

Amazon ACK HMCU On NuTiny-M451V

www.nuvoton.com

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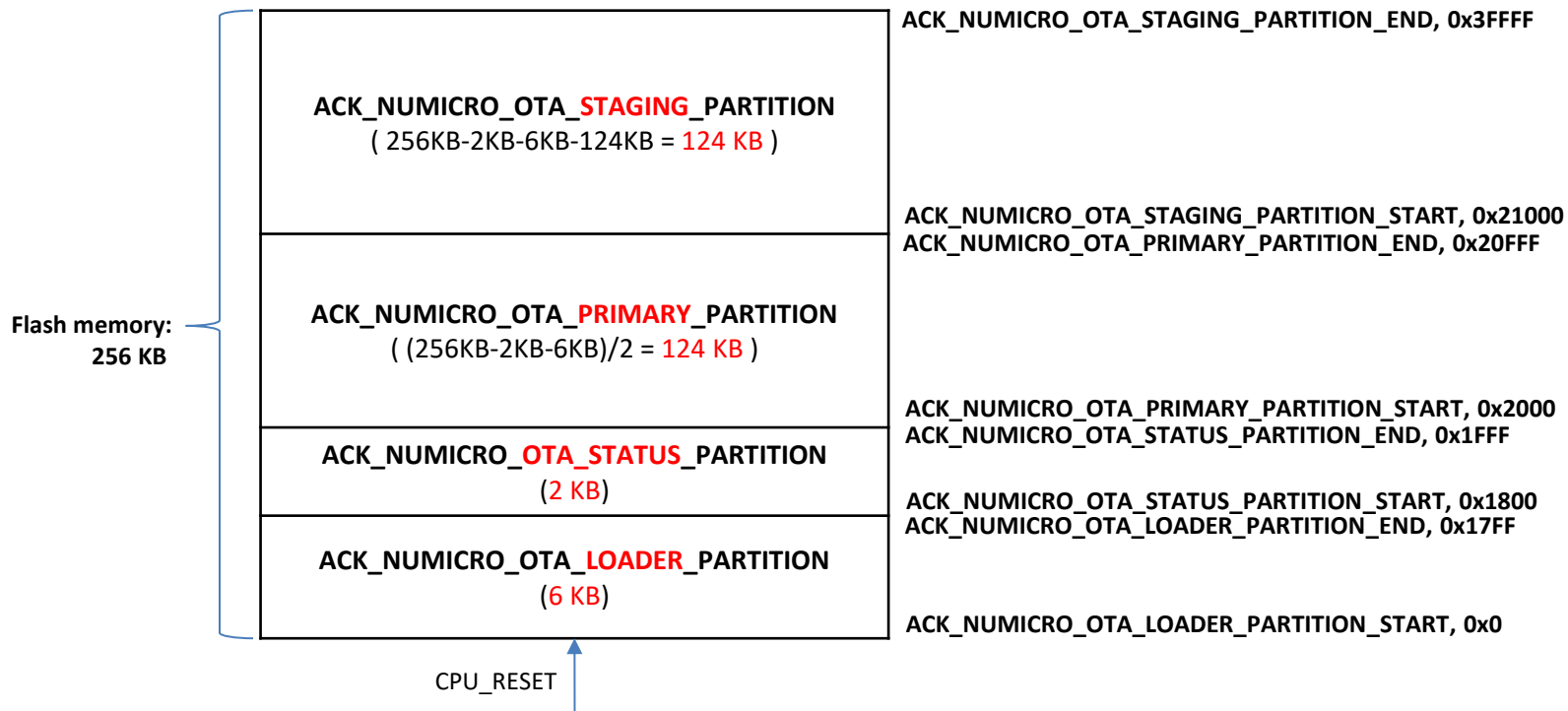
- **Introduction**
- **Partition layout, Boot flow & OTA upgrading**
- **Demo**
- **Some notes**

