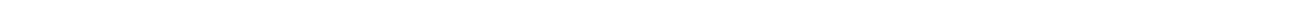


USER MANUAL

1ST EDITION (DRAFT) DATE: 2025.05.15

NMC-R014TN

NETWORK PLATFORM



Content

PREFACE	3
<i>REVISION HISTORY</i>	<i>3</i>
WARNINGS, CAUTIONS AND NOTES	4
<i>SAFETY INSTRUCTIONS</i>	<i>5</i>
<i>DECLARATION OF CONFORMITY</i>	<i>6</i>
1. INTRODUCTION.....	8
1.1 OVERVIEW	8
1.2 PRODUCT OUTLOOK.....	8
1.2.1 Front View	8
1.2.2 Side View.....	8
1.3 NMC CARD LAYOUT	9
1.4 BLOCK DIAGRAM	11
1.5 COMPONENT INSTALLATION	12
1.5.1 Dipole Antennas.....	12
1.5.2 Patch type Antennas	12
1.6 OPTIMUM MOUNTING ENVIRONMENT	13
1.6.1 Space Requirement.....	13
1.6.2 Temperature Requirement	13
2. OPERATION.....	14
2.1 POWERING UP/DOWN THE SERVER/CARD	14
2.2 LED BEHAVIOUR	14
2.2.1 BMC SKU	15
2.2.1.1 to Locate I2C root bus.	15
2.2.1.2 Control NMC-RFKIT I2C switch	15
2.2.1.3 Control LEDs.....	15
2.2.2 Non-BMC SKU	16
2.2.2.1 Preparation	16
2.2.2.2 I2C raw command to control LED	18
2.2.2.3 Kernel driver to control LED	19
2.2.3 Kernel LED sysfs with SW define LED	23
2.2.3.1 To add IO expander device and I2C switch to sysfs	24
2.2.3.2 Control LEDs.....	24

PREFACE

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<http://support.advantech.com.tw/support/>

REVISION HISTORY

Date	Edition	Modifications
2025.05.15	1.0	Initial Version

WARNINGS, CAUTIONS AND NOTES



Warning! Warnings indicate conditions, which, if not observed, can cause personal injury.

AVERTISSEMENT! Les avertissements indiquent des conditions qui, si elles ne sont pas observées, peuvent provoquer des blessures.



Caution! Cautions are included to help you avoid damaging hardware or losing data.

ATTENTION! Des précautions sont incluses pour vous aider à éviter d'endommager le matériel ou de perdre des données.



Note! Notes provide additional information.

Remarque! Les notes fournissent des informations supplémentaires.

Safety Instructions

1. Read these safety instructions carefully.
2. Keep this User Manual for later reference.
3. Disconnect this equipment from any AC outlet before cleaning. Use a damp cloth. Do not use liquid or spray detergents for cleaning.
4. For plug-in equipment, the power outlet socket must be located near the equipment and must be easily accessible.
5. Keep this equipment away from humidity.
6. Put this equipment on a reliable surface during installation. Dropping it or letting it fall may cause damage.
7. The openings on the enclosure are for air convection. Protect the equipment from overheating. **DO NOT COVER THE OPENINGS.**
8. Make sure the voltage of the power source is correct before connecting the equipment to the power outlet.
9. Position the power cord so that people cannot step on it. Do not place anything over the power cord.
10. All cautions and warnings on the equipment should be noted.
11. If the equipment is not used for a long time, disconnect it from the power source to avoid damage by transient overvoltage.
12. Never pour any liquid into an opening. This may cause fire or electrical shock.
13. Never open the equipment. For safety reasons, the equipment should be opened only by qualified service personnel.
14. If one of the following situations arises, get the equipment checked by service personnel:
 - The power cord or plug is damaged.
 - Liquid has penetrated into the equipment.
 - The equipment has been exposed to moisture.
 - The equipment does not work well, or you cannot get it to work according to the user's manual.
 - The equipment has been dropped and damaged.
 - The equipment has obvious signs of breakage.
15. Do not leave this equipment in an environment where the storage temperature may go below -40° C (-40° F) or above 85° C (185° F). This could damage the equipment. The equipment should be in a controlled environment.
16. Caution: Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended by the manufacturer, discard used batteries according to the manufacturer's instructions.
17. The sound pressure level at the operator's position according to IEC 704-1:1982 is no more than 70 dB (A).
18. FCC regulations restrict the operation of this device to indoor use only. Operation prohibited on oil platforms, cars, trains, boats, and aircraft, except that operation of this device is permitted in large aircraft while flying above 10,000 feet
19. **RESTRICTED ACCESS AREA:** The equipment should only be installed in a Restricted Access Area.
20. **DISCLAIMER:** This set of instructions is given according to IEC 704-1. Advantech disclaims all responsibility for the accuracy of any statements contained herein.

Declaration of Conformity

FCC CLASS B

This device complies with part 15 of the FCC rules: Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

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 when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

CE MARK The CE marking on this product indicates that it is in compliance with the European Union EMC Directive 2014/30/EU, Safety Directive 2014/35/EU.

