



# Packing List

- 1 x FEB600 device.
- 1 x Terminal Block to DC Jack.

# Ordering Information

Part number : **FEB600-xyz-m-n-MN**

- **xyz** : The feature code of Processor
  - Q10 Fanless ARM system with 1.0GHz NXP i.MX 6Quad Cortex-A9 SoC.
  - D10 Fanless ARM system with 1.0GHz NXP i.MX 6Dual Cortex-A9 SoC.
  - U10 Fanless ARM system with 1.0GHz NXP i.MX 6DualLite Cortex-A9 SoC.
- **m** : The size code of DDR3 Memory on board
  - 1 1GB of DDR3.
  - 2 2GB of DDR3.
- **n** : The size code of eMMC on board
  - 4 4GB of eMMC.
  - 8 8GB of eMMC.
  - F 16GB of eMMC.
- **MN** : The Function Summary code
  - SS HDMI, 3x USB2.0, Mini USB 2.0 OTG, 1x COM, Micro SD socket, CANbus & Debug port, GPIO, Gigabit Ethernet, line-out/MIC-in, DC12V-in.
  - PS HDMI, 3x USB2.0, Mini USB 2.0 OTG, 1x COM, Micro SD socket, CANbus & Debug port, GPIO, Gigabit Ethernet, line-out/MIC-in, DC12V-in, PoE (802.3af/ PD mode A/ endsparn only )

# Optional Accessories

Part Number	Description
<input checked="" type="checkbox"/> EP21-B4356C	AP12356,802.11 a/b/g/n/ac(2T2R)+BT(V4.1 LE), mPCIe Wifi module.
<input checked="" type="checkbox"/> WFS001I401nnnO8	SMA(ST. JR)to IPEX(IV) cable, 50Ω, nnn=130/230/400mm.
<input checked="" type="checkbox"/> LN1RF2G20M0	2.4/5Ghz, 2dBi-antenna, SMA(ST. PR), bendable, 110mm.

## Revision histories

Rev. No.	Date	Substantial Changes
1.0	2018/06	First issue.

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# 1. General Information

The FORENEX FEB600 BoxPC is an ultra-compact solution designed to take full advantage of ARM-based ultra-energy-saving and easily create a variety of easy-to-assemble, fanless system designs for a wide range of industrial automation, transportation, HMI and energy management applications.

The FEB600 is a completely fanless system. Its rugged design can endure a wide operating temperature range of -20 ° C to 70 ° C, and it consumes extremely low power under typical operating conditions. In addition, an optional miniPCIe slot is provided for 5G / Wi-Fi connection.

Comprehensive I / O functions on the front and rear panels make the FEB600 a flexible solution for a variety of embedded applications.

The heart of the FEB600 PC box is the i.MX 6Quad/Dual/DualLite processor which provides all of the interfaces necessary for connecting peripherals such as:

- Networking:** RJ45 Gigabit Ethernet port, an optional miniPCIe Wi-Fi(WLAN) connectivity.
- Serial port:** Mini USB 2.0 OTG port, USB 2.0 port, COM1/485/422 port, CAN/Debug port.
- Display:** HDMI® 1.4 port.
- Audio:** Stereo Line-out jack, MIC-in jack.
- Expansion storage & GPIO:** Micro SD slot, DIO port.
- Others:** Micro SD/eMMC boot select switch, reset button, power LED, Wi-Fi LED.

## 1-1. Features

### 1-1-1. ARM based System

ARM based Pico-ITX alike board with an NXP i.MX6 Quad (Dual or DualLite) Cortex-A9 ARM SoC, offering high performance processing optimized for the lowest power consumption.

### 1-1-2. Ultra compact, Ruggedized and Fanless

The FEB600 fanless system is a 143mm (W) x 60mm (H) x 74mm (D) ruggedized chassis, which is suitable to install in a space critical environment to ensure maximum reliability. The chassis design has a ridged aluminum top cover does also acts as the heatsink of the NXP i.MX6 processor.

### 1-1-3. The Operating Temperature

This provide a wide range from -20°C up to 70°C, suitable for critical environment applications.

**\*\*Note:** The Operating Temperature is a result of testing performed in an experimental chamber.

It is highly suggested to execute a solid testing under an actually application environment.

### 1-1-4. Storage Expansion

The Micro SD/SDHC card slot enables the FEB600 to have a flexible storage up to 32GB size.

**\*\*Note:** More frequent and larger data access on eMMC memory makes its lifespan shorter.

Therefore, it is highly recommended to use a Micro SD card for large data access.

### 1-1-5. Networking Option

The FEB600 is equipped with RJ-45 port that supports high speed Gigabit Ethernet. An optional miniPCIe slot is provided for 2.4G/5Ghz, Wi-Fi (WLAN) connectivity. The wireless module (Wi-Fi) complies with IEEE 802.11a/b/g/n/ac 2x2 MIMO standard.

