

**ARM<sup>®</sup> Cortex<sup>®</sup>-M**  
**32-bit Microcontroller**

**NuMaker M487 Advance**  
**User Manual**  
**NuMicro<sup>®</sup> M480 Series**

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## 1 OVERVIEW

This user manual is aimed to give users a fast introduction to the NuMaker M487 Advance (Ver 4.0) board. This board is a daughter board and it can't work independently by itself. It needs to be combined with the NuMaker-PFM-M487 (Ver 3.0) development board to implement some dedicated applications, for example the TFT LCD display with touch function, 1MB SRAM, MPU6500, I<sup>2</sup>C EEPROM, Mikro Bus, RS485 and CAN bus, etc., based on the target chip M487JIDAE microcontroller on the NuMaker-PFM-M487 board.

Figure 1-1 shows the combination picture of NuMaker M487 Advance board (top) and NuMaker-PFM-M487 board (bottom).

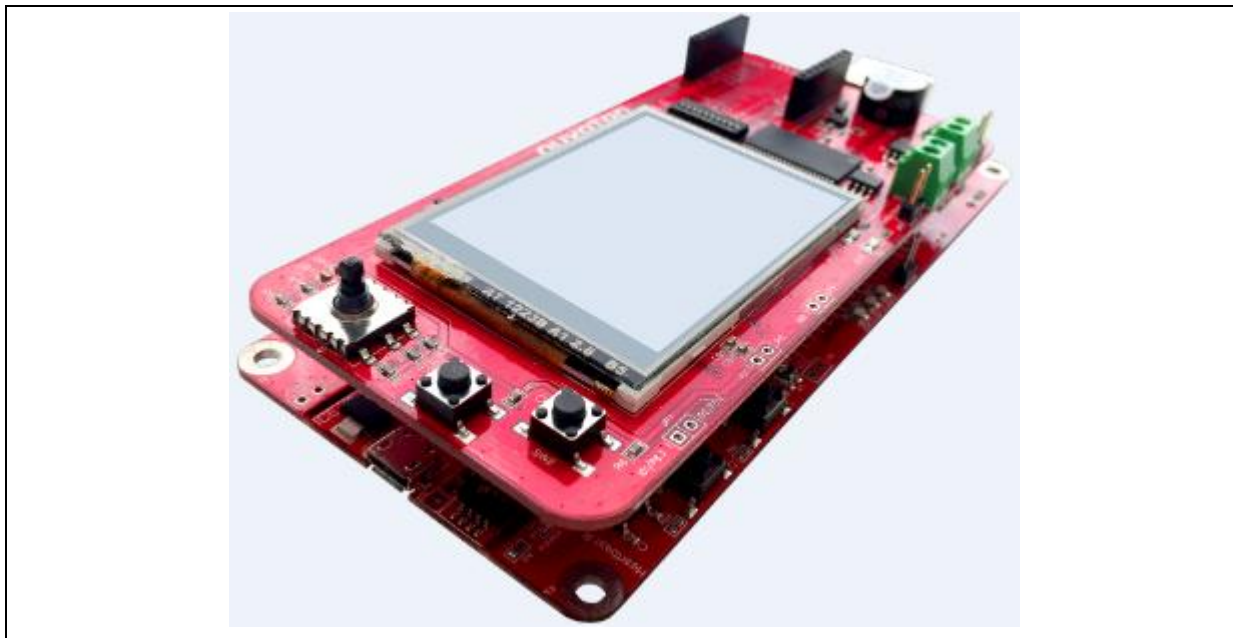


Figure 1-1 Combination of NuMaker M487 Advance Board and NuMaker-PFM-M487 Board

### 1.1 Brief Introduction to NuMaker-PFM-M487 Board

The NuMaker-PFM-M487 is a development board based on an ARM<sup>®</sup> Cortex<sup>®</sup>-M4 microcontroller (MCU) – M480 series which has very rich peripherals to help users easily to design-in their products or application systems.

This board is provided by Nuvoton and created specially to support the ARM<sup>®</sup> mbed<sup>™</sup> IoT Device Platform, and let user easily to develop the IoT application program on this board. The NuMaker-PFM-M487 also provides user many useful and powerful learning materials for how to develop and verify the application programs through the peripherals and interfaces on MCU and this board.

The NuMaker-PFM-M487 board consists of M487 Platform and Nu-Link-Me ICE Bridge. Figure 1-2 shows the NuMaker-PFM-M487 board. For more detailed information on the NuMaker-PFM-M487 board, please visit Nuvoton NuMicro Family ARM<sup>®</sup> Cortex<sup>®</sup> -M4 MCUs User Manual website:

[http://www.nuvoton.com/hq/products/microcontrollers/arm-cortex-m4-mcus/User-Manual/?\\_locale=en&resourcePage=Y](http://www.nuvoton.com/hq/products/microcontrollers/arm-cortex-m4-mcus/User-Manual/?_locale=en&resourcePage=Y)

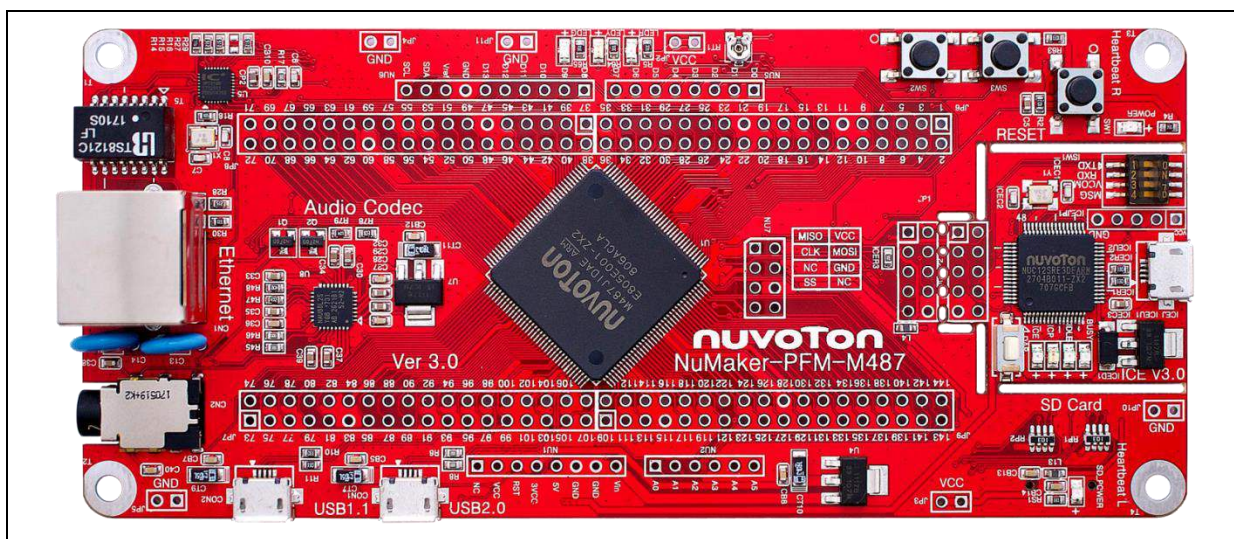


Figure 1-2 NuMaker-PFM-M487 Board

## 1.2 The Target Chip M487JIDAE MCU Features

- LQFP144 package
- ARM® Cortex®-M4 core running up to 192 MHz with DSP extensions and FPU (Floating Point Unit)
- Built-in LDO for wide operating voltage ranged from 1.8 V to 3.6 V
- 512 Kbytes Flash
- 160 Kbytes SRAM
- External Bus Interface (EBI)
- GPIO
- Peripheral DMA (PDMA)
- Timer
- EPWM and BPWM
- Quadrature Encoder Interface (QEI)
- WDT and WWDT
- RTC
- UART
- Smart Card (ISO-7816-3) Host Interface
- I<sup>2</sup>C
- SPI
- SPIM (SPI Master)
- I<sup>2</sup>S
- Universal Serial Control Interface (USCI)
- USB 2.0 High-Speed OTG / Host / Device

- USB 1.1 Full-Speed OTG / Host / Device
- CAN 2.0
- Ethernet MAC
- SD Host
- Cryptographic Accelerator
- CRC
- ADC
- DAC
- Comparator
- OPA

## 2 NUMAKER M487 ADVANCE BOARD OVERVIEW

### 2.1 Front View

Figure 2-1 shows the main components and connectors from the front side of NuMaker M487 Advance board.