Introduction

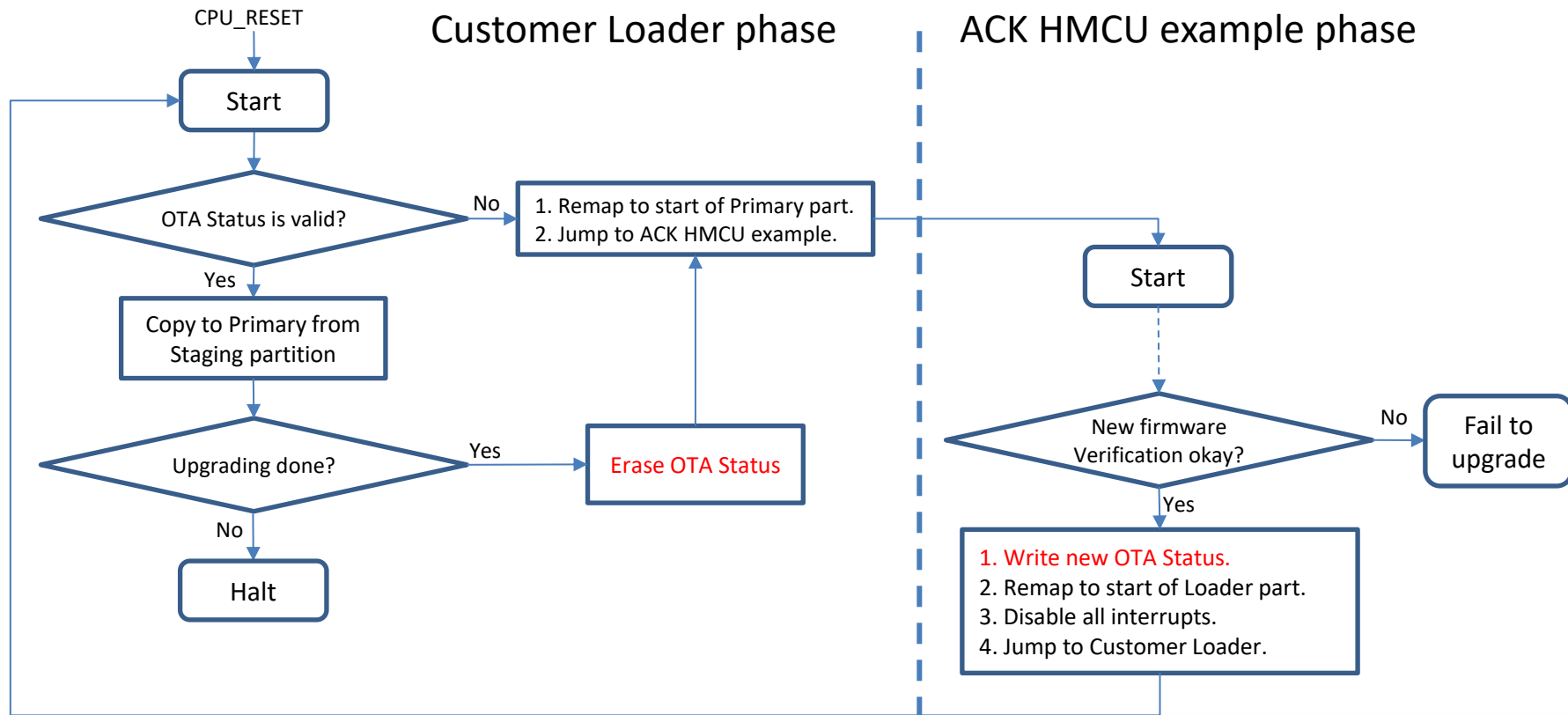
- **ACK – Alexa Connect Kit**
- **An Amazon-managed solution that makes it simpler, faster, and more economical to create and manage Alexa-controlled, Wi-Fi-enabled smart devices.**
 - ACK module
 - High-reliability/Low-latency device control cloud
 - ACK Management Console
 - Extensibility APIs
 - Dash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



Partition layout



Boot flow & OTA upgrading



Demo

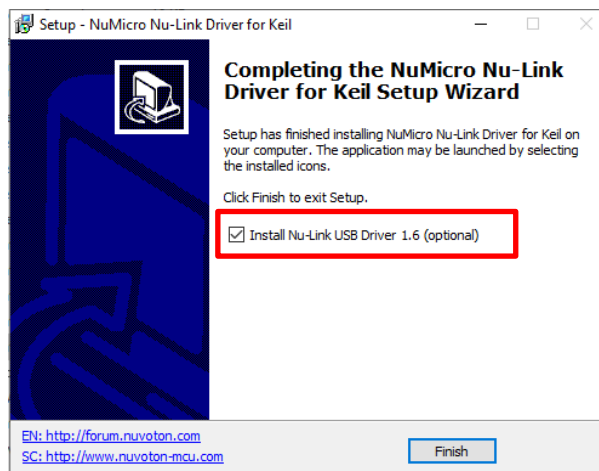
- Requirements
- Driver Installation
- Build Steps
- HMCU Board Setting
- ACK HMCU Firmware Installation
- ACK HMCU Boot Option Configuration

