Phase 3 – ThinSat EM

xChips Assembly & Programming

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This document attempts to illustrate the hardware component of Phase 3. It is important to follow the guide precisely as to avoid any potential complications that may arise. Also contained within the document are instructions on flashing the CC03.

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Date : 6/12/2018

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Contents

1. Phase 3 Requirements

The below list includes the hardware requirements for Phase 3.

- 1 x CC03   -   Core MCU
- 1 x IP03   -   Programmer
- 1 x MD01   -   Blank xChip
- 1 x MI02   -   xBUS Extender
- 1 x MN01   -   Motherboard
- 1 x MN02   -   Motherboard with on-board temperature sensors
- 1 x OD01   -   OLED Display
- 1 x SI01   -   Black xChip IMU with Temperature Sensor
- 1 x SL01   -   Black xChip Light Sensor
- 1 x SL19   -   Black xChip IR Temperature sensor
- 1 x SW10   -   Black xChip Temperature Sensor
- 11 x XC10   -   xBUS Connectors
- 1 x XC55   -   xPDI Connectors
- 6 x Metal Standoffs
- 1 x Micro USB to USB Type A cable.
- Computer running Windows or Mac iOS

Appendix A is a graphic of the full range of xChips in Phase 3.

2. Flashing CC03

2.1.   Hardware Requirements

In order to flash the CC03 and verify that firmware has been uploaded the following hardware is required:

- 1 x OD01
- 1 x IP03
- 1 x CC03
- 2 x XC10
- 1 x XC55
- Micro USB to Type A USB cable
- Computer running Windows or Mac iOS

Connect an XC10 connector and an XC55 connector to the xBUS and xPDI respectively on the IP03. Now connect CC03 to IP03 via the connectors just installed. The setup should be as per Figure 2.1-1 below.

Take the USB cable and insert it into the Micro USB port (indicated by the red outline in Figure 2.1-2) on the IP03. Insert the other end (Type A) of the USB cable into an available USB port on the computer. CC03 is now connected to the computer. Note the switch on the IP03 which will be used later on.
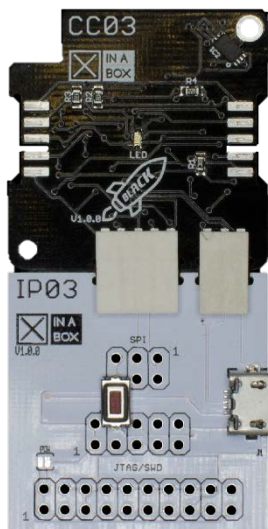

Figure 2.1-1 IP03 and CC03 connected via an XC10 and XC55 connector. CC03 is ready to flash once this setup is accomplished.
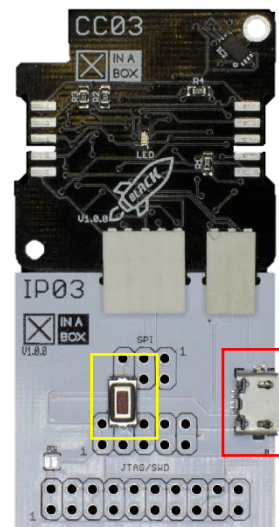
Figure 2.1-2 Red outline indicates the Micro USB port on the IP03.and the yellow outline indicates the switch.

2.2.   CC03 and Windows

CC03 has two modes; namely Bootloader mode and Sketch mode. When in bootloader mode the CC03 can be flashed – a file can be uploaded – and in sketch mode the CC03 runs the program. On connection of the CC03 to the computer the computer will beep indicating an external device has been connected but nothing will show up.

