

Amazon ACK HMCU On NuTiny-M4521S

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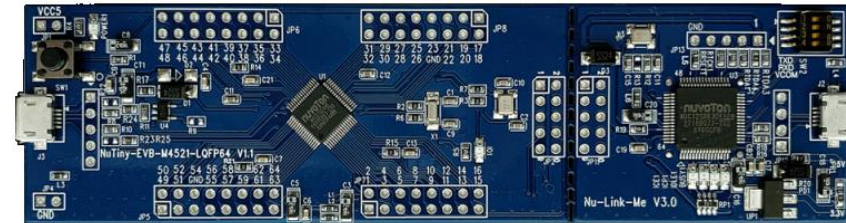
MS70 Wayne Lin

2021/4/28

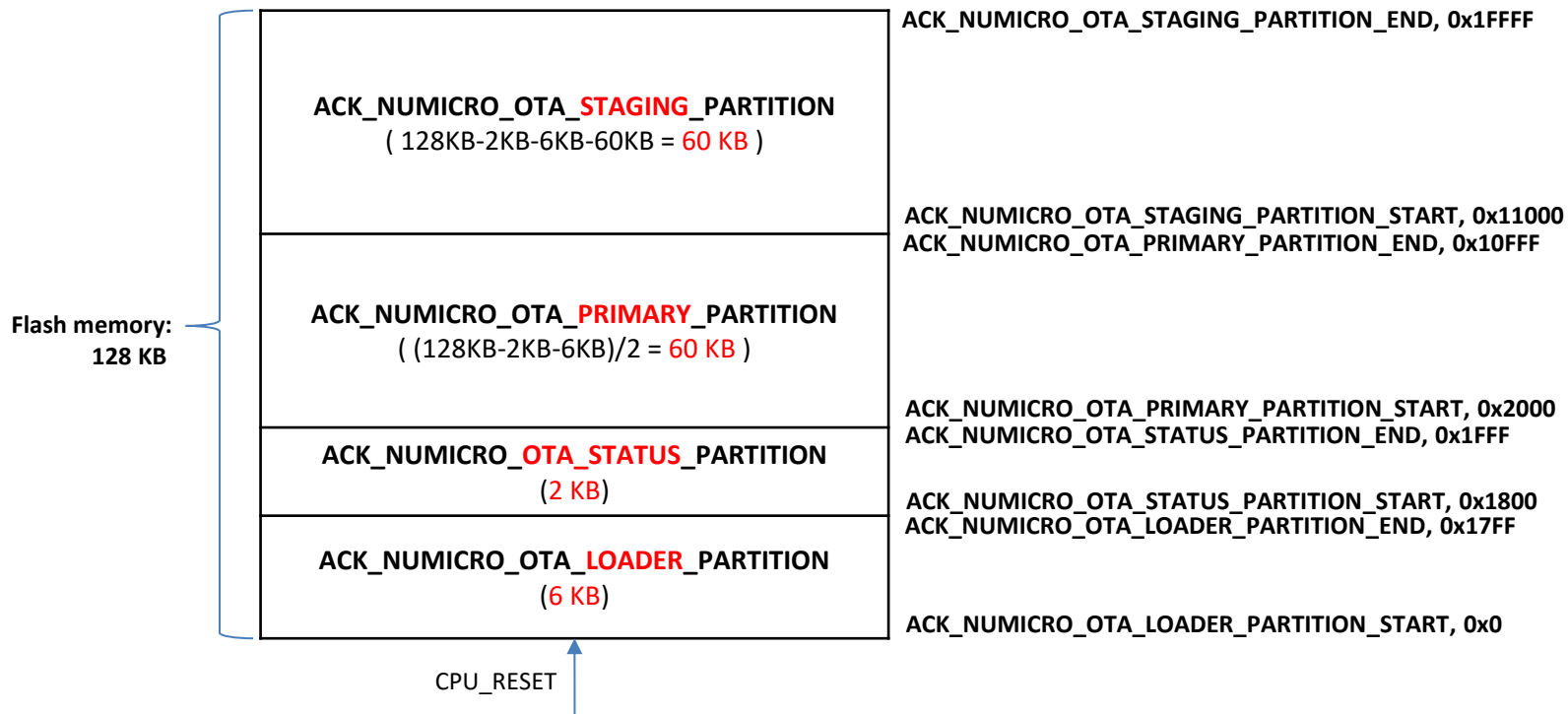
- **Introduction**
- **Partition layout, Boot flow & OTA upgrading**
- **Demo**
- **Some notes**