Technical Support and Assistance

1. Visit the Advantech web site at www.advantech.com/support where you can find the latest information about the product.
2. Contact your distributor, sales representative, or Advantech's customer service centre for technical support if you need additional assistance. Worldwide contact information can be found on www.advantech.com. Please have the following information ready before you call:
 - Product name and serial number
 - Description of your peripheral attachments
 - Description of firmware and software versions installed on the product
 - A complete description of the problem
 - The exact wording of any error messages
3. For more information please contact ncg@advantech.com or visit www.advantech.com/nc.

Warranty and RMA

Product Warranty (2 years)

Advantech warrants to you, the original purchaser, that each of its products will be free from defects in materials and workmanship for two years from the date of purchase.

This warranty does not apply to any products which have been repaired or altered by persons other than repair personnel authorized by Advantech, or which have been subject to misuse, abuse, accident or improper installation. Advantech assumes no liability under the terms of this warranty as a consequence of such events. Because of Advantech's high quality-control standards and rigorous testing, most of our customers never need to use our repair service. If an Advantech product is defective, it will be repaired or replaced at no charge during the warranty period. For out-of-warranty repairs, you will be billed according to the cost of replacement materials, service time

and freight. Please consult your dealer for more details. If you think you have a defective product, follow these steps:

1. Collect all the information about the problem encountered. (For example, CPU speed, Advantech products used, other hardware and software used, etc.) Note anything abnormal and list any onscreen messages you get when the problem occurs.
2. Call your dealer and describe the problem. Please have your manual, product, and any helpful information readily available.
3. If your product is diagnosed as defective, obtain an RMA (return merchandise authorization) number from your dealer. This allows us to process your return more quickly.
4. Carefully pack the defective product, a fully-completed Repair and Replacement Order Card and a photocopy proof of purchase date (such as your sales receipt) in a shippable container. A product returned without proof of the purchase date is not eligible for warranty service.
5. Write the RMA number visibly on the outside of the package and ship it prepaid to your dealer.

1. INTRODUCTION

1.1 Overview

NMC-R014TN is a network security platform Network Mezzanine Card which is powered by Telit LN920 LTE module. The Telit LN920 LTE module is designed to support 4G/LTE CAT-12 Radio Frequency.

NMC-R014TN module kit design is compatible with corresponding FWA Series Network Appliance platforms, like FWA-1013, FWA-3051, FWA-1081. Especially, Dual SIM cards holders design can install SIM cards, one for mainstream operation, another is for backup usage. NMC-R014TN also bundle with 2pcs 4G LTE Antennas.

1.2 Product Outlook

1.2.1 FRONT VIEW

There are total 2 x SMA cable with Antenna hole to assembly Antennas. LED indicators for signal strength and Link/activity.

For signal strength of LED, one grid means signal strength is fair, 2 grids means signal is good, 3 grids is Excellence.

For Link/activity LED, Green on is link, Green blinking is activity.



Figure 1: NMC-R014TN Front View

1.2.2 SIDE VIEW

There are 2 SIM cards holders/slots to plug into SIM cards. Before install SIM cards, need to remove LTE module for One is in left side with remark SIM1 for major SIM card usage, second one is in right sides with remark SIM2 for backup application.



Figure 2: Dis-assembly LTE module

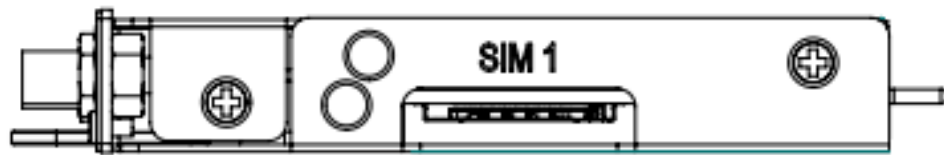


Figure 3: LTE module Right Side View



Figure 4: LTE module Left Side View

1.3 NMC Card layout

Card layout as below picture:

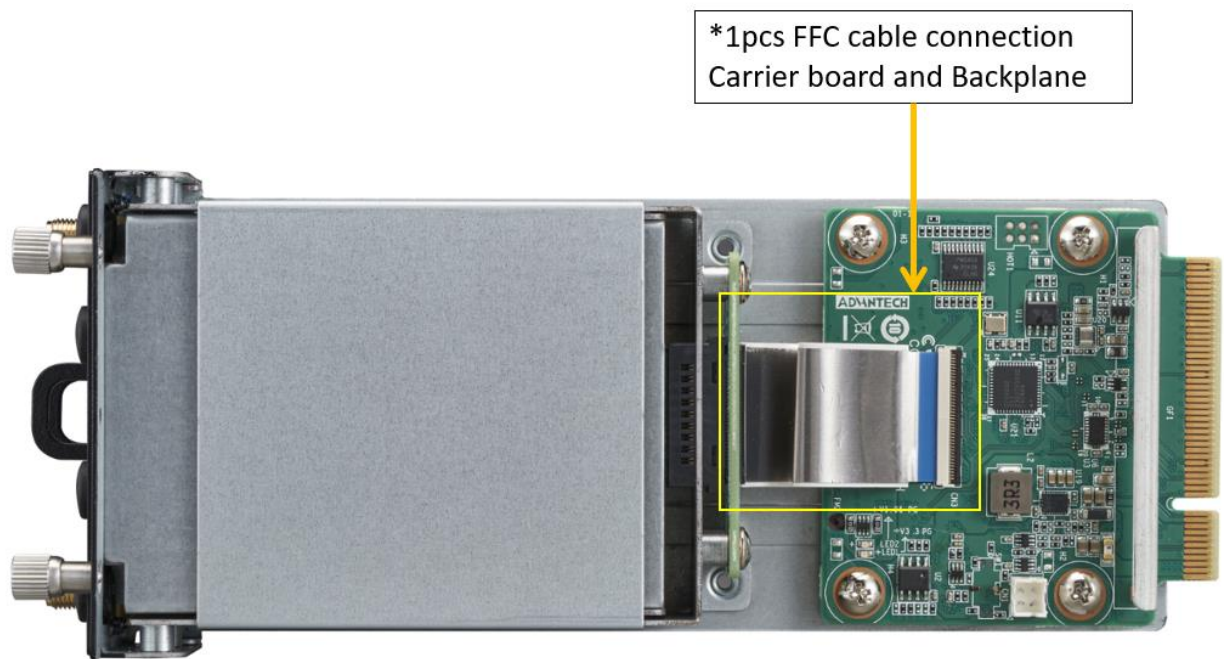


Figure 5: NMC-R014TN module

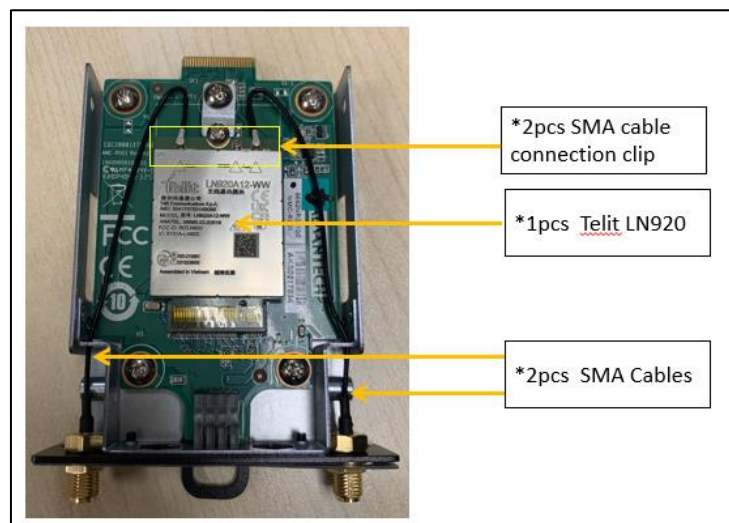


Figure 6: LTE module Architecture

Following table is Advantech 4G/ LTE module Part Number and suggesting to install 2 antennas for 4G/LTE telecommunications module test.

Model	Telit LN920Ax-WW
P/N	968DD00428
Size	30 x 42 x 2.4 mm
Interface	M.2
Main Chip	Qualcomm® SDX12
Support Modes	4G/LTE, 3G
Antenna	2