The following lists components and connectors from the front view:

- QVGA TFT LCM with Touch: LCDDT24963701 (J1, driver ILI9341)
- SRAM: IS62WV51216B (U3, 1M bytes)
- I<sup>2</sup>C EEPROM: 24LC64 (U4)
- Motion Tracking Device: MPU6500 (U5)
- CAN Transceiver: SN65HVD230 (U6)
- RS485 Transceiver: SN65HVD11DR (U7)
- Joystick (J2)
- Mikro Bus (J3 and J4)
- Buzzer (BZ1)
- LEDs (LEDG1 and LEDR1)
- Push-buttons (SW1 and SW2)
- Multi-function Switches (SW3)

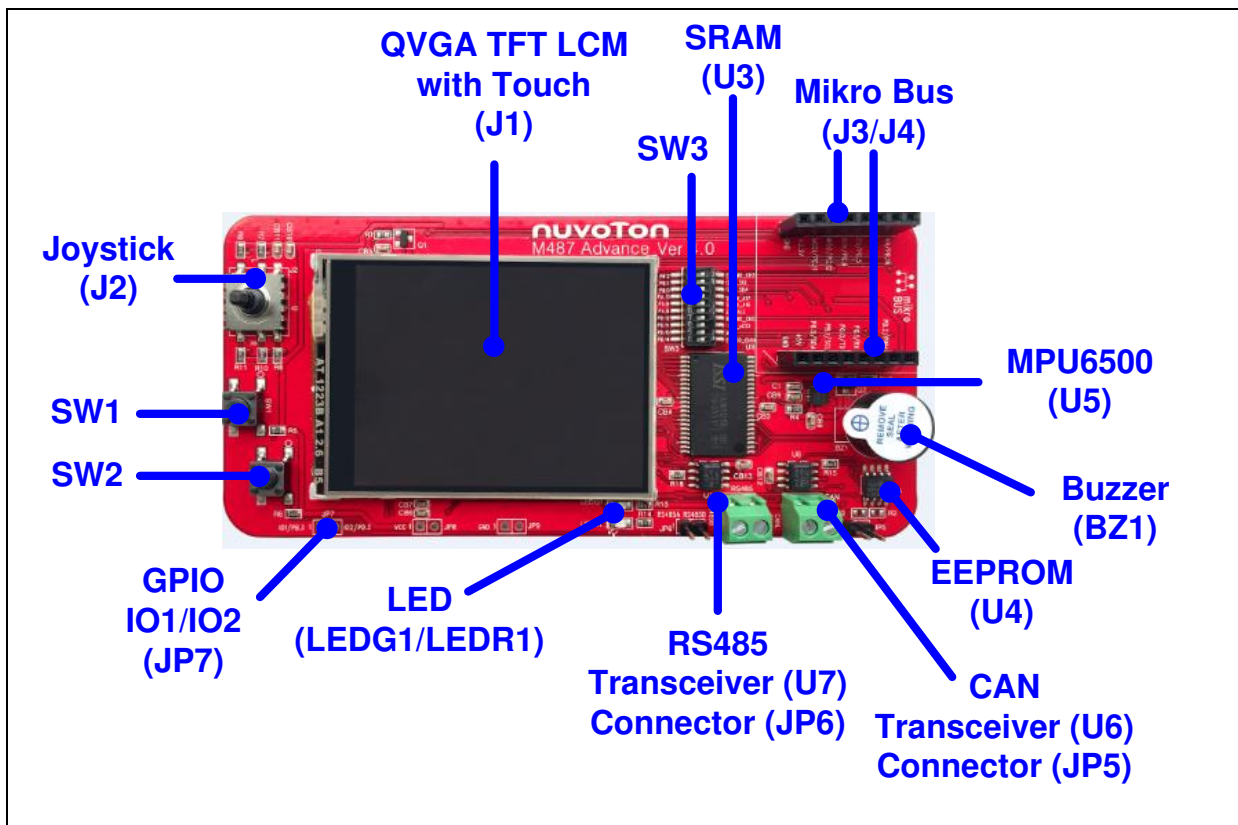


Figure 2-1 Front View of NuMaker M487 Advance Board



## 2.2 Rear View

Figure 2-2 shows the main components and connectors from the rear side of NuMaker M487 Advance board.

The following lists connectors from the rear view:

- Header Connectors: JP1, JP2, JP3 and JP4 for the NuMaker-PFM-M487 board
- Octal D-type Transparent Latch Device: 74HC373 (U1 and U2)

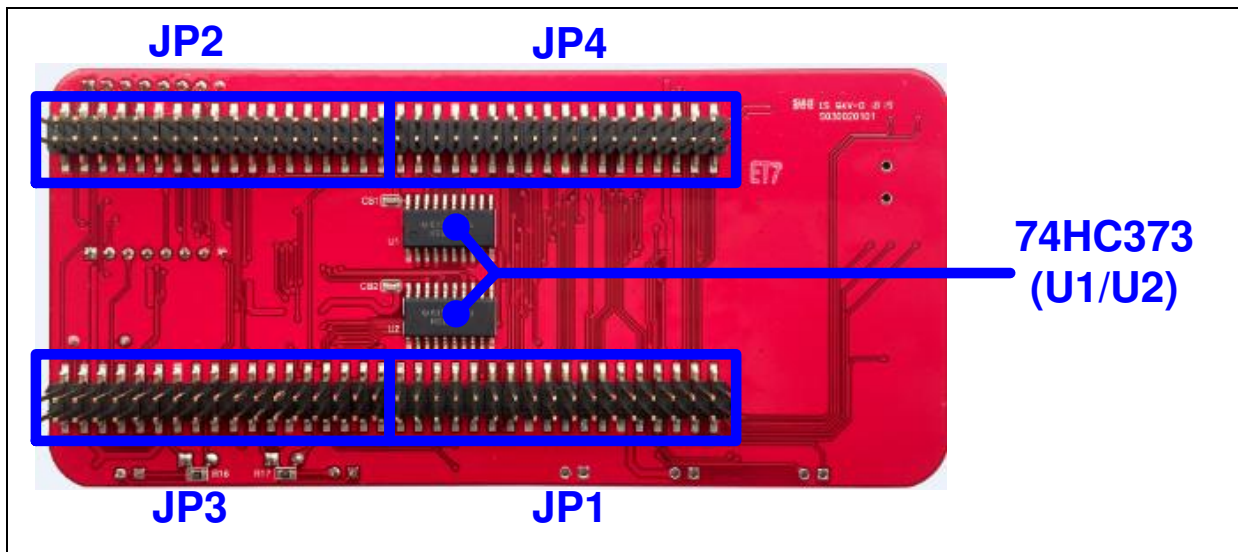


Figure 2-2 Rear View of NuMaker M487 Advance Board

### 2.3 The Connectors of NuMaker-PFM-M487 Board

The NuMaker-PFM-M487 board provides the M487JIDAE target chip onboard and extended connectors (JP6, JP7, JP8 and JP9) for LQFP144-pin. The Figure 2-3 shows the M487JIDAE extended connectors on the NuMaker-PFM-M487 board that should be connected to NuMaker M487 Advance board. The Table 2-1 to Table 2-4 shows the mapping tables on these connector headers of these two boards.