Introduction

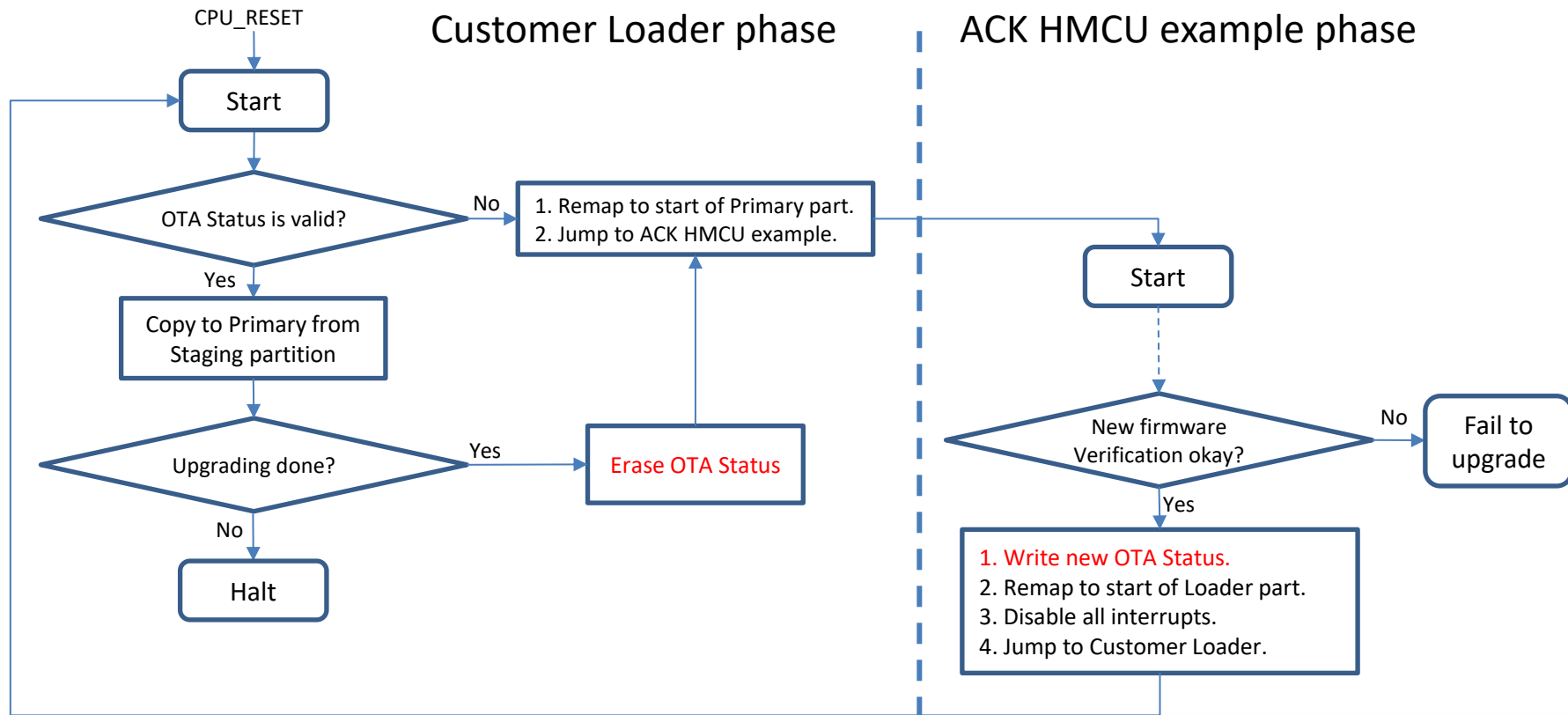
- **ACK – Alexa Connect Kit**
- **An Amazon-managed solution that makes it simpler, faster, and more economical to create and manage Alexa-controlled, Wi-Fi-enabled smart devices.**
 - ACK module
 - High-reliability/Low-latency device control cloud
 - ACK Management Console
 - Extensibility APIs
 - Dash Replenishment Service