Table1: Telit LN920 information

1.4 Block Diagram

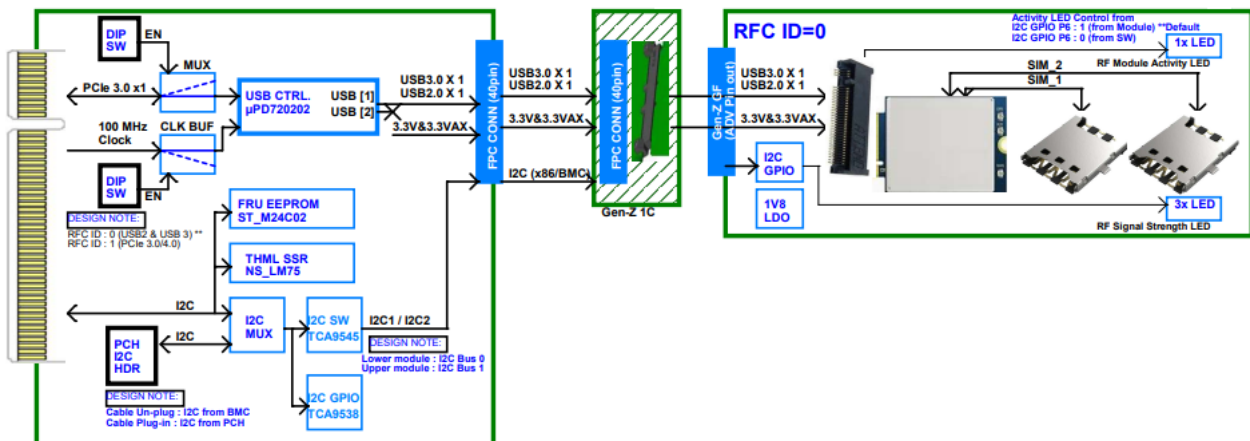


Figure 7: NMC card Block diagram

1.5 Component Installation

1.5.1 DIPOLE ANTENNAS

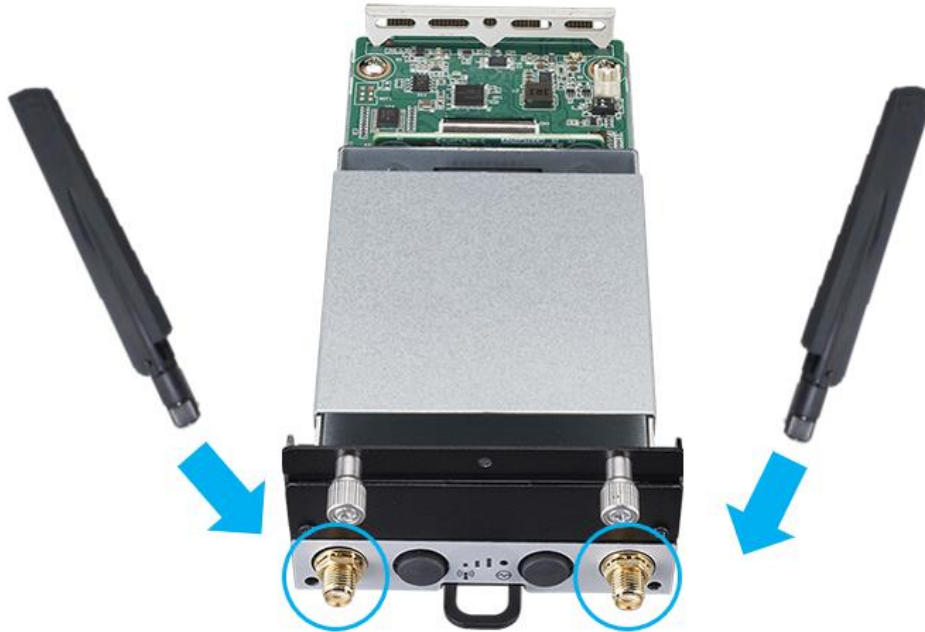


Figure 8: Dipole Antenna installation

1.5.2 PATCH TYPE ANTENNAS



Figure 9: Patch type Antenna installation

1.6 Optimum Mounting Environment

1.6.1 SPACE REQUIREMENT

Please always plug into FWA series system due to form factor is designed to support in FWA series system.

1.6.2 TEMPERATURE REQUIREMENT

Please make sure environment condition before power on this system:

- Operating temperature 0 ~ 40 °C (32 ~ 104 °F)
- Relative humidity 95% @ 60° C (non-condensing)
- Storage temperature -20 ~ 65° C (-4 ~ 149° F)

2. OPERATION

2.1 Powering up/down the server/card

To power up the Card, please make sure to plug the card into the PCIE slot of system and press the Power Switch.

Before powering down the card/server for any upgrade or maintenance procedures, perform a backup of critical server data and programs.

To power down the card/server, use one of the following methods:

- Press the Power Switch
1. FWA systems are using Power Switch to power ON/OFF system, when user press power switch as ON (|), system will auto power up and sync with NMC-R014TN, when user press power switch as OFF (O), system will force power OFF and sync with NMC-R014TN.
 2. Please don't direct plug or unplug AC power cord when Power Switch and NMC-R014TN sets as ON

2.2 LED Behaviour

4G / LTE LED INDICATION Excellent / Good / Fair is output of management Ethernet switch, they come from NAMB-2012MB Intel I201. Below is table show RJ45 connector pin assignment.



Figure 10: FIO Patch type Antenna installation

Speed LED	Left in LED light (Green)	Link/Active LED	Right (Green color)
RF Strength Fair (Low)	One Green Light On	Link	Solid ON Green
RF Strength Good (Medium)	Two LED Light On	Active	Blinking Green
RF Strength Excellent (High)	Three LED Light On		

Table2: NMC-R014TN LED Behaviour

All TCA9554 pins are active low.

Three strength LED can be controlled by TCA9554 directly. Active LED is controlled by module by default. If user want to control Active LED manually, set P6 to low first then use P7 to control the Active LED.

TCA9554's address is 0x23 (7bit) or 0x46 (8bit)

If the NMC-R014TN is connect to the carrier, NMC-RFKIT. NMC-RFKIT has two slots for NMC-R014TN. (bottom and top.) To manage this, there is another I2C switch on the NMC-RFKIT.

I2C switch TCA9545's address is 0x72 (7bit) or 0xE4 (8bit)

The channel 0 is for bottom slot, the channel 1 is for top slot.

So, the basic control logic is:

- Switch to correct I2C switch channel for NMC-R014TN if system is using NMC-RFKIT.
- Control the I2C GPIO for LED.

The I2C host will be BMC or x86 based on different platform.

2.2.1 BMC SKU

2.2.1.1 to Locate I2C root bus.

User can use *apdi -a* to check the I2C root bus. (apdi version v1.44 or higher)

Get model (NMC-RFKIT Top/Bottom) and get the slot name. (NMC 1 (B.6.255.255))

eth name	bus:dev.fun	vid	did	svid	sdid	mac address	slot name	panel name	feature	seg model
enxaaf4c6956241	00:14.0(u)	1809	0a02	N/A	N/A	aa:f4:c6:85:62:41	N/A	N/A	unknown	N/A ID not found
swan0	01:00.0(u)	2c7c	0801	N/A	N/A	N/A	NMC 1 (B.6.255.255)	N/A	N/A	N/A NMC-RFKIT Top
swan1	01:00.0(u)	2c7c	0306	N/A	N/A	12:d2:df:da:94:f1	NMC 1 (B.6.255.255)	N/A	N/A	N/A NMC-RFKIT Bottom

In this case, B.6.255.255 means

- B: the platform is BMC SKU
- 6: NMC I2C root port is 6
- 255: First I2C switch not exist.
- 255: Second I2C switch not exist.