Requirements

- **Hardware**
 - An ACK module board (USI MT7697H development kit)
 - An development board for ACK HMCU (NuTiny-M451V 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

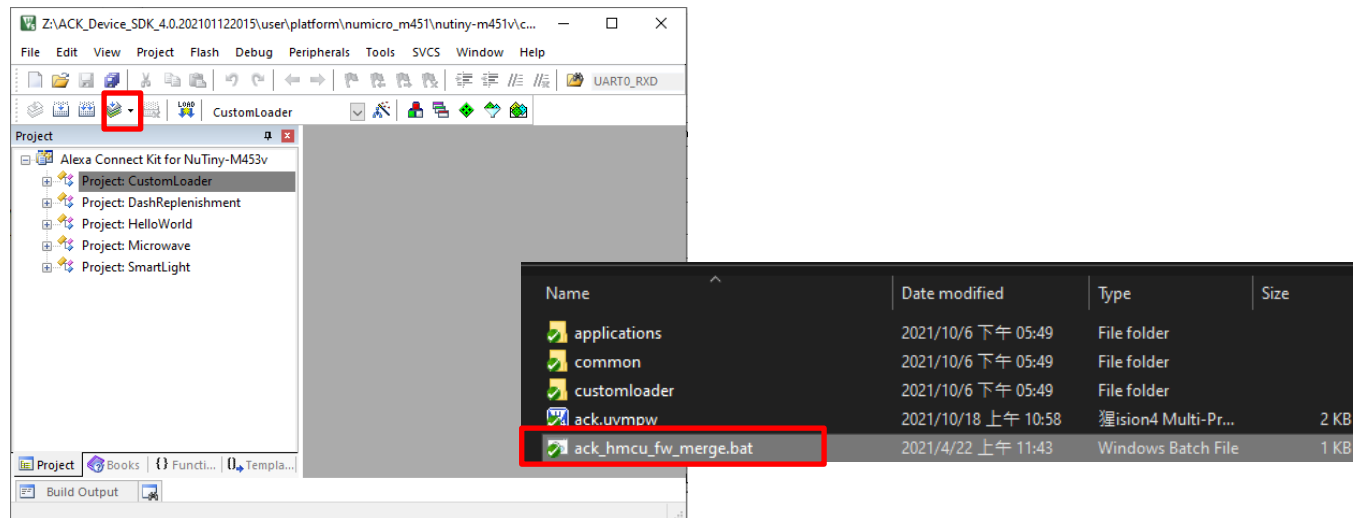
Driver Installation

- **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_m451\nutiny-m451v\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 [ack_hmcu_fw_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.
 - Notice: The Nu-Link-Me on NuTiny-M451V 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	2021/10/6 下午 05:49	File folder	
common	2021/10/6 下午 05:49	File folder	
customloader	2021/10/6 下午 05:49	File folder	
ack.uvmpw	2021/10/18 上午 10:58	vision4 Multi-Pr...	2 KB
ack_hmcu_fw_merge.bat	2021/4/22 上午 11:43	Windows Batch File	1 KB

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

- 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-M451V	ACK shield board
+ 3.3v	ioref
+5v	+5v
GND	GND

- Communication-related Pins

NuTiny-M451V	ACK shield board
P66	RX
P67	TX
P68	INT
P69	RES

- Other I/O Pins

NuTiny-M451V	Function description
On-board Heart Beat LED (GPIO output, IO1)	Alexa-connected indicator
P45 (Defined PWM I/O pin)	Smart Light LED
P43 (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

Nuvoton NuMicro ICP Programming Tool 3.03 - M451 Series

Project Chips Tool Language Help

Status: **Chip Connected with Nu-Link (ID: 18000574)**

Part No.: **M453V/G6AE** APROM: 256K, Data: 0K, LDROM: 4K, RAM: 32K
 UID/UCID: ...

Load File

APROM File Name: Z:\ACK_Device_SDK_4.0.202101122015\user\platform\numicro_m451\nutiny-m451-v\Merged, size: 58.2K Bytes, checksum: 3db5 Offset: 0x 0

Data Flash File Name: C:\Data.hex
 File not load.