Double press the switch on IP03 indicated in Figure 2.1-2. By double pressing the switch the CC03 enters Bootloader mode and the blue LED on CC03 will exhibit a fading pattern. At the same time, the computer would've detected a new device named "CC03" (See Figure 2.2-1). Depending on the settings of the machine the contents of CC03 drive will open up in file explorer or Autoplay will pop up; close either window for now. Figure 2.2-1 shows CC03 in Bootloader mode. A single press of the switch enters the CC03 into Sketch mode. Sketch mode is the default mode on power up.
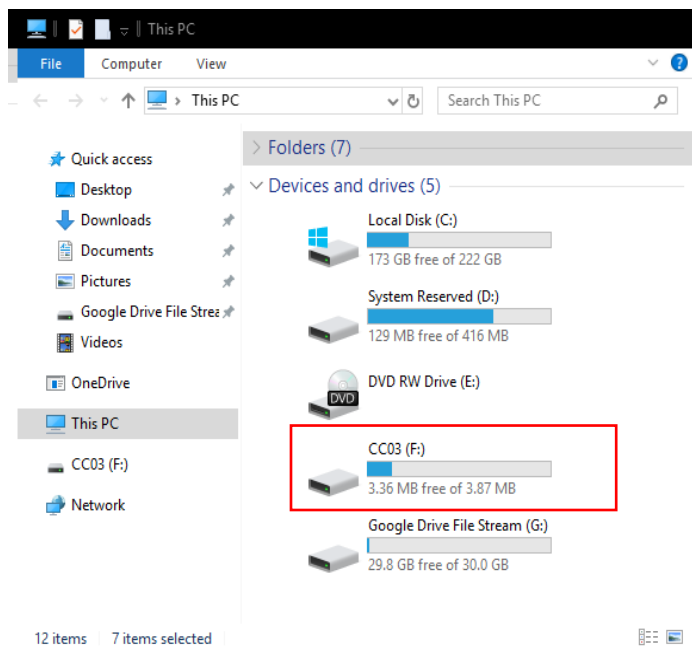

Figure 2.2-1 CC03 in bootloader mode is detected by the computer as a normal storage device. This is how its seen on a Windows 10 machine but similar conditions occur on other versions of Windows.

2.3.   Download Firmware

Download the firmware for Phase 3 at https://github.com/xinabox/Phase-3-Firmware/releases/latest. The only file required is the file with a .uf2 extension. The downloaded *Phase3_Firmware_V1_000.uf2* should be saved in the *Downloads* (Figure 2.3-1) folder by default on the machine. If not, navigate to where the file was saved on the machine.
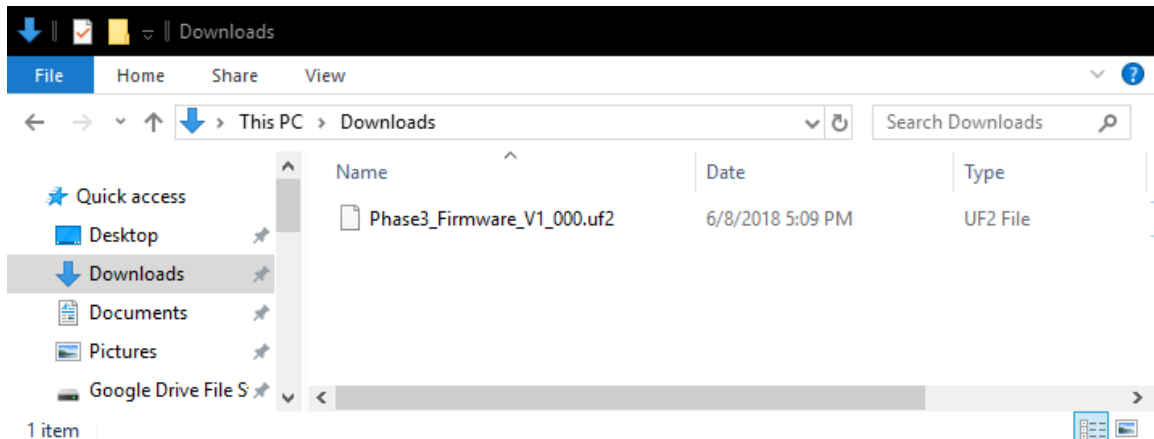

Figure 2.3-1 Firmware in the Downloads directory.