Partition layout



Boot flow & OTA upgrading



Demo

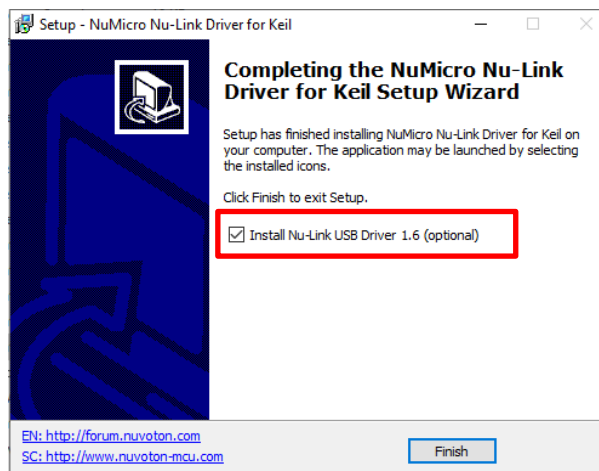
- Requirements
- Driver Installation
- Build Steps
- HMCU Board Setting
- ACK HMCU Firmware Installation
- ACK HMCU Boot Option Configuration

Requirements

- **Hardware**
 - An ACK module board (USI MT7697H development kit)
 - An development board for ACK HMCU (NuTiny-M4521S board)
 - An internet-accessible **2.4G** Wi-Fi router
 - A mobile phone with Alexa APP
 - A LED, some dupont lines and an USB Mini line
- **Software/Drivers**
 - Keil MDK 5.26
 - Latest Nu-Link Keil drivers
 - Python-3.8 environment

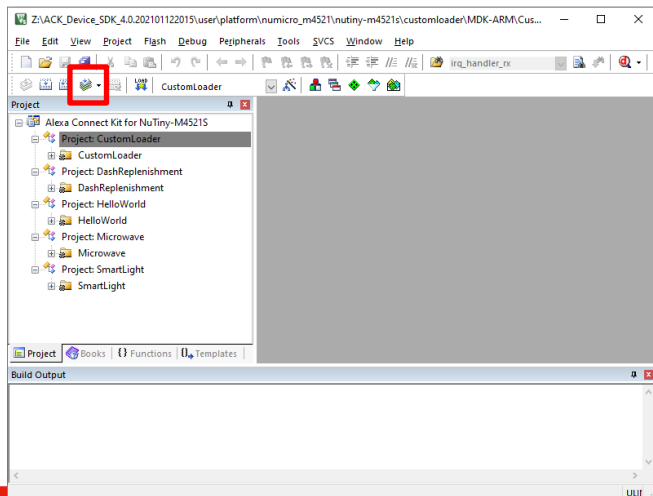
Driver Installation

- **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_m4521\nutiny-m4521s\ack.uvmpw
- Press “Batch rebuild” to build all examples.
- Finally, execute “m4521_merge.bat” to merge customer_loader and example into a hex file.



Name	Date modified	Type	Size
applications	2021/4/26 下午 07:19	File folder	
common	2021/4/26 下午 07:19	File folder	
customloader	2021/4/26 下午 07:19	File folder	
ack.uvmpw	2021/4/26 下午 07:24	Revision4 Multi-Pr...	2 KB
m4521_merge.bat	2021/4/22 上午 11:43	Windows Batch File	1 KB

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 **m4521_merge.bat** script.
 - To execute '**pip install intelhex**' in command line window.
 - Remember to add python execution to **PATH** variable.