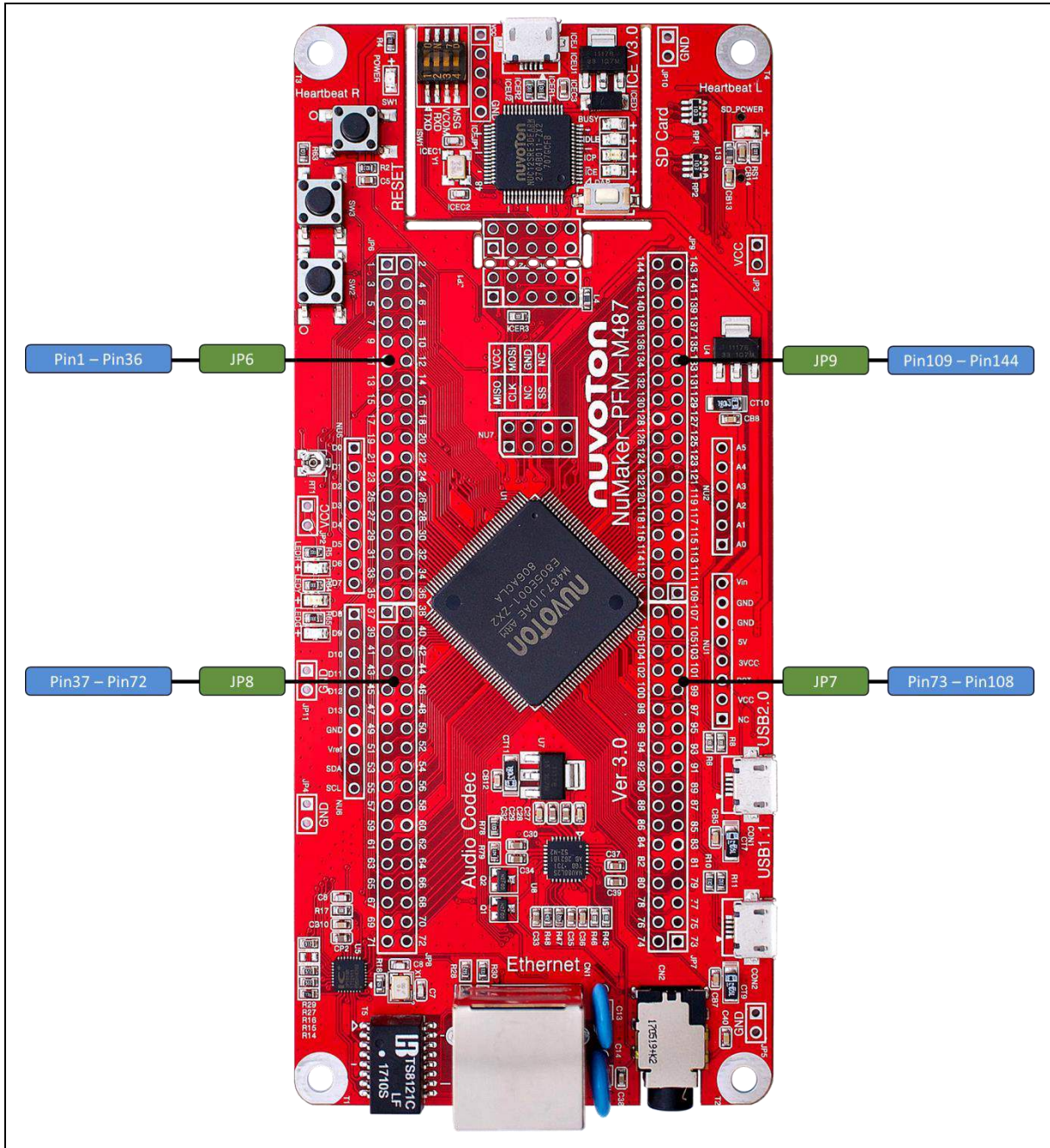


Figure 2-3 Connectors of NuMaker-PFM-M487

Table 2-1 Connector JP1 Mapping to Connector JP6 of NuMaker-PFM-M487

Header	M487	M487 PFM	Advance Board	Header	M487	M487 PFM	Advance Board	
	GPIO	Function	Function		GPIO	Function	Function	
JP1	JP1.1	PB.5	SD0_DAT3	-	JP1.2	PB.4	SD0_DAT2	-
	JP1.3	PB.3	-	IO1 (JP7)	JP1.4	PB.2	OPA0_O	EPWM0_CH3* <sup>1</sup> (Mikro Bus)
	JP1.5	PC.12	-	SPI3_MISO (Mikro Bus)	JP1.6	PC.11	-	SPI3_MOSI (Mikro Bus)
	JP1.7	PC.10	-	Down (Joystick)	JP1.8	PC.9	-	Left (Joystick)
	JP1.9	PB.1	OPA0_N	I2C1_SCL* <sup>1</sup> (Mikro Bus)	JP1.10	PB.0	OPA0_P	I2C1_SDA* <sup>1</sup> (Mikro Bus)
	JP1.11	VSS	GND	GND	JP1.12	VDD	3VCC	3VCC
	JP1.13	PA.11	-	A18 (SRAM)	JP1.14	PA.10	OPA1_O	A17* <sup>1</sup> (SRAM)
	JP1.15	PA.9	OPA1_N	A16* <sup>1</sup> (SRAM)	JP1.16	PA.8	OPA1_P	EBI_ALE* <sup>1</sup> (SRAM)
	JP1.17	PC.13	JKDET	-	JP1.18	PD.12	OPA2_O	BPWM0_CH5* <sup>1</sup> (Buzzer)
	JP1.19	PD.11	OPA2_N	EBI_nCS1* <sup>1</sup> (SRAM)	JP1.20	PD.10	OPA2_P	INT7* <sup>1</sup> (Mikro Bus)
	JP1.21	VSS	GND	GND	JP1.22	VDD	3VCC	3VCC
	JP1.23	PG.0	-	UART1_TXD (Mikro Bus)	JP1.24	PG.1	-	UART1_RXD (Mikro Bus)
	JP1.25	PG.2	-	Up (Joystick)	JP1.26	PG.3	-	Center (Joystick)
	JP1.27	PG.4	-	Right (Joystick)	JP1.28	PF.11	SW3	-
	JP1.29	PF.10	I2S0_BCLK	-	JP1.30	PF.9	I2S0_MCLK	-
	JP1.31	PF.8	I2S0_DI	-	JP1.32	PF.7	I2S0_DO	-
	JP1.33	PF.6	I2S0_LRCK	-	JP1.34	VBAT	VBAT	-
	JP1.35	PF.5	XT32_IN	-	JP1.36	PF.4	XT32_OUT	-

Note 1: These pins share the same GPIO pins with those dedicated pin-functions on the NuMaker-PFM-M487 board. Please make sure these related resistors are open (these resistors are NC in default) on the NuMaker-PFM-M487 board and switch all "ON" for these pins on the SW3 of the MuMaker M487 Advance board to implement the application functions on this NuMaker M487 Advance board.

Table 2-2 Connector JP3 Mapping to Connector JP8 of NuMaker-PFM-M487

Header		M487	M487 PFM	Advance Board	Header		M487	M487 PFM	Advance Board
		GPIO	Function	Function			GPIO	Function	Function
JP3	JP3.1	PH.0	LEDR* <sup>3</sup>	UART5_TXD <sup>*2</sup> (RS485)	JP3	JP3.2	PH.1	LEDY* <sup>3</sup>	UART5_RXD* <sup>2</sup> (RS485)
	JP3.3	PH.2	LEDG* <sup>3</sup>	UART5_nRTS <sup>*2</sup> (RS485)		JP3.4	PH.3	-	LCD_RS (LCD)
	JP3.5	PH.4	-	LCD_XL (LCD)		JP3.6	PH.5	-	LCD_YD (LCD)
	JP3.7	PH.6	-	LED2 (LEDR1)		JP3.8	PH.7	-	LED1 (LEDG1)
	JP3.9	PF.3	XT1_IN	-		JP3.10	PF.2	XT1_OUT	-
	JP3.11	VSS	GND	GND		JP3.12	VDD	3VCC	3VCC
	JP3.13	PE.8	EMAC_MDC	-		JP3.14	PE.9	EMAC_MDIO	-
	JP3.15	PE.10	EMAC_TXD0	-		JP3.16	PE.11	EMAC_TXD1	-
	JP3.17	PE.12	EMAC_TXEN	-		JP3.18	PE.13	#JKEN	-
	JP3.19	PC.8	EMAC_REFCLK	-		JP3.20	PC.7	EMAC_RXD0	-
	JP3.21	PC.6	EMCAC_RXD1	-		JP3.22	PA.7	EMAC_RXDV	-
	JP3.23	PA.6	EMAC_RXERR	-		JP3.24	VSS	GND	GND
	JP3.25	VDD	3VCC	3VCC		JP3.26	LDO	LDO_CAP	-
	JP3.27	PA.5	-	CAN0_TXD (CAN)		JP3.28	PA.4	-	CAN0_RXD (CAN)
	JP3.29	PA.3	-	C2 (CAN)		JP3.30	PA.2	-	C1 (CAN)
	JP3.31	PA.1	-	SW2 (Key button)		JP3.32	PA.0	-	SW1 (Key button)
	JP3.33	VDDIO	VDDIO	-		JP3.34	PE.14	-	EBI_AD8 (LCD/SRAM)
	JP3.35	PE.15	-	EBI_AD9 (LCD/SRAM)		JP3.36	nRESET	nRESET	RST (Mikro Bus)

Note 2: These LEDs (LEDR, LEDY and LEDG) of NuMaker-PFM-M487 board share the same pins (PH.0, PH.1 and PH.2) with these RS485 signals (UART5\_TXD, UART5\_RXD and UART5\_nRTS) of NuMaker M487 Advance board. When RS485 function is running on NuMaker M487 Advance board, user can ignore the status of these LEDs on NuMaker-PFM-M487 board.