### 1-1-6. Power over Ethernet option

Integrated 802.3af, mode A (endspan) only, Powered Device (PD) controller and switching regulator intended for high power IEEE 802.3at and 802.3af applications. The power over Ethernet (PoE) PD board can output 15.4W of power. The FEB600 can be operated using either PoE or external adaptors (12V).

### 1-1-7. Embedded OS ready

Android 6.0, Linux 4.1.15.

Yocto Project2.0 with QT 5.4 (Weston Wayland UI).

## 1-2. Product Specifications

### **Processor:**

- ✓ 1.0GHz NXP i.MX 6Quad Cortex-A9 SoC (FEB600-Q10xx).
- ✓ 1.0GHz NXP i.MX 6Dual Cortex-A9 SoC (FEB600-D10xx).
- ✓ 1.0GHz NXP i.MX 6DualLite Cortex-A9 SoC (FEB600-U10xx).

### **System Memory:**

- ✓ 2GB DDR3-1066 SDRAM onboard.

### **Storage:**

- ✓ 8GB eMMC Flash memory.

### **Graphics:**

#### ***Vivante GC2000 GPU (FEB600-Q10xx & FEB600-D10xx)***

- ✓ Two (identical) Image Processing Units (IPUs).
- ✓ Supports HDMI 1.4 port.
- ✓ Supports Hardware Graphics acceleration: OpenGL® ES 3.0, OpenCL and OpenVG™ 1.1.
- ✓ Supports Hardware video acceleration: HD1080p60 Decode, Dual HD720p Encode.

#### ***Vivante GC880 GPU (FEB600-U10xx)***

- ✓ Two (identical) Image Processing Units (IPUs).
- ✓ Supports HDMI 1.4 port.
- ✓ Supports Hardware Graphics acceleration: OpenGL® ES 3.0, OpenVG™ 1.1.
- ✓ Supports Hardware video acceleration: HD1080p30 Decode, Dual HD720p Encode.

### **LAN:**

- ✓ Atheros AR8031 Gigabit Ethernet transceiver with RGMII support.

### **WLAN: (Optional)**

- ✓ 2.4G/5Ghz Wi-Fi module with miniPCIe interface. The wireless module complies with IEEE 802.11a/b/g/n/ac 2x2 MIMO standard.

### **Audio:**

- ✓ NXP SGTL5000 low power stereo codec.

### **USB:**

- ✓ MicroChip USB2514 USB 2.0 high speed 4-port hub controllers.

### **CAN:**

- ✓ MicroChip MCP2551T\_I EMC optimized CAN transceiver.



**Front Panel I/O:**

- ✓ 1 x 2-pole Phoenix DC jack.
- ✓ 1 x Power LED & WLAN/WPAN/WWAN LED (if Wi-Fi has installed).
- ✓ 1 x COM1 port (supports 5-wire TX/RX/RTS/CTS) RS232 DTE mode/RS485/RS422.
- ✓ 1 x Gigabit Ethernet port (supports optional IEEE802.3 af type 1).
- ✓ 1 x Micro SD/eMMC boot select switch.
- ✓ 2 x Antenna holes for 5G/Wi-Fi.

**Rear Panel I/O:**

- ✓ 1 x Reset button.
- ✓ 1 x HDMI® port.
- ✓ 1 x Mini USB 2.0 type B port support OTG.
- ✓ 3 x USB 2.0 type A ports.
- ✓ 1 x Micro SD/SDHC card slot.
- ✓ 1 x CAN/Debug port supports one COM2(supports 2-wire TX/RX) and two CAN bus support CAN Protocol specification Version 2.0 B) through a cable.
- ✓ 1 x DIO port supports eight GPIOs.
- ✓ 1 x Audio jack for Line-out(default)/Earphone-out(option).
- ✓ 1 x Audio jack for Mic-in(default)/Line-in(option).

**Dimension (W x D x H):**

- ✓ 143mm x 74mm x 60mm (5.6" x 2.9" x 2.4").

**Weight:**

- ✓ TBD.

**Operating Temperature:**

- ✓ -20°C ~ 70°C.

**Operating Humidity:**

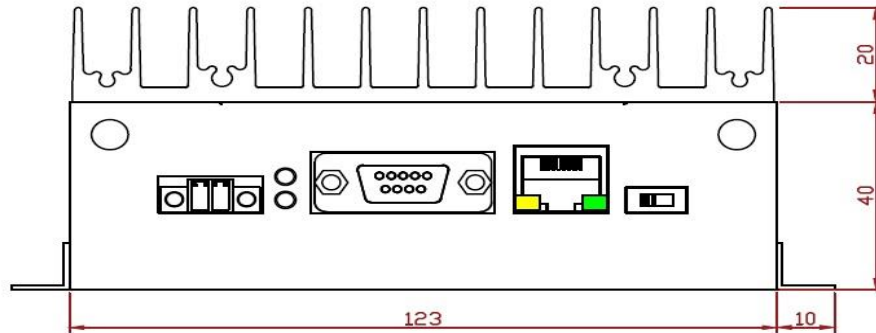
- ✓ 0% ~ 90% @ 45°C (non-condensing).