m4521_merge.bat

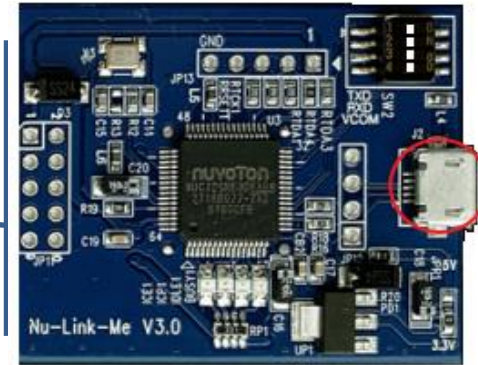
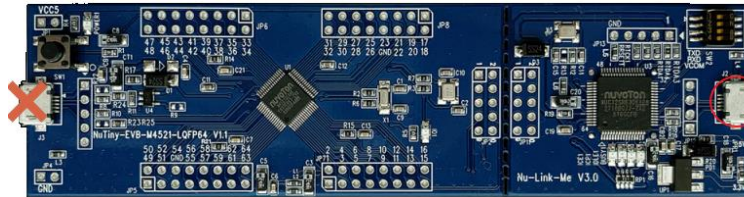
- This is batch script for window platform. Help user to get all merged firmwares for programming, just a double-click step.
- It invokes some python utilities Amazon provided
 - For producing a merged firmware for NuMicro MCU.
 - Notice: The Nu-Link-Me on NuTiny-M4521S board is without Drag-and-drop firmware downloading function.
 - For OTA upgrading file for publishing on Amazon Cloud.
 - Please remember to modify the device type for yours.

Name	Date modified	Type	Size
applications	2021/4/26 下午 07:19	File folder	
common	2021/4/26 下午 07:19	File folder	
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Merged_DashReplenishment.hex	2021/4/26 下午 07:28	HEX File	112 KB
Merged_HelloWorld.hex	2021/4/26 下午 07:28	HEX File	127 KB
Merged_Microwave.hex	2021/4/26 下午 07:28	HEX File	156 KB
Merged_SmartLight.hex	2021/4/26 下午 07:28	HEX File	157 KB

HMCU board Setting

- Switch Pin 1 and pin 2 of VCOM(SW2) on Nu-Link-Me to “ON” position.
- Bridge USB micro line between Nu-Link-Me and PC.



- Nu-Link-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\.

HMCU board and ACK shield board wiring

- Power-related Pins

NuTiny-M4521S	ACK shield board
+ 3.3v	ioref
+5v	+5v
GND	GND

- Communication-related Pins

NuTiny-M4521S	ACK shield board
P37	RX
P38	TX
P39	INT
P40	RES

- Other I/O Pins

NuTiny-M4521S	Function description
On-board Heart Beat LED (GPIO output, IO1)	Alexa-connected indicator
P28 (Defined PWM I/O pin)	Smart Light LED
P23 (GPIO input)	Factory Setting Restore

ACK HMCU Firmware Installation

- Using Nuvoton NuMicro ICP Programming Tool to program merged ACK HMCU and CustomerLoader hex file into MCU's APROM.
 - Specify the path of merged file in APROM entry.
 - Configure “Boot Options” is in “**APROM with IAP**” mode.
 - Select APROM and Config options to start programming.

ACK HMCU Firmware Installation

The image displays three screenshots of the Nuvoton NuMicro ICP Programming Tool 3.03 interface, illustrating the steps for firmware installation.

Screenshot 1: Select Target Chip
 The "Select Target Chip" dropdown menu is set to "M451 Series".

Screenshot 2: Main Programming Tool Interface
 The "Load File" section shows the "APROM" file selected. The file name is "Z:\ACK_Device_SDK_4.0.202101122015\user\platform\numicro\m4521\nuiling-m4521s\Meigri\size: 58.4K Bytes, checksum: 020a". The "Config Bits" section shows "Config 0" as "0xFFFFF8BF" and "Config 1" as "0xFFFFFFFF". The "File Data" table shows the on-board flash data.