Table 2-3 Connector JP2 Mapping to Connector JP7 of NuMaker-PFM-M487

Header	M487	M487 PFM	Advance Board	Header	M487	M487 PFM	Advance Board		
	GPIO	Function	Function		GPIO	Function	Function		
<b>JP2</b>	JP2.1	PF.0	ICEDAT	-	<b>JP2</b>	JP2.2	PF.1	ICECLK	-
	JP2.3	PD.9	-	EBI_AD7 (LCD/SRAM)		JP2.4	PD.8	-	EBI_AD6 (LCD/SRAM)
	JP2.5	PC.5	SPIM_D2	-		JP2.6	PC.4	SPIM_D3	-
	JP2.7	PC.3	SPIM_SS	-		JP2.8	PC.2	SPIM_CLK	-
	JP2.9	PC.1	SPIM_MISO	-		JP2.10	PC.0	SPIM_MOSI	-
	JP2.11	VSS	GND	GND		JP2.12	VDD	3VCC	3VCC
	JP2.13	PG.9	-	EBI_AD0 (LCD/SRAM)		JP2.14	PG.10	-	EBI_AD1 (LCD/SRAM)
	JP2.15	PG.11	-	EBI_AD2 (LCD/SRAM)		JP2.16	PG.12	-	EBI_AD3 (LCD/SRAM)
	JP2.17	PG.13	-	EBI_AD4 (LCD/SRAM)		JP2.18	PG.14	-	EBI_AD5 (LCD/SRAM)
	JP2.19	PG.15	SW2	-		JP2.20	PD.3	-	IO2 (JP7)
	JP2.21	PD.2	-	INT (MPU6500)		JP2.22	PD.1	I2C2_SCL	I2C2_SCL (MPU6500/ EEPROM)
	JP2.23	PD.0	I2C2_SDA	I2C2_SDA (MPU6500/ EEPROM)		JP2.24	PD.12	SD0_nCD	
	JP2.25	PA.12	USB_VBUS	5V_IN (Mikro Bus)		JP2.26	PA.13	USB_D-	-
	JP2.27	PA.14	USB_D+	-		JP2.28	PA.15	USB_OTG_ID	-
	JP2.29	HSUSB_VRES	HSUSB_VRES	-		JP2.30	HSUSB_VDD33	HSUSB_VDD33	-
	JP2.31	HSUSB_VBUS	HSUSB_VBUS	5V_IN (Mikro Bus)		JP2.32	HSUSB_D-	HSUSB_D-	-
	JP2.33	HSUSB_VSS	HSUSB_VSS	-		JP2.34	HSUSB_D+	HSUSB_D+	-
	JP2.35	HSUSB_VDD12_CAP	HSUSB_VDD12_CAP	-		JP2.36	HSUSB_ID	HSUSB_ID	-

Table 2-4 Connector JP4 Mapping to Connector JP9 of NuMaker-PFM-M487

Header	M487	M487 PFM	Advance Board	Header	M487	M487 PFM	Advance Board		
	GPIO	Function	Function		GPIO	Function	Function		
<b>JP4</b>	JP4.1	PE.7	SD0_CMD	-	<b>JP4</b>	JP4.2	PE.6	SD0_CLK	-
	JP4.3	PE.5	-	EBI_nRD (LCD/SRAM)		JP4.4	PE.4	-	EBI_nWR (LCD/SRAM)
	JP4.5	PE.3	SD0_DAT1	-		JP4.6	PE.2	SD0_DAT0	-
	JP4.7	VSS	GND	GND		JP4.8	VDD	3VCC	3VCC
	JP4.9	PE.1	-	EBI_AD10 (LCD/SRAM)		JP4.10	PE.0	-	EBI_AD11 (LCD/SRAM)
	JP4.11	PH.8	-	EBI_AD12 (LCD/SRAM)		JP4.12	PH.9	-	EBI_AD13 (LCD/SRAM)
	JP4.13	PH.10	-	EBI_AD14 (LCD/SRAM)		JP4.14	PH.11	-	EBI_AD15 (LCD/SRAM)
	JP4.15	PD.14	-	EBI_nCS0 (LCD)		JP4.16	PG.5	-	SPI3_SS (Mikro Bus)
	JP4.17	PG.6	-	SPI3_CLK (Mikro Bus)		JP4.18	PG.7	-	EBI_nWRL (SRAM)
	JP4.19	PG.8	-	EBI_nWRH (SRAM)		JP4.20	VSS	GND	GND
	JP4.21	LDO	LDO_CAP	-		JP4.22	VDD	3VCC	3VCC
	JP4.23	PC.14	USB_VBUS_ST	-		JP4.24	PB.15	USB_VBUS_EN	-
	JP4.25	PB.14	EADC0_CH14	EADC0_CH14 <sup>3</sup> (Mikro Bus)		JP4.26	PB.13	UART0_TXD	-
	JP4.27	PB.12	UART0_RXD	-		JP4.28	AVDD	AVDD	AVDD
	JP4.29	VREF	VREF	-		JP4.30	AVSS	ADAVSS	AVSS
	JP4.31	PB.11	HSUSB_VBUS_ST	-		JP4.32	PB.10	HSUSB_VBUS_EN	-
	JP4.33	PB.9	-	LCD_XR (LCD)		JP4.34	PB.8	-	LCD_YU (LCD)
	JP4.35	PB.7	-	LCD_BL (LCD)		JP4.36	PB.6	-	LCD_RESET (LCD)

Note 3: This pin shares the same GPIO pin with the dedicated pin-function on the NuMaker-PFM-M487 board. Please make sure this related resistor is open (the resistor is NC in default) on the NuMaker-PFM-M487 board and switch "ON" for this pin on the SW3 of the MuMaker M487 Advance board to implement the application function on this NuMaker M487 Advance board.

## 2.4 PCB Placement

Figure 2-4 and Figure 2-5 show the front and rear placement of NuMaker M487 Advance board.