**Operating System:**

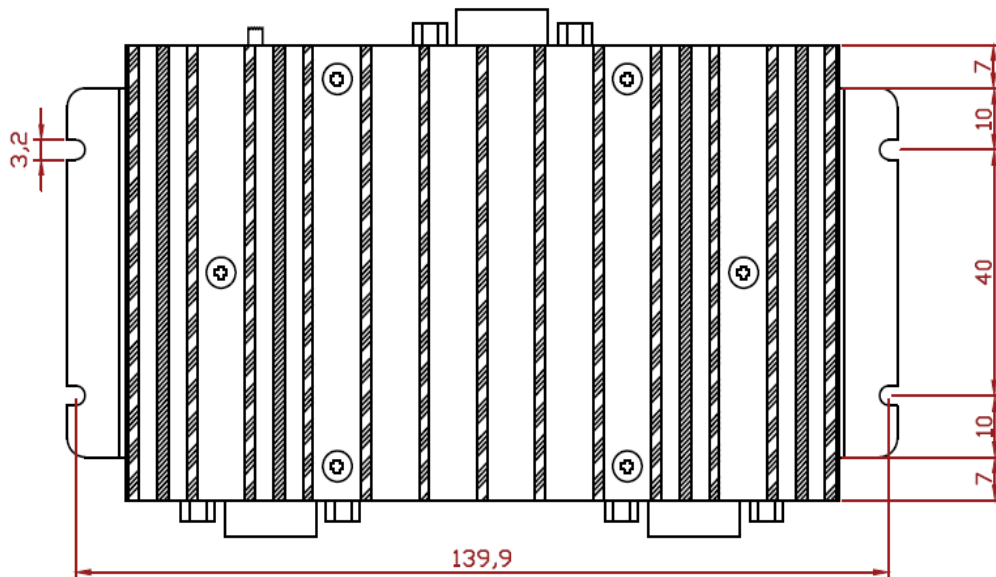
- ✓ Android 6.0, Linux 4.1.15 (AMOS-820-QP SKU).
- ✓ Yocto Project2.0 with QT 5.4 (Weston Wayland UI).