On-board Flash										Offline Flash									
APROM	DATA	LDROM	SPROM	APROM	DATA	LDROM	SPROM	APROM	DATA	LDROM	SPROM	Info							
00000000:	08 12 00 20	5D 01 00 00	8F 01 00 00	41 01 00 00	00000000:	08 12 00 20	5D 01 00 00	8F 01 00 00	41 01 00 00										
00000010:	93 01 00 00	95 01 00 00	97 01 00 00	00 00 00 00	00000010:	93 01 00 00	95 01 00 00	97 01 00 00	00 00 00 00										
00000020:	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00	00000020:	00 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00										
00000030:	98 01 00 00	00 00 00 00	9D 01 00 00	00 00 00 00	00000030:	98 01 00 00	00 00 00 00	9D 01 00 00	00 00 00 00										
00000040:	A1 01 00 00	A1 01 00 00	A1 01 00 00	A1 01 00 00	00000040:	A1 01 00 00	A1 01 00 00	A1 01 00 00	A1 01 00 00										
00000050:	A1 01 00 00	A1 01 00 00	A1 01 00 00	A1 01 00 00	00000050:	A1 01 00 00	A1 01 00 00	A1 01 00 00	A1 01 00 00										
00000060:	A1 01 00 00	A1 01 00 00	A1 01 00 00	A1 01 00 00	00000060:	A1 01 00 00	A1 01 00 00	A1 01 00 00	A1 01 00 00										
00000070:	A1 01 00 00	A1 01 00 00	A1 01 00 00	A1 01 00 00	00000070:	A1 01 00 00	A1 01 00 00	A1 01 00 00	A1 01 00 00										
00000080:	65 07 00 00	71 07 00 00	7D 07 00 00	A1 01 00 00	00000080:	65 07 00 00	71 07 00 00	7D 07 00 00	A1 01 00 00										
00000090:	95 07 00 00	A1 01 00 00	A1 01 00 00	A1 01 00 00	00000090:	95 07 00 00	A1 01 00 00	A1 01 00 00	A1 01 00 00										
000000A0:	A1 01 00 00	A1 01 00 00	A1 01 00 00	A1 01 00 00	000000A0:	A1 01 00 00	A1 01 00 00	A1 01 00 00	A1 01 00 00										
000000B0:	A1 01 00 00	A1 01 00 00	A1 01 00 00	A1 01 00 00	000000B0:	A1 01 00 00	A1 01 00 00	A1 01 00 00	A1 01 00 00										
000000C0:	A1 01 00 00	A1 01 00 00	A1 01 00 00	A1 01 00 00	000000C0:	A1 01 00 00	A1 01 00 00	A1 01 00 00	A1 01 00 00										

The "Programming" section shows "APROM" and "Config" selected. The "Start" button is highlighted.

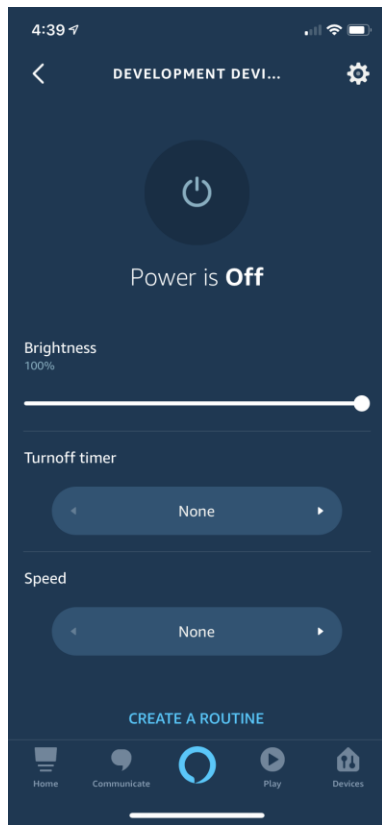
Screenshot 3: Chip Settings
 The "Chip Settings" dialog box shows the "Configuration" tab. The "Chip Booting Selection" is set to "APROM with IAP". The "Brown Out Voltage" is set to "4.5V". The "Watchdog Timer Mode Selection" is set to "WDT is inactive". The "Data Flash Options" section shows "Data Flash Enable" unchecked. The "Security Lock" is unchecked. The "Config Value" section shows "Config 0" as "0xFFFFF8BF" and "Config 1" as "0xFFFFFFFF".

Wiring and Alexa APP

- **Mount ACK connectivity board on Arduino shield of NuMaker board.**
- **Connect a LED to P28 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.

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%]

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_m4521\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.

ACK development kits

- Please visit Amazon ACK official page
 - <https://developer.amazon.com/en-US/alexa/connected-devices/alexa-connect-kit/dev-kits>

M4521 Series Resources

- **Link to Keil tools for Nuvoton NuMicro**
 - <http://www2.keil.com/nuvoton/M0-M23>
- **Technical reference manual**
 - https://www.nuvoton.com/export/resource-files/TRM_M4521_Series_EN_Rev1.00.pdf
- **Development board schematics**
 - https://www.nuvoton.com/resource-download.jsp?tp_GUID=HL0320181128163025
- **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