***NB Version numbers may differ.

2.4.   Upload the File

Drag *Phase3_Firmware_V1_100.uf2* onto the CC03 drive. Left click on the file and hold down. Drag the file onto the CC03 Drive (in this case F:) and release the left mouse button. See Figure 2.4-1.
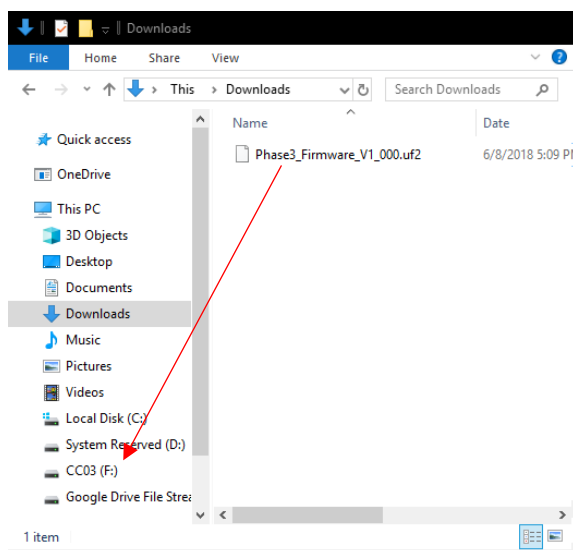
Figure 2.4-1 Drag and Drop the Firmware onto the CC03 Drive. If the drive doesn't display simply double press the switch on CC03 again. It will only display in Bootloader mode with the blue LED fading in and out.

If the file was successfully uploaded the blue LED with flash at an interval of 500ms. This flashing indicates that no sensors are connected. With IP03 still connected to the computer, connect an OD01 to the left xBUS on CC03 with an XC10 connector as shown in Figure 2.4-2. Information will be displayed on OD01 verifying that no sensors are connected. OD01 will also state that the EM has not yet sent a request for data. Refer to Figure 2.4-3.
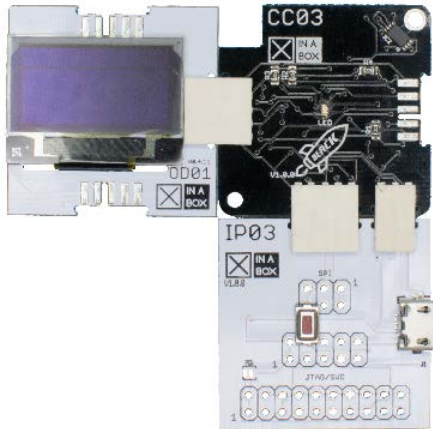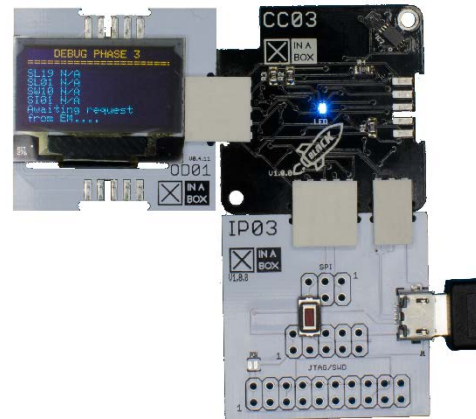

Figure 2.4-2 Add OD01 to the left xBUS of CC03.

Figure 2.4-3 OD01 verifying that no sensors are connected.

Once verified that the Firmware has been uploaded, remove the cable from the computer and separate all xChips and connectors from one another. The next step is to assemble the xChips and interface it with the ThinSat EM.

3. Assemble xChips

3.1.   Bottom Layer

Required xChips:

- 1 x CC03
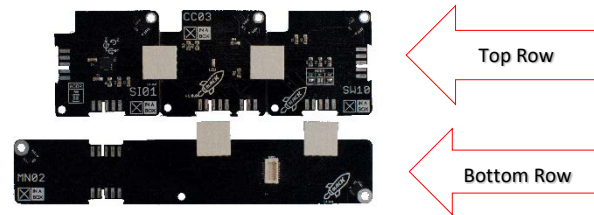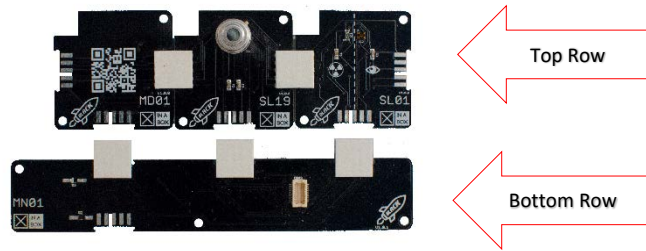
- 1 x MN02

- 1 x SI01

- 1 x SW10

- 4 x XC10

Figure 3.1-1 Recommended way to assemble the bottom layer is to first assemble the top and bottom row separately.