## 1-3. Outline Dimensions

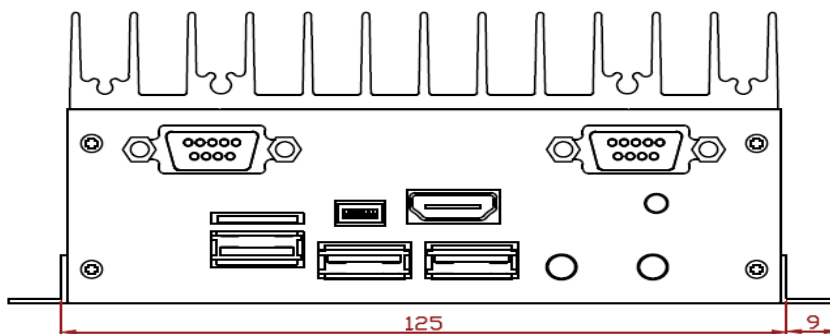
### 1-3-1. Front view



### 1-3-2. Top view

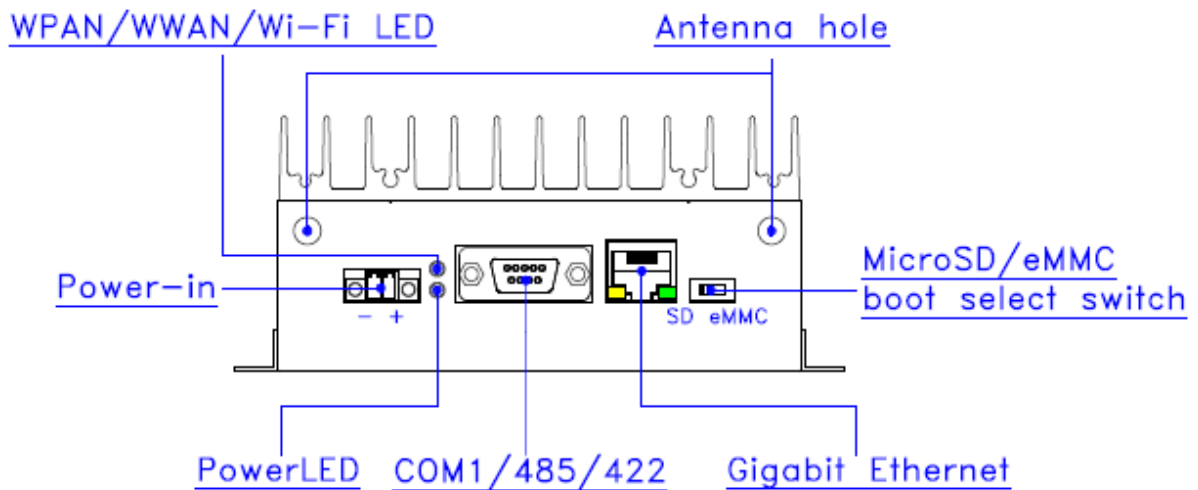


### 1-3-3. Rear view

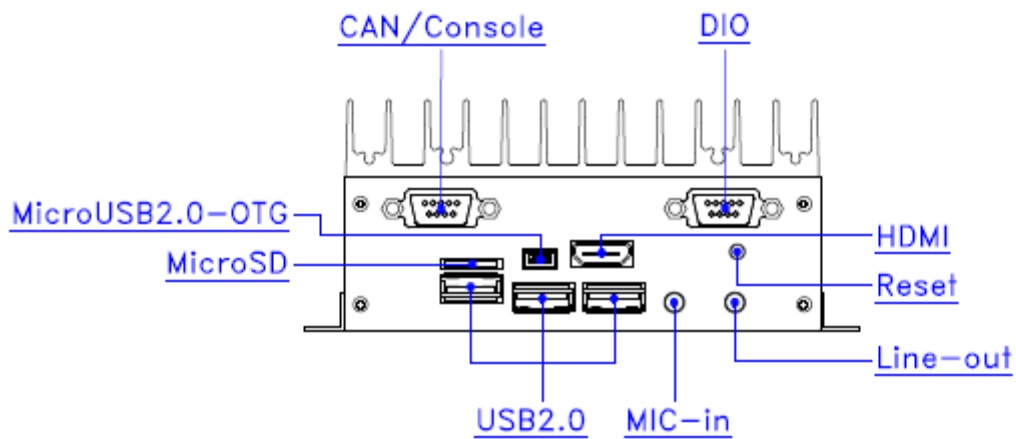


## 1-4. Peripherals Port layout diagram

### 1-4-1. Front Panel



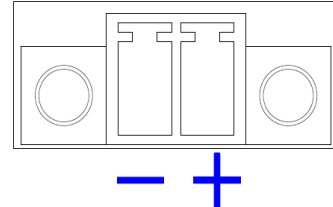
### 1-4-2. Rear Panel



## 2. Peripherals Port Description

### 2-1. DC-in Jack

- On front panel, carries external power input.



- Pin Assignment:

Connector: ( 2-pole Phoenix DC Jack )	
Pin number	Description
1	DC12V ~ 24V
2	GND

### 2-2. LEDs Indicator

- On front panel.
- The green LED indicates the system's power is plugged.
- The red LED indicates the WPAN/WWAN status of the Wi-Fi module as installed.

### 2-3. Micro SD/eMMC boot select switch

- On front panel.
- The FEB600 comes with a boot select switch which allows users to select boot device from Micro SD and eMMC.

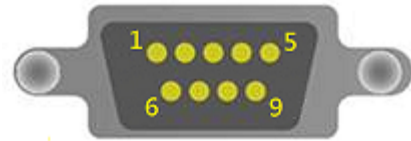


**To boot from eMMC device**

**To boot from SD card**

## 2-4. COM1 Port

- On front panel.
- The integrated 9-pin of COM1 port provides optional RS232/485/422 three operating modes.
- **Please note the following!!!**
  - Even though the COM1 can be selected as RS232, RS422 or RS485 operating modes, these absolutely cannot be used simultaneously.
  - It is not allowed to use those pins which are specified with “DNC” in each individual operating mode.



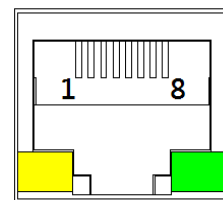
- Pin Assignment:

Connector: ( DB-9/DTE-Male )			
Pin number	RS232 mode	RS422 mode	RS485 mode
1	DNC	422-RX-A/Y	DNC
2	COM1-RX (SIN)	DNC	DNC
3	COM1-TX (SOUT)	DNC	DNC
4	DNC	422-TX-A/Y	485-A/Y
5	GND	GND	GND
6	DNC	422-RX-B/Z	DNC
7	COM1-RTS	DNC	DNC
8	COM1-CTS	DNC	DNC
9	DNC	422-TX-B/Z	485-B/Z

“DNC”- means do not connection

## 2-5. Gigabit Ethernet Port

- On front panel.
- The integrated 8-pin Gigabit Ethernet port is using an 8 Position 8 Contact (8P8C) receptacle connector (commonly referred to as RJ-45).
- The Gigabit Ethernet port (RJ-45 port) has two individual LED indicators located on the front side to show:
  - Active LED is blinking in **green** color means activity of data flow IN or OUT of the device.
  - Link LED is in **Red** color means devices is operating in speeds 10/100Mbps.  
Link LED is in **Green** color means devices is operating in speeds 1000Mbps.