LDROM File Name: C:\LDROM.hex
 File not load.

SPROM File Name: C:\SPROM.hex
 File not load. Last Byte: 0x FF

Config Bits

Setting Config 0: 0xFFFFFBBF Config 1: 0xFFFFFFFF < Update History >

File Data

On-board Flash				Offline Flash			
APROM	DATA	LDROM	SPROM	APROM	DATA	LDROM	SPROM
00000000:	08 06 00 20	71 01 00 00	A3 01 00 00	55 01 00 00			
00000010:	A7 01 00 00	A9 01 00 00	AB 01 00 00	00 00 00 00			
00000020:	00 00 00 00	00 00 00 00	00 00 00 00	AD 01 00 00			
00000030:	AF 01 00 00	00 00 00 00	B1 01 00 00	ED 0C 00 00			
00000040:	B5 01 00 00	B5 01 00 00	B5 01 00 00	B5 01 00 00			
00000050:	B5 01 00 00	B5 01 00 00	B5 01 00 00	B5 01 00 00			
00000060:	B5 01 00 00	B5 01 00 00	B5 01 00 00	B5 01 00 00			
00000070:	B5 01 00 00	B5 01 00 00	B5 01 00 00	B5 01 00 00			
00000080:	75 07 00 00	B1 07 00 00	8D 07 00 00	99 07 00 00			
00000090:	A5 07 00 00	B1 07 00 00	B5 01 00 00	B5 01 00 00			
000000A0:	B5 01 00 00	B5 01 00 00	B5 01 00 00	B5 01 00 00			
000000B0:	B5 01 00 00	B5 01 00 00	B5 01 00 00	B5 01 00 00			
000000C0:	8C 01 00 00	B5 01 00 00	B5 01 00 00	B5 01 00 00			

Programming

☒ APROM ☐ Data Flash ☐ LDROM ☐ SPROM ☒ Config Options **Start**

Chip Settings

Configuration

I/O Initial State Selection

☒ Input Tri-state Mode ☐ Quasi Bi-directional Mode

HXT Mode Selection

☒ Crystal Mode ☐ External Clock Mode

Chip Booting Selection

☐ APROM ☐ LDROM
☒ **APROM with IAP** ☐ LDROM with IAP

Brown Out Voltage

☒ 4.5V ☐ 3.7V ☐ 2.7V ☐ 2.2V

☐ Brown Out Detector ☐ Brown Out Reset

Watchdog Timer Mode Selection

☒ WDT is inactive.
☐ WDT is active and WDT clock is always on.
☐ WDT is active and WDT clock is controlled by LIRCEN in power-down.

Data Flash Options

☐ Data Flash Enable Base Address: 0x FFFFFFFF
 Data Flash Size: 0.00K

☐ Security Lock

Config Value

Config 0: 0x 0xFFFFFBBF Config 1: 0x 0xFFFFFFFF

OK **Cancel**

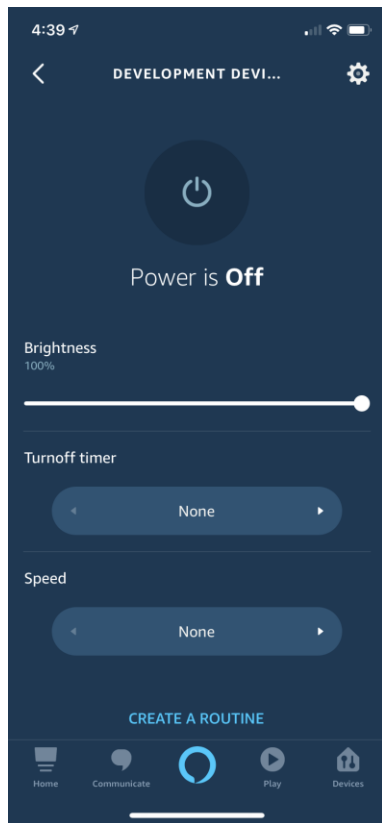
Build: 7091r

Wiring and Alexa APP

- **Connect a LED to P45 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_m451\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>

M451 Series Resources

- **Link to Keil tools for Nuvoton NuMicro**
 - <http://www2.keil.com/nuvoton/M0-M23>
- **Development board schematics**
 - https://www.nuvoton.com/resource-download.jsp?tp_GUID=HL0120141225192023
- **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