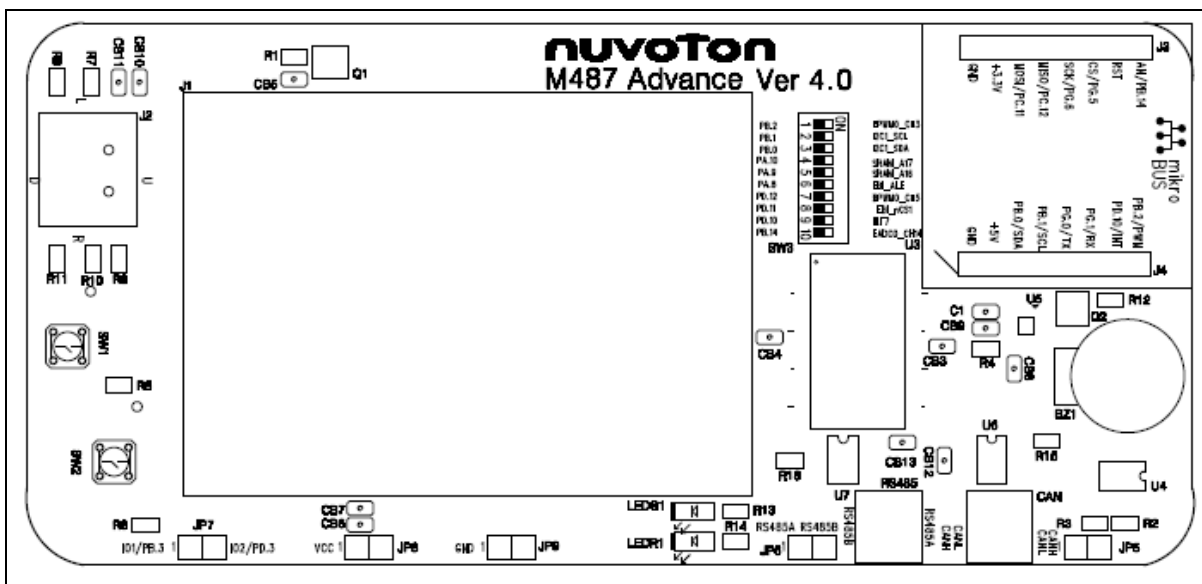


Figure 2-4 Front Placement

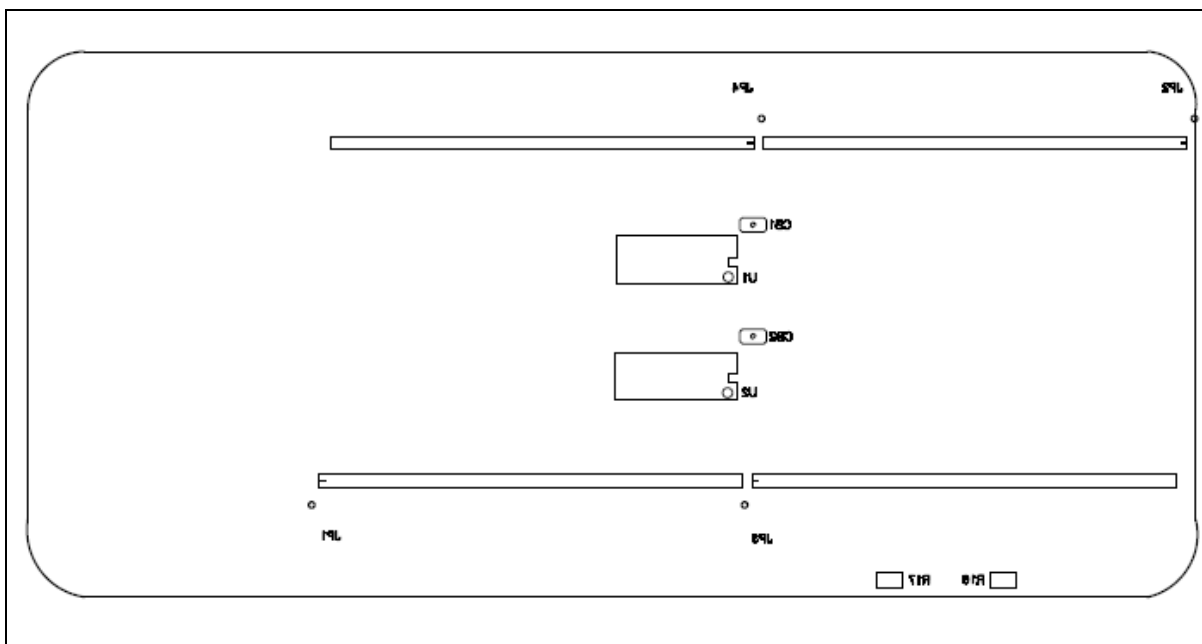


Figure 2-5 Rear Placement

### 3 NUMAKER M487 ADVANCE SCHEMATICS

#### 3.1 Header Connectors

Figure 3-1 shows the all the header connectors JP1~JP4 that should be connected to the header connectors JP6~JP9 of NuMaker-PFM-M487 board. For the SW3 switches, there are ten pins share the same GPIO pins with those dedicated pin-functions on the NuMaker-PFM-M487 board. Please make sure these related resistors are open (these resistors are NC in default) on the NuMaker-PFM-M487 board (Ver 3.0) and switch all "ON" for these pins on this SW3 to implement the application functions on the NuMaker M487 Advance board.

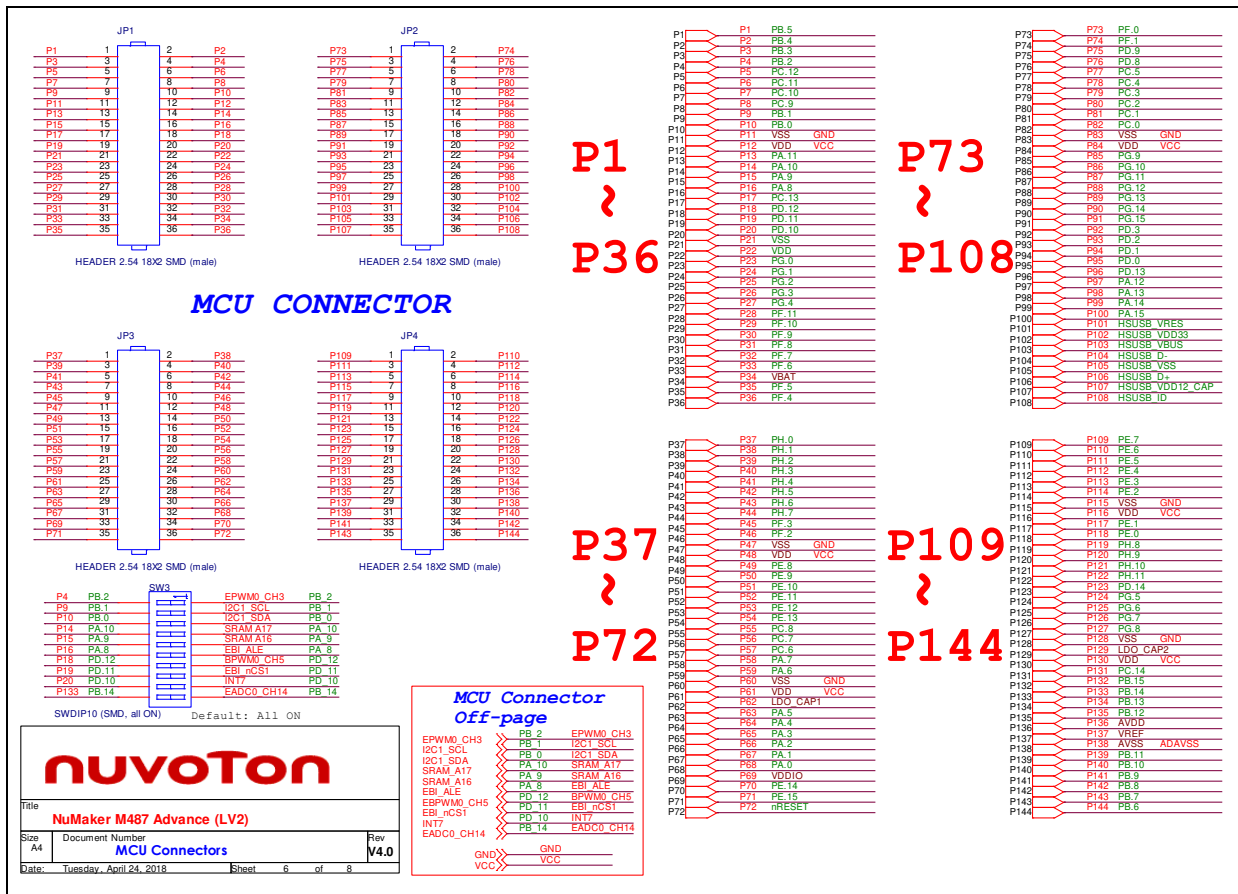


Figure 3-1 Header Connectors



### 3.2 QVGA TFT LCD Module with Touch

Figure 3-2 shows the QVGA TFT LCD module with touch circuit and the related EBI interface and GPIO control pins.