## 2-6. Reset Button

- On rear panel.
- Makes system warm start.

## 2-7. USB 2.0 Port

- On rear panel.
- The FEB600 provides three USB 2.0 ports. Each USB port gives complete hot plug capability and complies with USB UHCI, Rev. 2.0.
- Pin Assignment:

<b>Connector: ( USB Type A )</b>	
<b>Pin number</b>	<b>Description</b>
1	+5V
2	USB Data -
3	USB Data +
4	GND

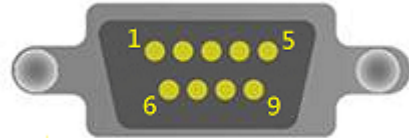
## 2-8. Mini USB OTG Port

- On rear panel.
- The Mini USB 2.0 OTG(On-The-Go) port.
- The FEB600 is regarded as an USB device by default when connected to an USB host.
- Pin Assignment:

<b>Connector: ( Mini USB Type B )</b>	
<b>Pin number</b>	<b>Description</b>
1	VBUS
2	D-
3	D+
4	ID
5	GND

## 2-9. CAN/Debug Port

- On rear panel.
- The integrated 9-pin of CAN/Debug port uses a male DB-9 connector. The CAN bus port supports CAN protocol specification Version 2.0 B while the Debug port supports TX/RX. The purpose of the Debug port is for debug only.
- Did not provide galvanic isolation.



- Pin Assignment:

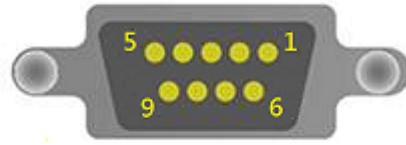
Connector: ( DB-9/Male )	
Pin number	Description
1	COM-GND
2	Debug-RX (SIN), RS232 level
3	Debug-TX (SOUT), RS232 level
4	NC
5	COM-GND
6	CAN-GND
7	CANL
8	CANH
9	CAN-GND

## 2-10. Micro SD/SDHC card Slot

- On rear panel.
- Micro SD/SDHC card slot without spring and enable the SD storage up to 32GB size.
- Providing others OS boot from SD card.
- Functions as an extra-storage device. Prevent more frequent and larger data access on eMMC memory makes its lifespan shorter.

## 2-11. DIO port

- On rear panel.
- Supports eight GPIOs without isolated

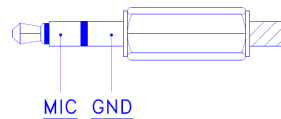


- Pin Assignment:

Connector: ( DB-9/Female )	
Pin number	Description
1	3.3V_GPO_3
2	3.3V_GPI_3
3	3.3V_GPO_2
4	3.3V_GPI_2
5	3.3V_GPO_1
6	3.3V_GPI_1
7	3.3V_GPO_0
8	3.3V_GPI_0
9	DIO-GND

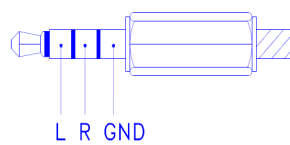
## 2-12. MIC with Stereo Jack

- On rear panel.
- The MIC-in jack is a 3.5 mm connector for connecting to an external microphone.
- The Jack can be re-defined to Line-IN before ordering



## 2-13. Headphone with Stereo Jack

- On rear panel.
- The Headphone Stereo jack is a 3.5 mm Tip Ring Sleeve (TRS) connector.
- The Jack can be re-defined to Line Out before ordering.





## 2-14. HDMI®-1.4 port

- On rear panel.
- The HDMI port uses an HDMI Type A receptacle connector. It allows connecting the digital video devices which utilize a high definition video signal without a HDCP.
- Pin Assignment:

<b>Connector: (19-pin HDMI Type A )</b>			
<b>Pin number</b>	<b>Signal</b>	<b>Pin number</b>	<b>Signal</b>
1	TMDA_Data2+	2	Data2_GND
3	TMDA_Data 2-	4	TMDA_Data1+
5	Data1_GND	6	TMDA_Data1-
7	TMDA_Data0+	8	Data0_GND
9	TMDA_Data0-	10	TMDA_CLK+
11	CLK_GND	12	TMDA_CLK-
13	NC	14	NC
15	DDC-SCL	16	DDC-SDA
17	CEC GND	18	Power 5V supply
19	Hot Plug Detect		