First assemble the top row using SI01, CC03, SW10 and 2×XC10 connectors as shown above in Figure 3.1-1. These xChips all hold on-board temperature sensors. Next, assemble the bottom row with MN02 and 2×XC10 connectors as shown in Figure 3.1-1. This is the most efficient way to assemble the bottom layer.

Now join the two rows as shown in Figure 3.1-2. The bottom layer is complete. Notice that an XC10 connector is omitted between the SI01 and MN02. The omission is due to an interference on the ThinSat EM.
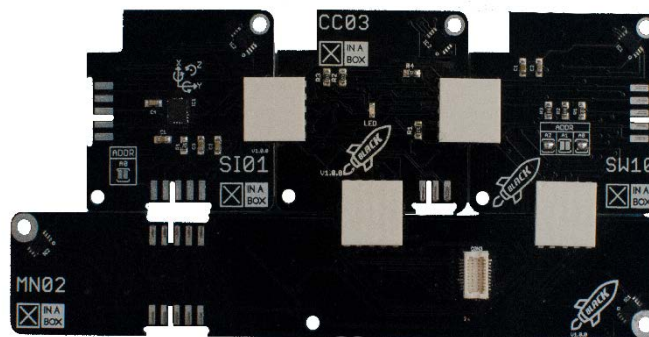
Figure 3.1-2 Bottom layer completed.

3.2.   Top Layer

Required xChips:

- 1 x MD01
- 1 x MN01
- 1 x SL01
- 1 x SL19
- 5 x XC10

Figure 3.2-1 Recommended way to assemble the bottom layer is to first assemble the top and bottom row separately.

First assemble the top row using MD01, SL01, SL19 and 2×XC10 connectors as shown above in Figure 3.2-1. SL01 requires light and needs to be placed on top. Next, assemble the bottom row with MN01 and 3×XC10 connectors as shown in Figure 3.2-1. This is the most efficient way to assemble the top layer.

Now join the two rows as shown in Figure 3.2-2 below. The top layer is complete.
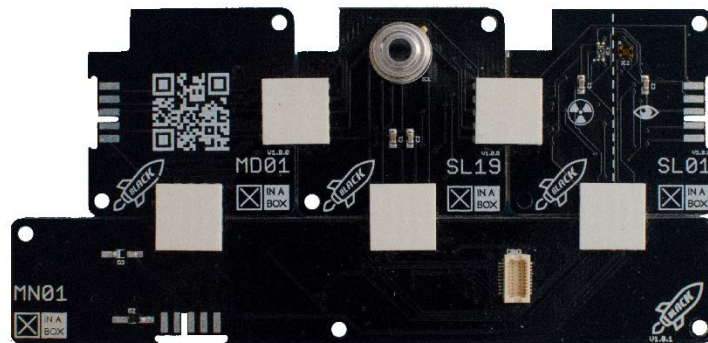
Figure 3.2-2 Top layer completed.

4. Interface xChips and ThinSat

4.1.   Install xChips into ThinSat

6×Metal Standoffs is required between the bottom layer and the EM. The standoffs must be metal for optimum heat transfer to the temperatures sensors. Place the bottom layer into the designated payload section for XinaBox in the 3D-printed frame on the EM. Press down the bottom layer ensuring that the connector on the bottom of MN02 and the connector at the top of the EM click together. See Figure 4.1-1.
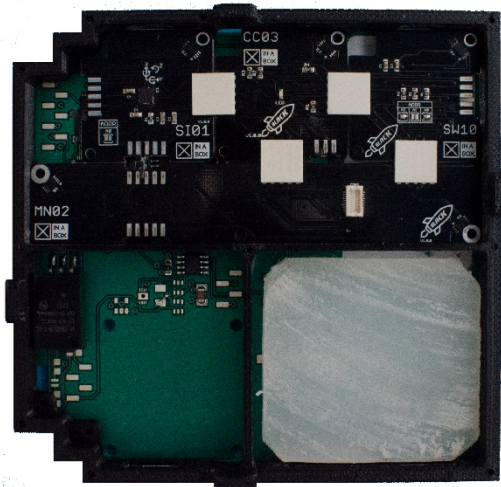