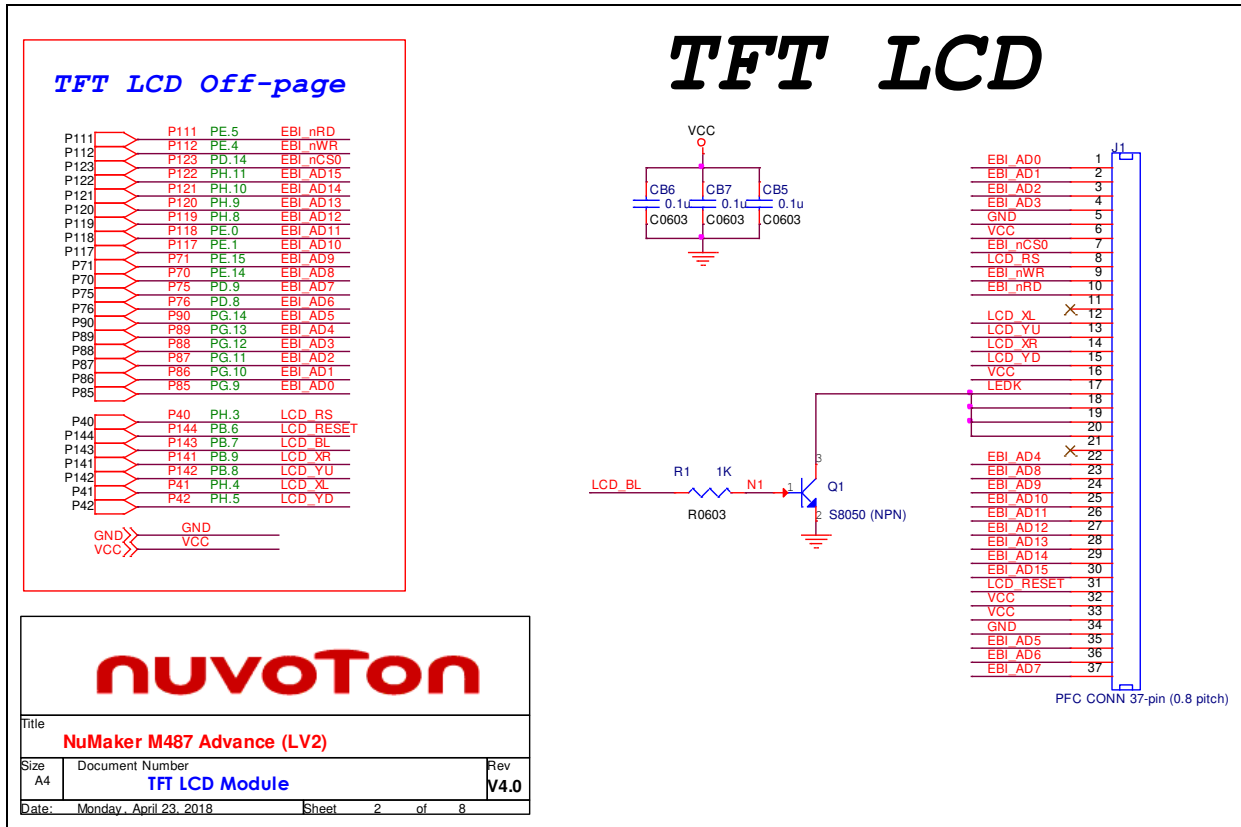


Figure 3-2 QVGA TFT LCD Module with Touch Circuit

### 3.3 SRAM (IS62WV51216B)

Figure 3-3 shows the SRAM (IS62WV51216B) circuit that can be accessed by M487 MCU through the EBI bus. But, the MSB address pins A16/A17/A18 to the SRAM are controlled by the GPIO (PA.9, PA.10 and PA.11) through the firmware controlled. These pins are not drove by the EBI bus directly.

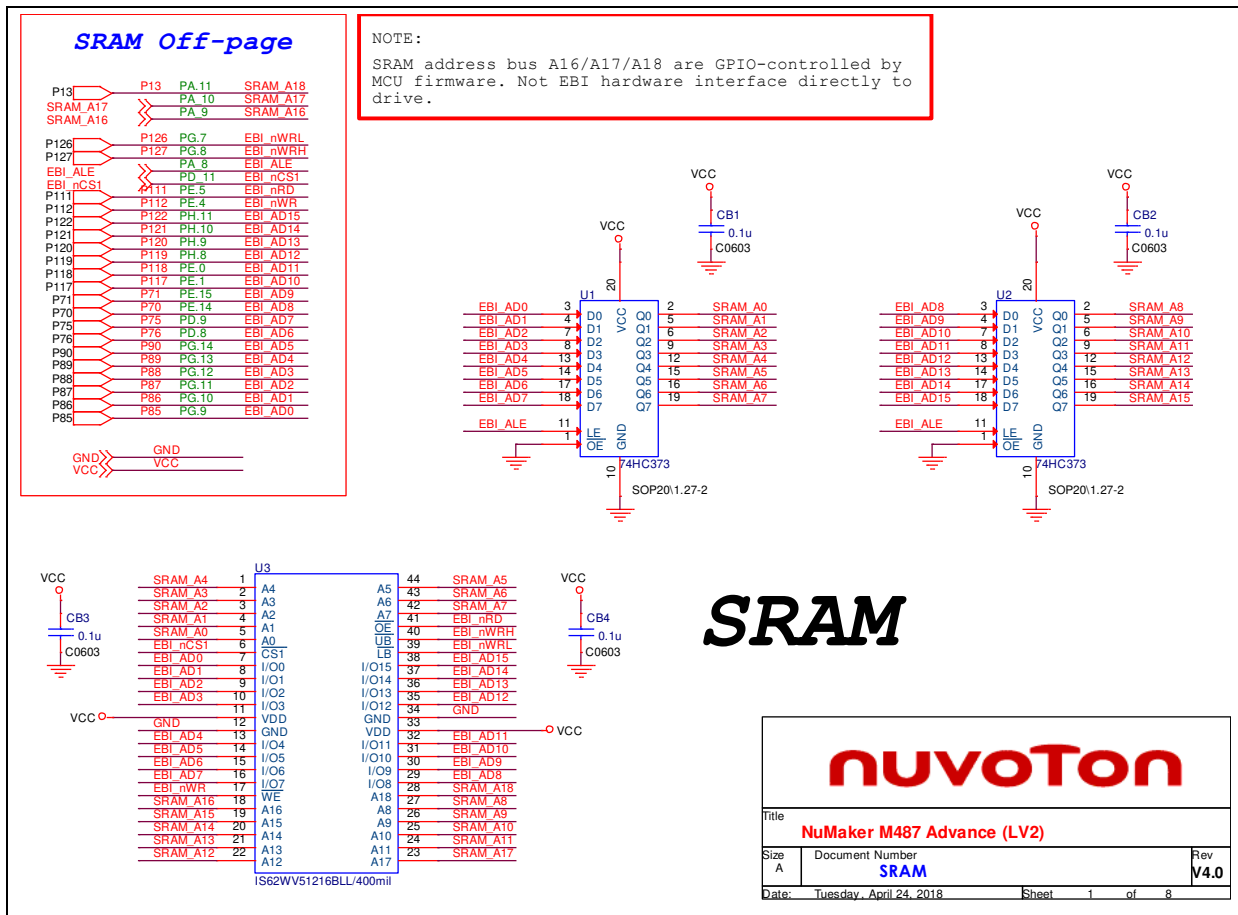


Figure 3-3 SRAM Circuit

### 3.4 I<sup>2</sup>C EEPROM (24LC64)

Figure 3-5 shows the I<sup>2</sup>C EEPROM (24LC64) circuit.