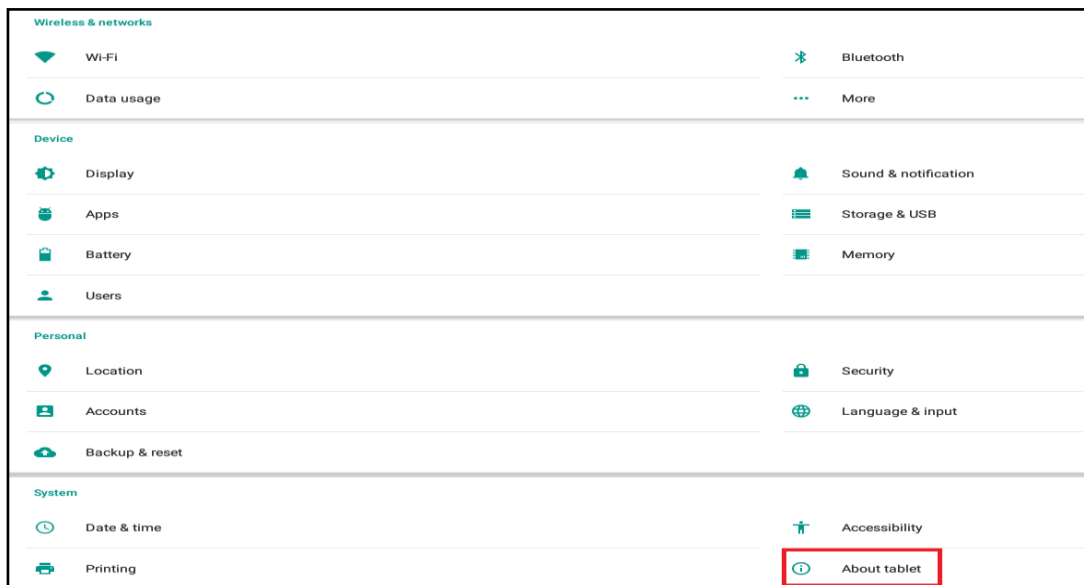
## 3. Software and Technical Supports

### 3-1. Android Programming Guide

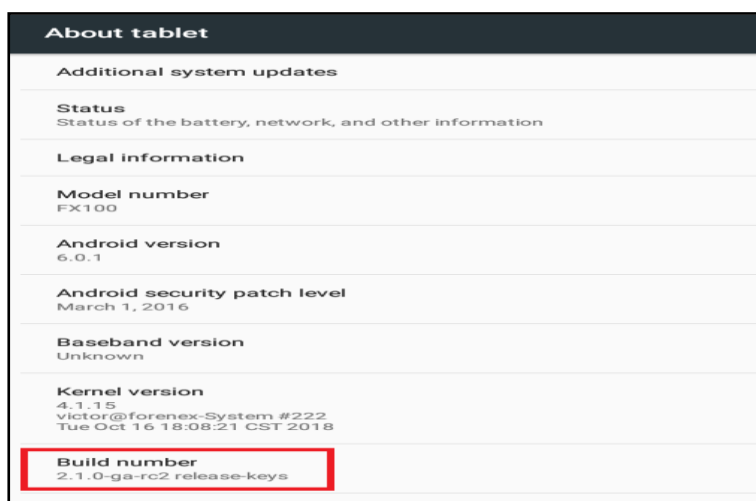
#### 3-1-1. ADB installation

- **Enable USB debugging from Android environment of MBE60 :**

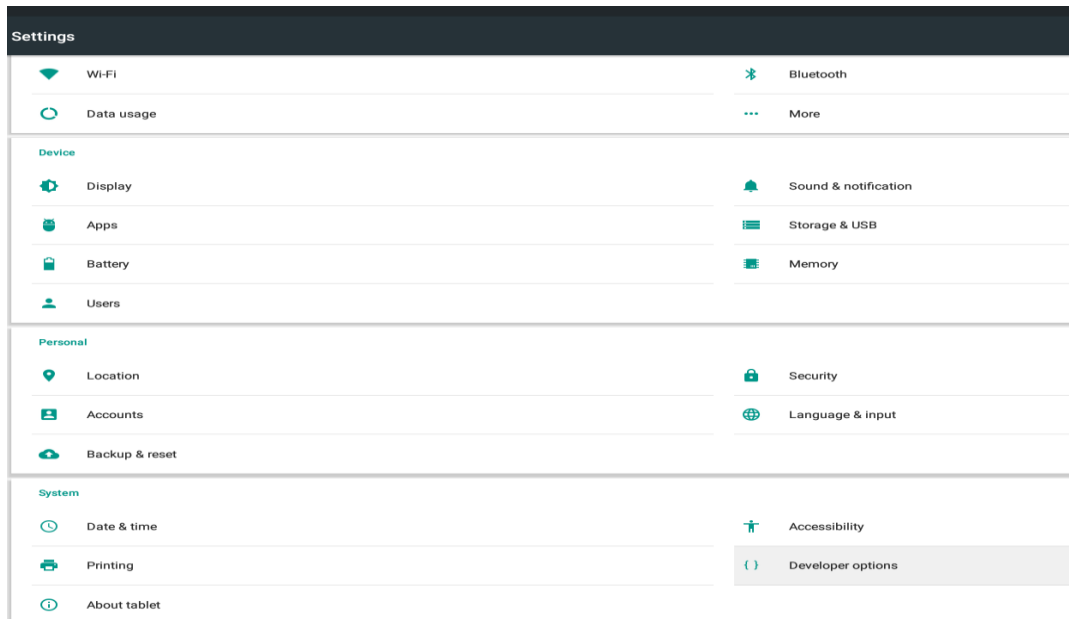
1. Scroll to "Settings > About Tablet"