Figure 4.1-1 Bottom layer connected to EM.
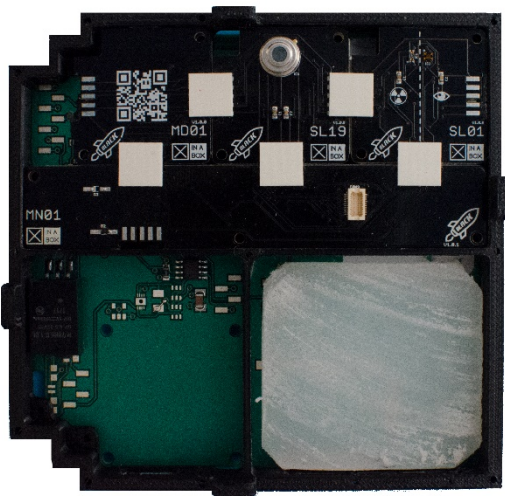
Figure 4.1-2 Top layer connected to the EM.

Now insert the top layer (MN01) above the bottom layer ensuring that the connector on the top layer clicks together with the connector on the bottom layer (MN02). It is important to ensure that everything is connected firmly and all electrical connections are making contact. See Figure 4.1-2 alongside showing the top layer connected.

To verify that all xChips are making contact we will use the MI02 and the OLED.

4.2. Debug and Verify

Connect MI02 and OD01 using 2×XC10 connectors as shown in Figure 4.2-1. On the 3D-printed frame there is a cut out on the right side of the EM. Insert the XC10 connector that's connected to the left xBUS of MI02 through the cut out clicking it in place with the bottom layer (Figure 4.2-2).
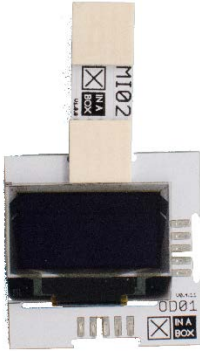

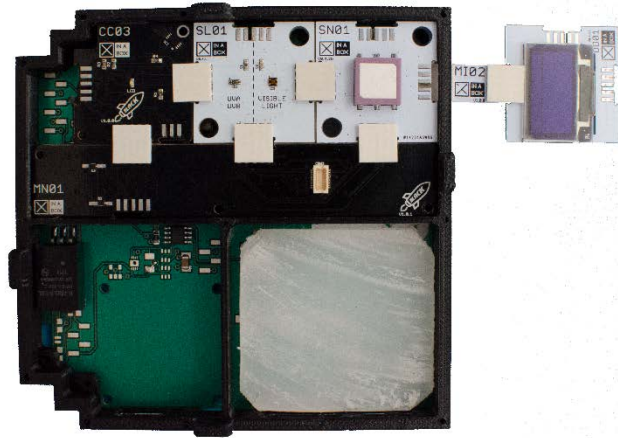*Figure 4.2-1 XC10 connected to the left xBUS of MI02.*

Figure 4.2-2 MI02 connected to the EM.

Power up the EM according to the *ThinSat EM Set Up Procedure* document. Power is released to the XinaBox payload 30 seconds after the EM has been powered. Once powered up, operations are as follows:

- OD01 will display information indicating whether sensors are available or not. If a sensor is available data will be displayed on OD01 from the respective sensor. OD01 also displays that its awaiting a request from the EM to send data. Once the request is received data is sent to the EM. CC03 will then await another request and if successful the OLED will display "EM PASS". See Figure 4.2-3 and 4.2-4

- Blue LED on CC03:
  - Remains off if all sensors are connected. Will blink quickly every time data is sent to the EM.
  - Blinks at 500ms if any sensor fails to connect.

If any sensor fails to connect or no power is present at all, troubleshoot as follows:

- Check that XC10 connectors are making contact.
- Ensure the bottom layer (MN02) is firmly connected to the EM.

- Ensure the top layer (MN01) is connected firmly to the bottom layer (MN02).

- Make sure you have power.