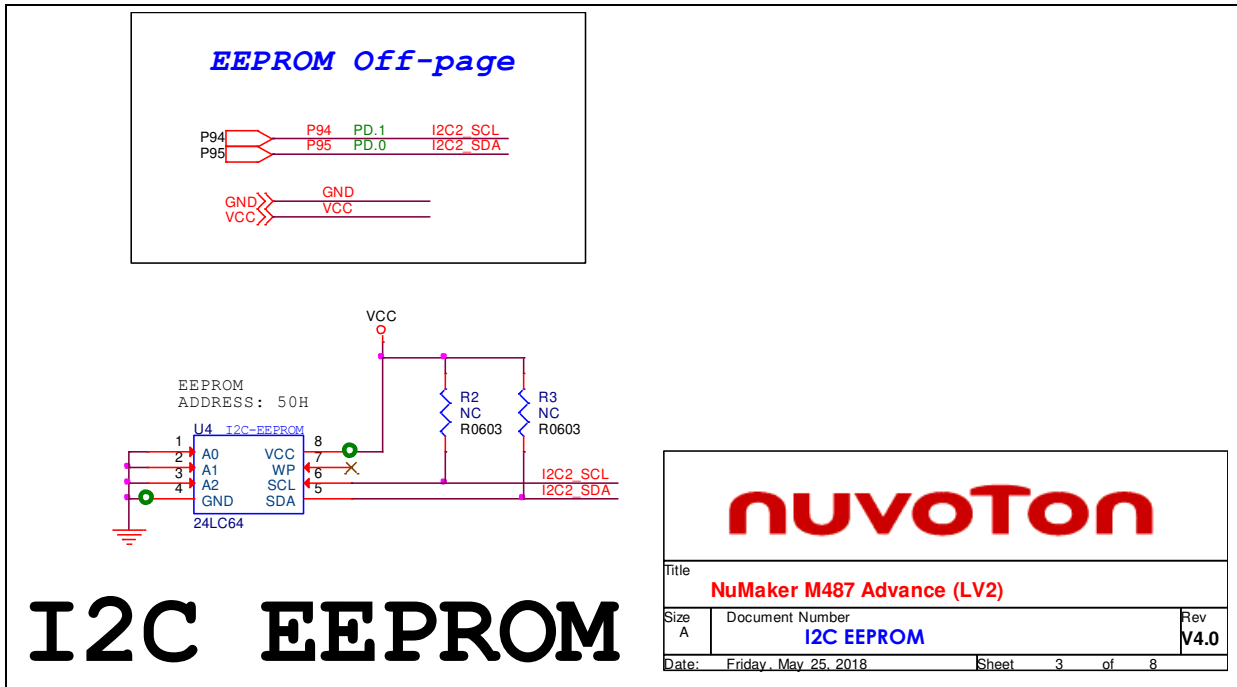


Figure 3-4 I<sup>2</sup>C EEPROM Circuit

### 3.5 I<sup>2</sup>C MEMS (MPU6500)

Figure 3-5 shows the I<sup>2</sup>C MEMS (MPU6500) circuit.

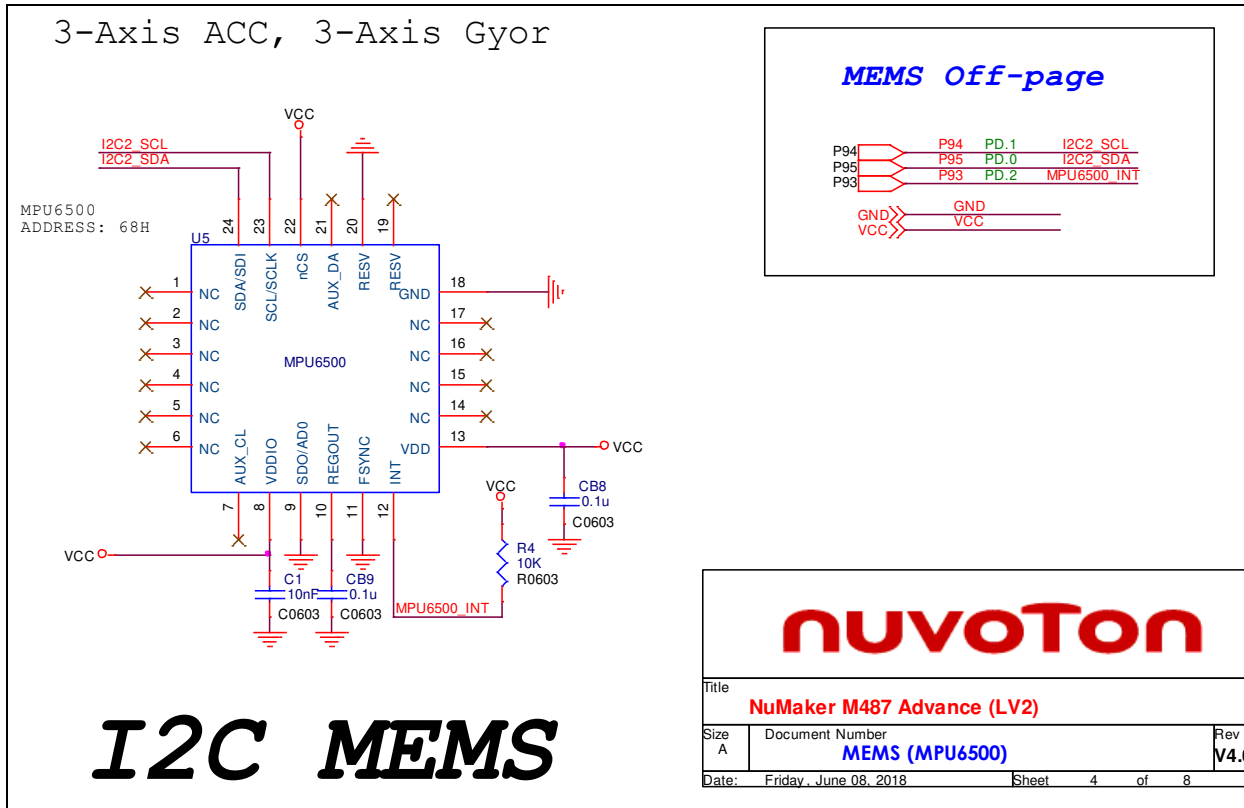


Figure 3-5 I<sup>2</sup>C MEMS Circuit

### 3.6 Joystick, Key Buttons, Buzzer, IO and LED

Figure 3-6 shows the joystick, key buttons, buzzer, IO and LED circuit.

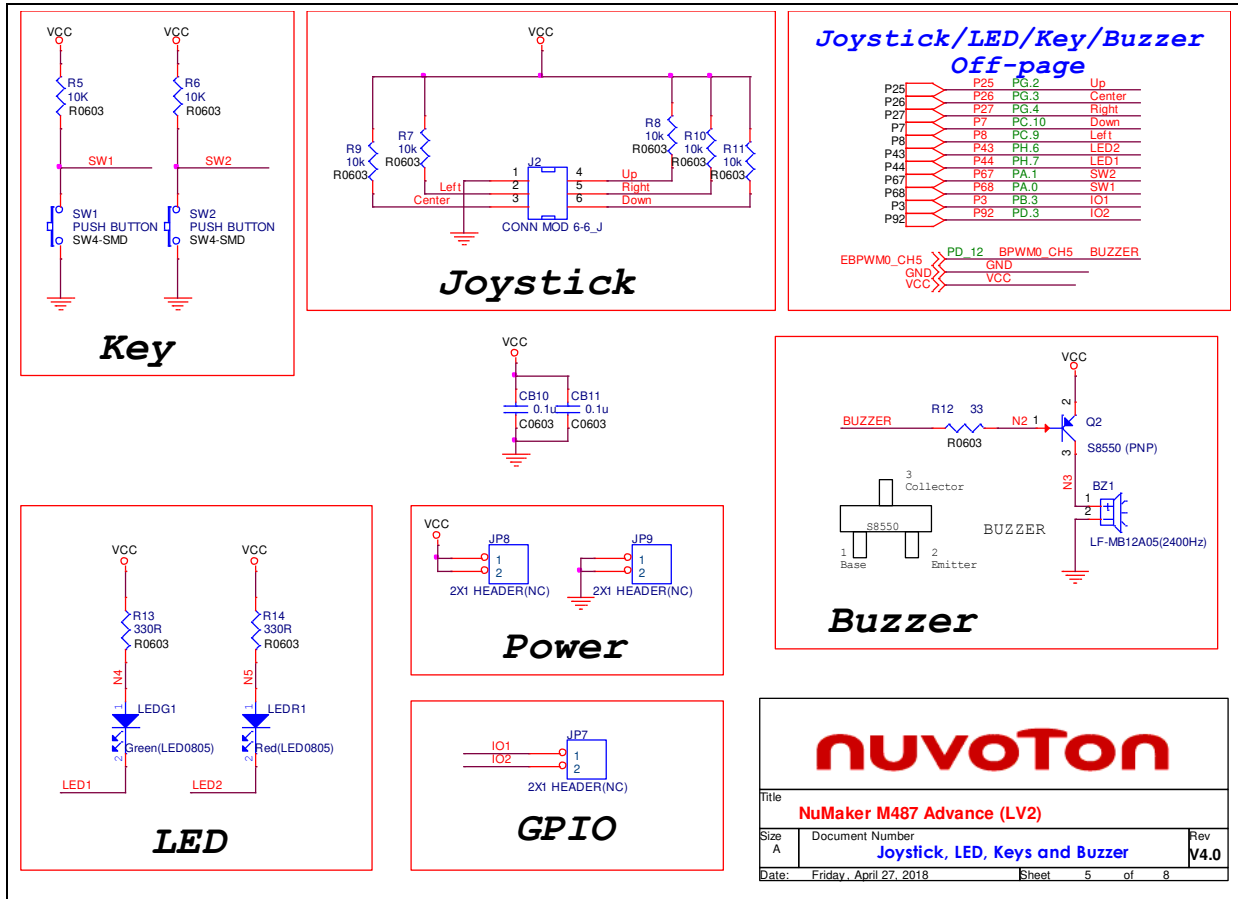


Figure 3-6 Joystick, Key Buttons, Buzzer, IO and LED Circuit

### 3.7 Mikro Bus

Figure 3-7 shows the Mikro Bus circuit.

