

  - **Alexa, turn-off light**

  - **Alexa, set turn off timer to five minutes. (none/5minutes/10minutes/1hour)**

  - **Alexa, set the speed to low on light. (none/low/medium/high)**

  - **Alexa, set light to fifty percent. [1-100%]**

To Restore factory setting

- **You can use a dupont line to short A0 to GND over 5 seconds to enter restoring factory setting mode.**

  - After restoring, all settings on ACK module will be cleared. So, you need to register ACK module again.


GND A0
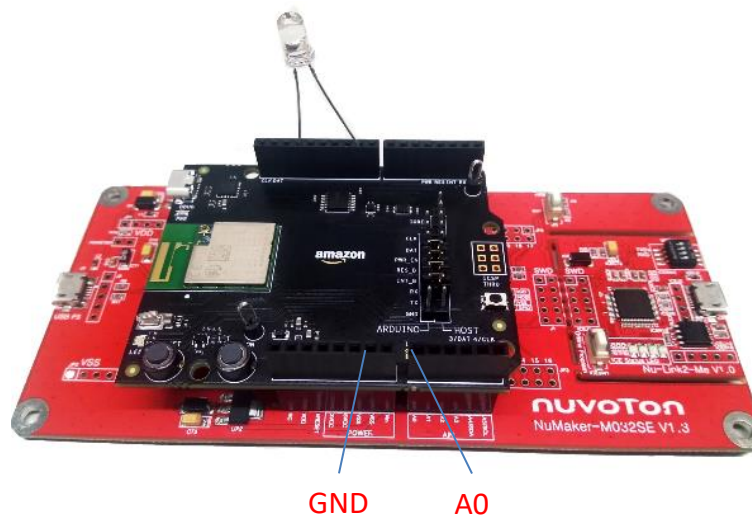
HMCU firmware version control

- **You can modify ACKUser_GetFirmwareVersion function to do version control. This version number is for ACK HMCU firmware OTA upgrading.**

  - PATH: <PATH-TO-ACKDeviceSDK>\user\platform\numicro_m031\ack_user_device.c

  - We use building-date-time to implement the function.

  - You need to publish new version number and HMCU firmware on Amazon cloud.

Offline OTA Validation

- **Amazon engineer develops an ACK module simulator using python language. This is without ACK module connective, just connect HMCU board with an USB2Serial dongle.**
    - Path: <Path_To_ACK_Device_SDK>\test\validation\validate-ota.py
- **More details, you should follow steps in readme.txt file.**
    - Path: <Path_To_ACK_Device_SDK>\test\validation\readme.txt

- **Wiring**
    - HMCU_UART_TX -- USB2Serial_RX,
    - HMCU_UART_RX -- USB2Serial_TX
    - HMCU_HOSTINT -- USB2Serial_RTS
    - HMCU_RESET   -- USB2Serial_CTS
    - HMCU_GND   -- USB2Serial_GND
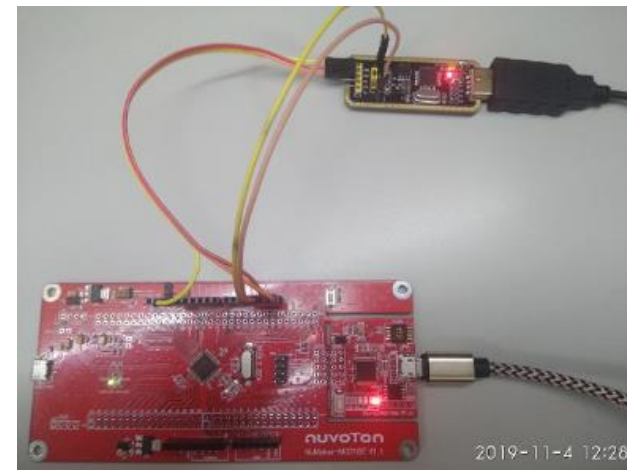
m031_offline_ota.bat

- **This is batch script for window platform. It can help user to do ACK HMCU offline OTA validation.**

- **Hint: Before do the batch script, you should finished steps in previous 'Offline OTA validation' slide.**

- **Set timeout thresholds**

  - If your xxxxx.ota file size is bigger, you should enlarge the timeout thresholds in validate-ota.py for firmware downloading and applying.

  - For smartlight.ota example, we enlarge the **HMCU_OTA_COMPLETE to 30** and **RESTART_DEVICE to 10** seconds.

- **Execute**

  - Execute m031_offline_ota.bat, then press reset button on board.

  - Wait validation done, then see report .

```
77        ackModule.SetOtaImage(otaImage, args.force)
78        orchestrator.WaitForMarkers(
79            Marker(MarkerKind.HMCU_OTA_COMPLETE),
80            timeout = 30,
81            description = STR_SCRIPT_STEP_ADVERTISE_OTA)
82
83        orchestrator.WaitForMarkers(
84            Marker(MarkerKind.HMCU_OTA_RESTART_DEVICE),
85            timeout = 10,
86            description = STR_SCRIPT_WAIT_FOR_OTA_APPLY)
```

ACK development kits

- **Please visit Amazon ACK official page**

  - https://developer.amazon.com/en-US/alexa/connected-devices/alexa-connect-kit/dev-kits

MO31 Series Resources

- **Link to Keil tools for Nuvoton NuMicro**

  - http://www2.keil.com/nuvoton/M0-M23

- **Technical reference manual**

  - http://www.nuvoton.com/resource-files/TRM_M031_Series_EN_Rev1.03.pdf

- **Development board user manual**

  - http://www.nuvoton.com/resource-files/UM_NuMaker-M032SE_EN_Rev1.00.pdf

- **Latest Nu-Link Keil driver download**

  - https://www.nuvoton.com/opencms/resource-download.jsp?tp_GUID=SW0520101208200142

- **Latest ICP Programming tool download**

  - https://www.nuvoton.com/resource-download.jsp?tp_GUID=SW1720200221181328