So, the I2C root bus is 6.

Since some platform's BMC I2C root bus might over 7, so we use IPMI raw command as example.

IPMI Master write read command:

```
#ipmitool raw 0x06 0x52 <bus number *2 + 1> <8 bit address> <read number> <write data>
```

2.2.1.2 Control NMC-RFKIT I2C switch

Top RF module

```
# ipmitool raw 0x06 0x52 13 0xE4 0x00 0x02
```

Bottom RF module

```
# ipmitool raw 0x06 0x52 13 0xE4 0x00 0x01
```

In our case, to access the bottom NMC-R014TN's LED. The I2C switch on NMC-RFKIT need to set to channel 0. i.e. write 0x01 to address 0xE4, bus number = $6*2+1 = 13$

```
# ipmitool raw 0x06 0x52 13 0xE4 0x00 0x01
```

2.2.1.3 Control LEDs.

Set all TCA9554's output value to high first (output value is register 0x01)

```
#ipmitool raw 0x06 0x52 13 0x46 0x00 0x01 0xff
Set all TCA9554's pin to output (pin direction is register 0x03, set corresponding bit to low as output.)
#ipmitool raw 0x06 0x52 13 0x46 0x00 0x03 0x00
Set RF strength Low to Green. (set register 0x01 bit 0 as low, other is high)
# ipmitool raw 0x06 0x52 13 0x46 0x00 0x01 0xfe
Set RF strength Low to Amber. (set register 0x01 bit 1 as low, other is high)
# ipmitool raw 0x06 0x52 13 0x46 0x00 0x01 0xfd
Set RF strength Low, Medium to Green. (set register 0x01 bit 0, 2 as low, other is high)
# ipmitool raw 0x06 0x52 13 0x46 0x00 0x01 0xfa
Set RF strength Low, Medium to Amber. (set register 0x01 bit 1, 3 as low, other is high)
# ipmitool raw 0x06 0x52 13 0x46 0x00 0x01 0xf5
Set RF strength Low, Medium, High to Green. (set register 0x01 bit 0, 2, 4 as low, other is high)
# ipmitool raw 0x06 0x52 13 0x46 0x00 0x01 0xea
Set RF strength Low, Medium, High to Amber. (set register 0x01 bit 1, 3, 5 as low, other is high)
# ipmitool raw 0x06 0x52 13 0x46 0x00 0x01 0xd5
To control the Active LED. User need to set pin 6 to low first. (set register 0x01 bit 6 as low) In this example, we turn off
other LEDs and turn on the Active LED (set register 0x01 bit 7 as low)
# ipmitool raw 0x06 0x52 13 0x46 0x00 0x01 0x3f
```

2.2.2 Non-BMC SKU

In Non-BMC SKU, SW Define LED, NMC and NMC-R014TN use the same I2C buses. So the BIOS configurations for SW Define LED will impact the NMC-R014TN LED control. User need to use the same BIOS configuration for SW Define LED and NMC-R014TN. The impact is highlighted in this document.

For Non-BMC SKU, there is a TCA9548 I2C switch on the motherboard that connect NMC slot and onboard devices. The TCA9548 address is 0x71 (7bits)

The Software Defined LED control method has two type BIOS setting , relationship table as below:

	BIOS setting in Platform > SW GPIO Configuration
I2c raw command	SW GPIO Driver Mode > GPIO Only
Kernel GPIO sysfs	SW GPIO Driver Mode > GPIO Only
Kernel LED sysfs	SW GPIO Driver Mode > LED+GPIO

Please configure SW GPIO Configuratoin before LED test.

2.2.2.1 Preparation

A. Locate i2c bus of IO expander

User can use *apdi -a* to check the I2C root bus. (apdi version v1.44 or higher)

Get model (NMC-RFKIT Top/Bottom) and get the slot name. (NMC 1 (H.0.0.255))

eth name	bus:dev:fun	vid	did	evdid	adid	mac address	slot name	panel name	feature	seg model
evan0	01:00:0(u)	2c7c	0801	N/A	N/A	N/A	NMC 1 (H.0.0.255)	N/A	N/A	N/A NMC-RFKIT Top
evan1	01:00:0(u)	2c7c	0306	N/A	N/A	c2:22:94:b8:89:b0	NMC 1 (H.0.0.255)	N/A	N/A	N/A NMC-RFKIT Bottom

In this case, H.0.0.255 means

- H: the platform is non-BMC SKU
- 0: PCH root port is 0. Means it use PCH I2C root bus.
- 0: First I2C switch channel is 0. (TCA9548, Address is 0x71 (7bit), 0xE2 (8bit))
- 255: Second I2C switch not exist.

So, the I2C root bus is 0, the first I2C switch channel for NMC 1 is channel 0.

B. To find IO expander device address at Non-BMC SKU

Step 1: Before LED test , please configure

Platform > SW GPIO Configuration > SW GPIO Driver Mode > GPIO Only on BIOS menu.



Step 2: Scan smbus in system by i2cdetect.