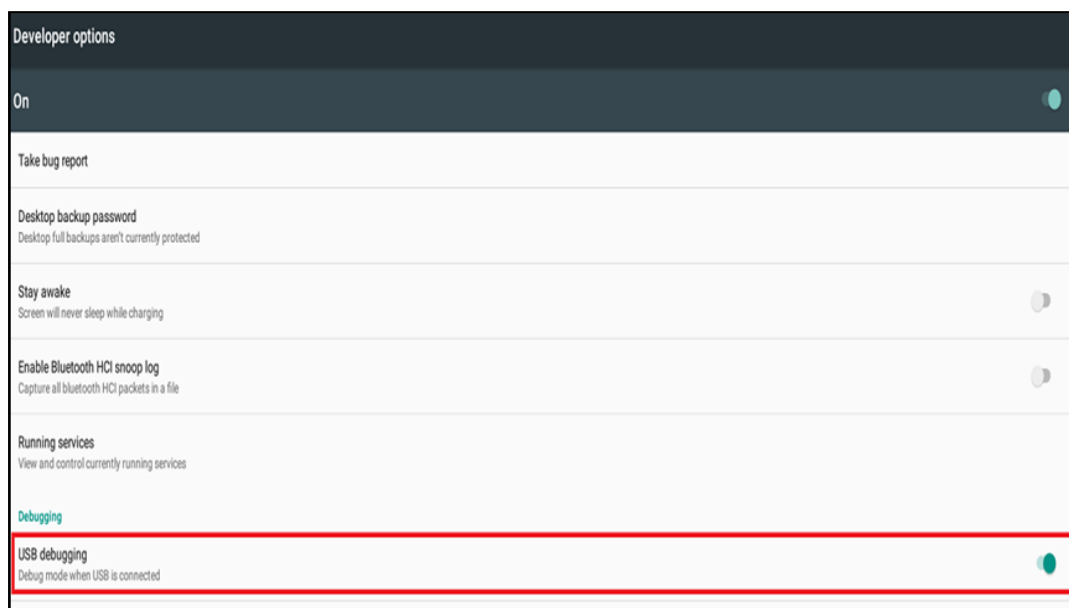
2. From "Settings" select "About tablet" to enter the dialog, and then click "Build number" in the dialog as shown. Android will pop up a countdown message. Keep clicking it until zero for Android to authorize the user to be a Developer.



- After completing the above action, a new item "Developer Options" will appear in the system block.



- Next select "Developer Options" and turn on the USB debugging function.



Note: Please do not change the other settings if you do not understand what they do.

- To install APK software over the ADB function of PC :**
- Complete the connectivity between USB-OTG port of MBE60 and USB port of PC.
  - Enter the command string "adb install xxxxx.apk" from PC and to begin

user's APK software installation.

### 3-1-2. GPIO installation

- GPIOs definition

Position	PIN name	Linux node/Note	Direction
PIN 7	3.3V		
PIN 8	Ground		
PIN 9	DOUT0	/sys/class/gpio/gpio15/value	Out
PIN 10	DIN0	/sys/class/gpio/gpio193/value	In
PIN 11	DOUT1	/sys/class/gpio/gpio14/value	Out
PIN 12	DIN1	/sys/class/gpio/gpio192/value	In
PIN 13	DOUT2	/sys/class/gpio/gpio13/value	Out
PIN 14	DIN2	/sys/class/gpio/gpio178/value	In
PIN 15	DOUT3	/sys/class/gpio/gpio12/value	Out
PIN 16	DIN3	/sys/class/gpio/gpio177/value	In

- GPIOs control method

The status of GPIOs can be set or read with the Linux command echo/cat Debug.

```
root@imx6qsabresd:/# echo 1 > /sys/class/gpio/gpio15/value
root@imx6qsabresd:/# cat /sys/class/gpio/gpio15/value
1
root@imx6qsabresd:/# echo 0 > /sys/class/gpio/gpio15/value
root@imx6qsabresd:/# cat /sys/class/gpio/gpio15/value
0
```