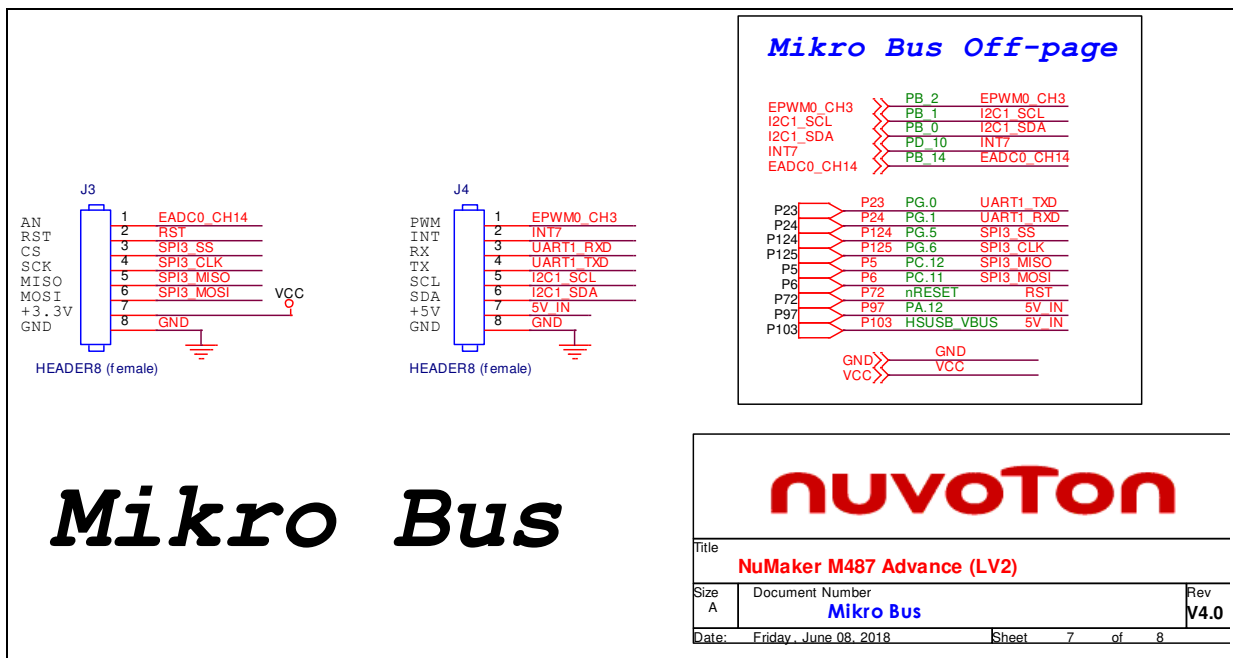


Figure 3-7 Mikro Bus Circuit

3.8 CAN and RS485

Figure 3-8 shows CAN and RS485 circuit.

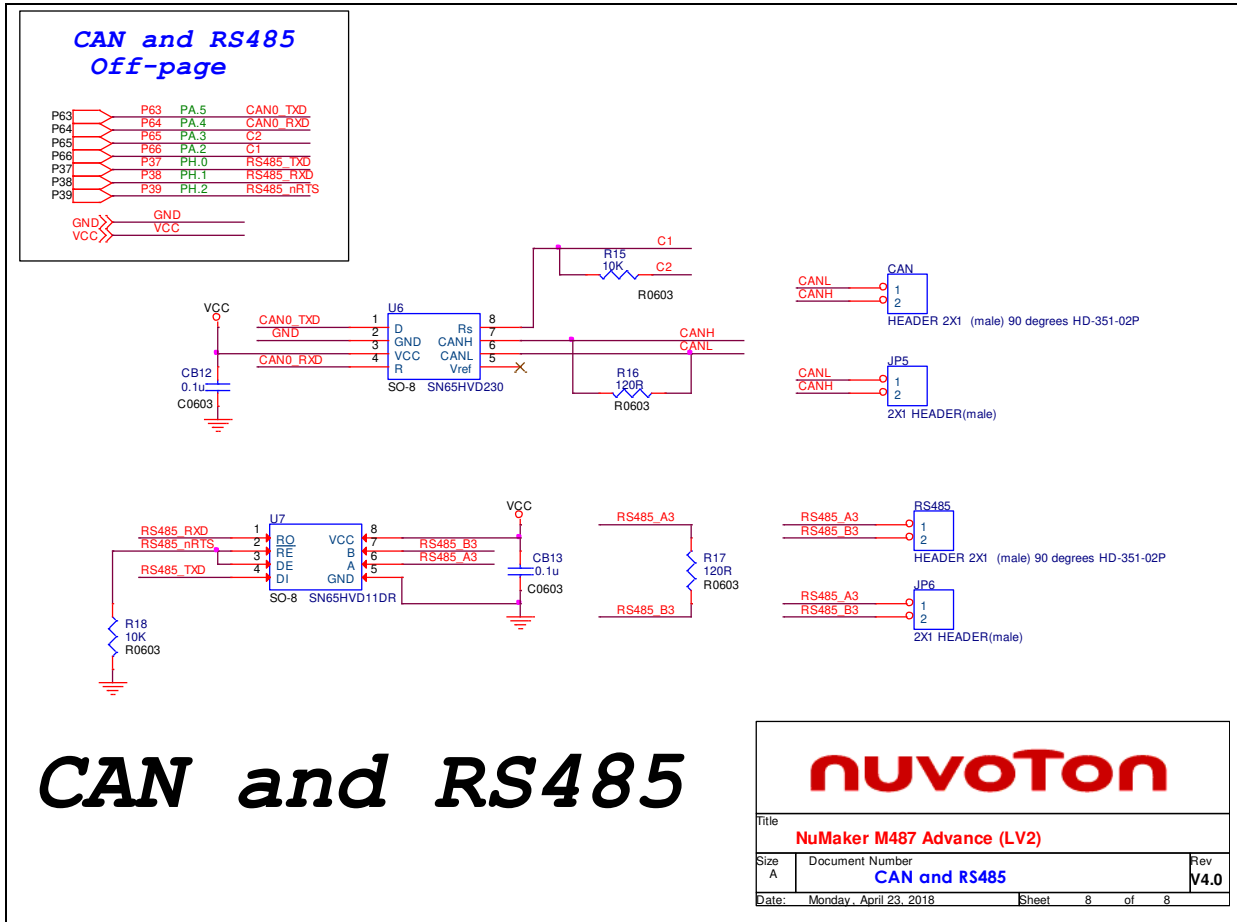


Figure 3-8 CAN and RS485 Circuit

**4 REVISION HISTORY**

Date	Revision	Description
2018.06.05	1.00	1. Initially issued.



### Important Notice

**Nuvoton Products are neither intended nor warranted for usage in systems or equipment, any malfunction or failure of which may cause loss of human life, bodily injury or severe property damage. Such applications are deemed, “Insecure Usage”.**

**Insecure usage includes, but is not limited to: equipment for surgical implementation, atomic energy control instruments, airplane or spaceship instruments, the control or operation of dynamic, brake or safety systems designed for vehicular use, traffic signal instruments, all types of safety devices, and other applications intended to support or sustain life.**

**All Insecure Usage shall be made at customer’s risk, and in the event that third parties lay claims to Nuvoton as a result of customer’s Insecure Usage, customer shall indemnify the damages and liabilities thus incurred by Nuvoton.**

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