Here shows system smbus adapter is located at bus 0.

```
# i2cdetect -l
i2c-0 smbus SMBus I801 adapter at efa0 SMBus adapter
```

please note the bus number could be different due to different hardware configuration, kernel version and driver of other devices.

Scanning the devices on smbus which is got in step 2, and smbus address of the i2c bus switch TCA9548 appears at 0x71

```
# i2cdetect -y 0
 0 1 2 3 4 5 6 7 8 9 a b c d e f
00:      08 -----
10: -----
20: -----
30: -----
40: --- 44 --- 48 ---
50: 50 --- 56 ---
60: -----
70: -- 71 -----
```

Then to turn-on the CH0 of the TCA9548 I2C bus switch. And it could detect TCA9545 I2C bus switch (0x72) on the NMC-RFKIT LED Chip. That value 0x01 (0000 0001b) mean channel selection CH0 bit of control register is enable status.

```
# i2cset -y 0 0x71 0x01
# i2cdetect -y 0
```

```

 0 1 2 3 4 5 6 7 8 9 a b c d e f
00:  ----- 08 -----
10:  -----
20:  -----
30:  -----
40:  ----- 44 ----- 48 ----- 4f
50: 50 ----- 56 57 -----
60:  -----
70: -- 71 72 73 -----

```

Next step is to turn on the I2C switch on NMC-RFKIT. To access the bottom NMC-RF01, open the channel 0 on the TCA9545. Then you can control TCA9554, (0x23).

```

Top RF module
# ipmitool raw 0x06 0x52 13 0xE4 0x00 0x02
Bottom RF module
# ipmitool raw 0x06 0x52 13 0xE4 0x00 0x01

```

```

# i2cset -y 0 0x72 0x01
# i2cdetect -y 0
 0 1 2 3 4 5 6 7 8 9 a b c d e f
00:  ----- 08 -----
10:  -----
20:  ----- 23 -----
30:  -----
40:  ----- 44 ----- 48 ----- 4f
50: 50 ----- 56 57 -----
60:  -----
70: -- 71 72 73 -----

```

IO expander device address is 0x23 (7-bit address) in this system.

2.2.2.2 I2C raw command to control LED

Here shows how to control LEDs using i2c raw command, it will use smbus number and device address of IO expander located in previous chapter.

Step 1: Set pins to output mode, this need be done once every time Linux booted.

```
# i2cset -y 0 0x23 0x03 0x00
```

Here “0” is smbus number and “0x23” is device address. “0x03” is offset and “0x00” is value, combined to set GPIO pin 0 to pin 7 to output mode. “0x00” is hex of binary “0000 0000”, which means pin 0 to 7 is set to bit “0” (output mode).

Step 2: Control LEDs

```

# i2cset -y 0 0x23 0x01 0xff (Set all Pins to high)
# i2cset -y 0 0x23 0x03 0x00 (Set all Pins to output)

# i2cset -y 0 0x23 0x01 0xfe (Set RF strength Low, green, 1111 1110b)
# i2cset -y 0 0x23 0x01 0xfd (Set RF strength Low, Amber, 1111 1101b)

```

```
# i2cset -y 0 0x23 0x01 0xfa (Set RF strength Medium, green, 1111 1011b)
# i2cset -y 0 0x23 0x01 0xf5 (Set RF strength Medium, Amber, 1111 0111b)

# i2cset -y 0 0x23 0x01 0xea (Set RF strength High, green, 1110 1111b)
# i2cset -y 0 0x23 0x01 0xd5 (Set RF strength High, Amber, 1101 1111b)
```

To control Active LED, User need to set pin 6 to low first (set register 0x01, bit 6 as low.) In this example, we turn off other LEDs and turn on the Active LED (set register 0x01 bit 7 as low, 00111111b)

```
# i2cset -y 0 0x23 0x01 0x3f
```

“0” is smbus number and “0x23” is device address. “0x01” is offset

2.2.2.3 Kernel driver to control LED

The second way to control LED from user space is by kernel GPIO sysfs. GPIO sysfs also depends on i2c driver thus i2c_i801 must be loaded. It will use smbus number and device address of IO expander located in previous chapter.

Please note that if user decide to use kernel driver to handle GPIO, then user must use kernel driver to handle I2C switch too.

For more detail, please refer to kernel document:

<https://www.kernel.org/doc/Documentation/gpio/sysfs.txt>.

A. To add IO expander device and I2C switch to sysfs

Add I2C switch to sysfs:

Please make sure kernel module *i2c_mux*, *i2c_mux_pca954x* and *gpio_pca953x* exist in your system.

B. Load PCA9548 for onboard I2C switch

Load first I2C switch on the motherboard and the bus we are going to use is i2c-0-mux (chan_id 0), You can find the 0x72 under this bus.