- **Do not plug the EM power supply into the IP03.**

Once you've verified that all sensors have been installed you may remove MI02 from the EM. That completes the setup procedures for xChips.
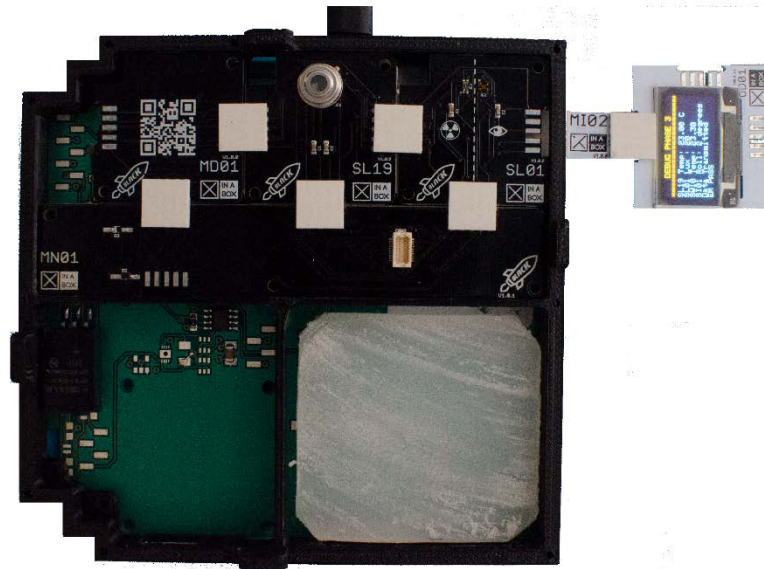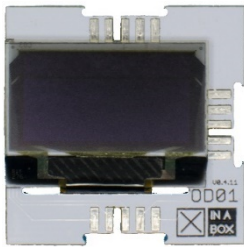

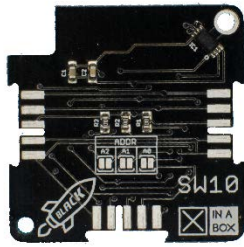*Figure 4.2-3 EM powered up and OD01 displaying debugging information.*

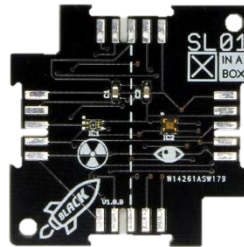*Figure 4.2-4 OD01 displaying a measurement from each sensor and indicating that communication with the EM is successful.*

5. Appendices

Appendix A
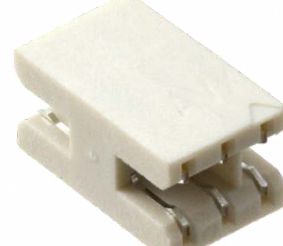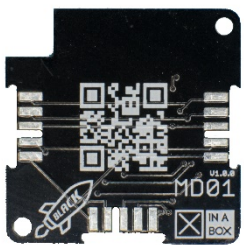

1 × OD01

1 × SW10

1 × SL01
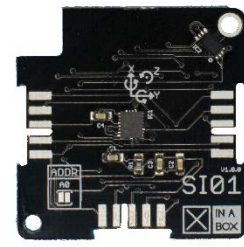
1 × SI01
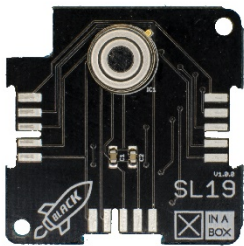
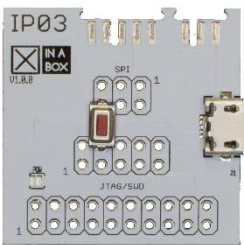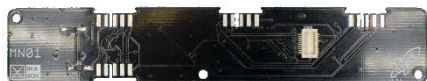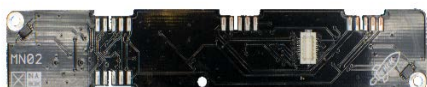1 × SL19
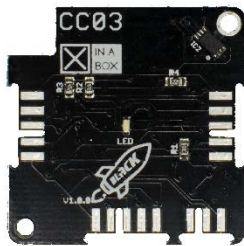
1 × CC03
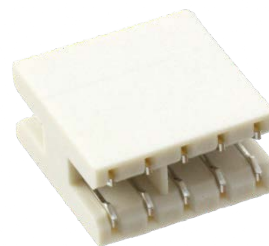
11 × XC10 xBUS Connectors

1 × XC55 xPDI Connector

1 × MD01

1 × IP03

1 × MN01

1 × MN02

1 × ThinSat EM