### 3-1-3. CANbus installation

- The socketCAN statistics can be retrieved with this command:

```
<root@imx6qsabresd:/#> cat /proc/net/can/stats
```

```
0 transmitted frames (TXF)
0 received frames (RXF)
0 matched frames (RXMF)

0 % total match ratio (RXMR)
0 frames/s total tx rate (TXR)
0 frames/s total rx rate (RXR)

0 % current match ratio (CRXMR)
0 frames/s current tx rate (CTXR)
0 frames/s current rx rate (CRXR)

0 % max match ratio (MRXMR)
0 frames/s max tx rate (MTXR)
0 frames/s max rx rate (MRXR)

0 current receive list entries (CRCV)
0 maximum receive list entries (MRCV)
```

- **Initial stages:**

1. Set CAN port0 link down  
<root@imx6qsabresd:/#> ip link set can0 down
2. Set CAN port0 loopback mode  
<root@imx6qsabresd:/#> ip link set can0 type can bitrate 50000 loopback on
3. Set CAN port0 link up  
<root@imx6qsabresd:/#> ip link set can0 up

- **Transceive stages:**

1. Send the data  
<root@imx6qsabresd:/#> cansend can0 123#11223344556677
2. Receive the data  
<root@imx6qsabresd:/#> candump can0 &

### 3-1-4. COM port installation and Sample code

COM port device is “/dev/ttymx1”.

As COM port working in RS485 mode, the gpio 82 is used as data-in/out control.

As COM port working in RS422 mode, the gpio 82 has to keep high status to make data-out in properly.

Refer to the JNI usage in Java environment, and download COMport control App package “MBE60-Android-COMport-SF” at web:

<http://www.forenex.com.tw/download/MBE60-MainBoard/Software>

## 3-2. Linux Programming Guide

### 3-2-1. GPIOs installation

- GPIOs definition

Position	PIN name	Linux node/Note	Direction
PIN 7	3.3V		
PIN 8	Ground		
PIN 9	DOUT0	/sys/class/gpio/gpio15/value	Out
PIN 10	DIN0	/sys/class/gpio/gpio193/value	In
PIN 11	DOUT1	/sys/class/gpio/gpio14/value	Out
PIN 12	DIN1	/sys/class/gpio/gpio192/value	In
PIN 13	DOUT2	/sys/class/gpio/gpio13/value	Out
PIN 14	DIN2	/sys/class/gpio/gpio178/value	In
PIN 15	DOUT3	/sys/class/gpio/gpio12/value	Out
PIN 16	DIN3	/sys/class/gpio/gpio177/value	In

- GPIOs control method

The status of GPIOs can be set or read with the Linux command echo/cat Debug.

```

root@imx6qsabresd:/# echo 1 > /sys/class/gpio/gpio15/value
root@imx6qsabresd:/# cat /sys/class/gpio/gpio15/value
1
root@imx6qsabresd:/# echo 0 > /sys/class/gpio/gpio15/value
root@imx6qsabresd:/# cat /sys/class/gpio/gpio15/value
0

```

### 3-2-2. CANbus installation

- The socketCAN statistics can be retrieved with this command:

```
<root@imx6qsabresd:/#> cat /proc/net/can/stats
```

```
0 transmitted frames (TXF)
0 received frames (RXF)
0 matched frames (RXMF)

0 % total match ratio (RXMR)
0 frames/s total tx rate (TXR)
0 frames/s total rx rate (RXR)

0 % current match ratio (CRXMR)
0 frames/s current tx rate (CTXR)
0 frames/s current rx rate (CRXR)

0 % max match ratio (MRXMR)
0 frames/s max tx rate (MTXR)
0 frames/s max rx rate (MRXR)

0 current receive list entries (CRCV)
0 maximum receive list entries (MRCV)
```

- **Initial stages:**

1. Set CAN port0 link down  
<root@imx6qsabresd:/#> ip link set can0 down
2. Set CAN port0 loopback mode  
<root@imx6qsabresd:/#> ip link set can0 type can bitrate 50000 loopback on
3. Set CAN port0 link up  
<root@imx6qsabresd:/#> ip link set can0 up

- **Transceive stages:**

3. Send the data  
<root@imx6qsabresd:/#> cansend can0 123#11223344556677
4. Receive the data  
<root@imx6qsabresd:/#> candump can0 &

### 3-2-3. COM port installation and Sample code

COM port device is `"/dev/ttymx1"`.

As COM port working in RS485 mode, the gpio 82 is used as data-in/out control.

As COM port working in RS422 mode, the gpio 82 has to keep high status to make data-out in properly.

Refer to COMport sample code `"MBE60-Linux-COMport-SF.c"` at web:  
<http://www.forenex.com.tw/download/MBE60-MainBoard/Software>