Top RF module

```
# echo pca9548 0x72 > /sys/class/i2c-adapter/i2c-1/new_device
```

Bottom RF module

```
# echo pca9548 0x71 > /sys/class/i2c-adapter/i2c-0/new_device
```

Example:

```
# echo pca9548 0x71 > /sys/class/i2c-adapter/i2c-0/new_device
# i2cdetect -l

i2c-3 i2c i915 gmbus dpc I2C adapter
i2c-10 i2c AUX USBC3/DDI TC3/PHY D I2C adapter
i2c-1 i2c i915 gmbus dpa I2C adapter
i2c-17 smbus i2c-0-mux (chan_id 6) SMBus adapter
i2c-8 i2c i915 gmbus tc5 I2C adapter
i2c-15 smbus i2c-0-mux (chan_id 4) SMBus adapter
```

```

i2c-6 i2c i915 gmbus tc3 I2C adapter
i2c-13 smbus i2c-0-mux (chan_id 2) SMBus adapter
i2c-4 i2c i915 gmbus tc1 I2C adapter
i2c-11 smbus i2c-0-mux (chan_id 0) SMBus adapter
i2c-2 i2c i915 gmbus dpb I2C adapter
i2c-0 smbus SMBus I801 adapter at efa0 SMBus adapter
i2c-18 smbus i2c-0-mux (chan_id 7) SMBus adapter
i2c-9 i2c i915 gmbus tc6 I2C adapter
i2c-16 smbus i2c-0-mux (chan_id 5) SMBus adapter
i2c-7 i2c i915 gmbus tc4 I2C adapter
i2c-14 smbus i2c-0-mux (chan_id 3) SMBus adapter
i2c-5 i2c i915 gmbus tc2 I2C adapter
i2c-12 smbus i2c-0-mux (chan_id 1) SMBus adapter
# i2cdetect -y 11
  0 1 2 3 4 5 6 7 8 9 a b c d e f
00:  ----- 08 -----
10: -----
20: -----
30: -----
40: ----- 44 ----- 48 ----- 4f
50: 50 ----- 56 57 -----
60: -----
70: -- UU 72 73 -----

```

C. Load the second I2C switch on NMC-RFKIT.

The bus we are going to use is i2c-11-mux (chan_id 0), You can find the 0x23 under this bus.

Note that the bottom NMC-R014TN is on i2c-11-mux (chan_id 0) and the top NMC-R014TN is on i2c-11-mux (chan_id 1)

```

# echo pca9545 0x72 > /sys/bus/class/i2c-adapter/i2c-11/new_device
# i2cdetect -l
i2c-3 i2c i915 gmbus dpc I2C adapter
i2c-20 smbus i2c-11-mux (chan_id 1) SMBus adapter
i2c-10 i2c AUX USBC3/DDI TC3/PHY D I2C adapter
i2c-1 i2c i915 gmbus dpa I2C adapter
i2c-19 smbus i2c-11-mux (chan_id 0) SMBus adapter
i2c-17 smbus i2c-0-mux (chan_id 6) SMBus adapter
i2c-8 i2c i915 gmbus tc5 I2C adapter
i2c-15 smbus i2c-0-mux (chan_id 4) SMBus adapter
i2c-6 i2c i915 gmbus tc3 I2C adapter
i2c-13 smbus i2c-0-mux (chan_id 2) SMBus adapter

```

```
i2c-4 i2c i915 gmbus tc1 I2C adapter
i2c-21 smbus i2c-11-mux (chan_id 2) SMBus adapter
i2c-11 smbus i2c-0-mux (chan_id 0) SMBus adapter
i2c-2 i2c i915 gmbus dpb I2C adapter
i2c-0 smbus SMBus I801 adapter at efa0 SMBus adapter
i2c-18 smbus i2c-0-mux (chan_id 7) SMBus adapter
i2c-9 i2c i915 gmbus tc6 I2C adapter
i2c-16 smbus i2c-0-mux (chan_id 5) SMBus adapter
i2c-7 i2c i915 gmbus tc4 I2C adapter
i2c-14 smbus i2c-0-mux (chan_id 3) SMBus adapter
i2c-5 i2c i915 gmbus tc2 I2C adapter
i2c-22 smbus i2c-11-mux (chan_id 3) SMBus adapter
i2c-12 smbus i2c-0-mux (chan_id 1) SMBus adapter
```

```
# i2cdetect -y 19
```

```
  0 1 2 3 4 5 6 7 8 9 a b c d e f
00:  ----- 08 -----
10: -----
20: ----- 23 -----
30: -----
40: ----- 44 ----- 48 ----- 4f
50: 50 ----- 56 57 -----
60: -----
70: -- UU UU 73 -----
```

Load IO expander on NMC-R014TN

```
# echo pca9554 0x23 > /sys/class/i2c-adapter/i2c-19/new_device
```

“i2c-19” is target to smbus number 19 and “0x23” is device address. "pca9554" is name of this IO expander.

D. To find GPIO base-port file

GPIO base-port file under /sys/class/gpio appears after device are added. (gpiochip543) However, there might be several other gpio base port file, so it's necessary to locate which gpio base-port file.

```
# cat /sys/class/gpio/gpiochip543/label
19-0023
```

19-0023 means this device is on bus 19 and address is 0x23.

please note gpio numbers like 543 depends on kernel and hardware platform, thus it could be different.

E. Expose the GPIO pins as output mode.

Export the GPIO pins, set output to high and set it to output mode

```
Export the pins
```

```
# echo 543 > /sys/class/gpio/export
# echo 544 > /sys/class/gpio/export
# echo 545 > /sys/class/gpio/export
# echo 546 > /sys/class/gpio/export
# echo 547 > /sys/class/gpio/export
# echo 548 > /sys/class/gpio/export
# echo 549 > /sys/class/gpio/export
# echo 550 > /sys/class/gpio/export
```

Set pin to output mode

```
# echo out > /sys/class/gpio/gpio543/direction
# echo out > /sys/class/gpio/gpio544/direction
# echo out > /sys/class/gpio/gpio545/direction
# echo out > /sys/class/gpio/gpio546/direction
# echo out > /sys/class/gpio/gpio547/direction
# echo out > /sys/class/gpio/gpio548/direction
# echo out > /sys/class/gpio/gpio549/direction
# echo out > /sys/class/gpio/gpio550/direction
```

Set output to high

```
# echo 1 > /sys/class/gpio/gpio543/value
# echo 1 > /sys/class/gpio/gpio544/value
# echo 1 > /sys/class/gpio/gpio545/value
# echo 1 > /sys/class/gpio/gpio546/value
# echo 1 > /sys/class/gpio/gpio547/value
# echo 1 > /sys/class/gpio/gpio548/value
# echo 1 > /sys/class/gpio/gpio549/value
# echo 1 > /sys/class/gpio/gpio550/value
```

F. Control LEDs via gpio sysfs method

Control LEDs command as below

```
# echo 0 > /sys/class/gpio/gpio543/value (RF strength low green set to on)
# echo 1 > /sys/class/gpio/gpio543/value (RF strength low green set to off)

# echo 0 > /sys/class/gpio/gpio544/value (RF strength low amber set to on)
# echo 1 > /sys/class/gpio/gpio544/value (RF strength low amber set to off)
```

```
# echo 0 > /sys/class/gpio/gpio545/value (RF strength medium green set to on)
# echo 1 > /sys/class/gpio/gpio545/value (RF strength medium green set to off)

# echo 0 > /sys/class/gpio/gpio546/value (RF strength medium amber set to on)
# echo 1 > /sys/class/gpio/gpio546/value (RF strength medium amber set to off)

# echo 0 > /sys/class/gpio/gpio547/value (RF strength high green set to on)
# echo 1 > /sys/class/gpio/gpio547/value (RF strength high green set to off)

# echo 0 > /sys/class/gpio/gpio548/value (RF strength high amber set to on)
# echo 1 > /sys/class/gpio/gpio548/value (RF strength high amber set to off)
```

To control Active LED, User need to set pin 6 to low first and turn on the Active LED

```
# echo 0 > /sys/class/gpio/gpio549/value (Set Active LED to SW control.)
# echo 0 > /sys/class/gpio/gpio550/value (Active LED green set to on)
# echo 1 > /sys/class/gpio/gpio550/value (Active LED green set to off)
```

2.2.3 KERNEL LED SYSFS WITH SW DEFINE LED.

The third interface to control LEDs from user space is by kernel LEDs sysfs which is provide by Advantech amix955x driver for SW define LED on the system front panel. This LED sysfs also depends on i2c driver thus i2c_i801 must be loaded.

Note that NMC-R014TN LED control is not the same as SW Define LED on the system so the SW Define LED control method is not covered in this document, please check FWA-3034 Platform Software guide for SW Define LED control mechanism.

Note: This usage only workable on BIOS V100 and later version.

Step 1: Enable GPIO+GPIO Driver Mode

Before LED test , please configure

Platform > SW GPIO Configuration > SW GPIO Driver Mode > LED+GPIO on BIOS menu.



2.2.3.1 To add IO expander device and I2C switch to sysfs

In this mode, the first I2C switch driver for onboard TCA9548 will be loaded automatically. But notice that the bus number for channel id 0 is changed.

```
root@ub2204-hdd:~# i2cdetect -l
```

i2c-3	smbus	i2c-0-mux (chan_id 2)	SMBus adapter
i2c-10	i2c	i915 gmbus dpb	I2C adapter
i2c-1	smbus	i2c-0-mux (chan_id 0)	SMBus adapter
i2c-17	i2c	i915 gmbus tc6	I2C adapter
i2c-8	smbus	i2c-0-mux (chan_id 7)	SMBus adapter
i2c-15	i2c	i915 gmbus tc4	I2C adapter
i2c-6	smbus	i2c-0-mux (chan_id 5)	SMBus adapter
i2c-13	i2c	i915 gmbus tc2	I2C adapter
i2c-4	smbus	i2c-0-mux (chan_id 3)	SMBus adapter
i2c-11	i2c	i915 gmbus dpc	I2C adapter
i2c-2	smbus	i2c-0-mux (chan_id 1)	SMBus adapter
i2c-0	smbus	SMBus I801 adapter at efa0	SMBus adapter
i2c-18	i2c	AUX USBC3/DDI TC3/PHY D	I2C adapter
i2c-9	i2c	i915 gmbus dpa	I2C adapter
i2c-16	i2c	i915 gmbus tc5	I2C adapter
i2c-7	smbus	i2c-0-mux (chan_id 6)	SMBus adapter
i2c-14	i2c	i915 gmbus tc3	I2C adapter
i2c-5	smbus	i2c-0-mux (chan_id 4)	SMBus adapter
i2c-12	i2c	i915 gmbus tc1	I2C adapter

2.2.3.2 Control LEDs

User can follow C to F for NMC-R014TN LED control.

For front panel SW Define LED, please check FWA-3034 Platform Software guide for SW Define LED control mechanism.

