



LoRa Provisioning Over BLE Getting Started Guide

LoRa_Provisioning_Over_BLE_Getting_Started_Guide

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1. Overview

This document explains how to setup a LoRa End-Device provisioning over BLE demo using SAMR34 and BTLC1000. This document briefly talks about setting up hardware, building application, programming firmware and running a demo.

This demo application showcases a Proof-of-Concept example of using LoRaWAN SDK and BluSDK to setup SAMR34 and BTLC1000 as LoRa End-Device which uses BLE to provision from Smart phone. This demo uses two BLE custom services, LoRaWAN Provisioning Service and LoRaWAN RF Parameter Service defined by Microchip.

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1.1. Hardware Setup

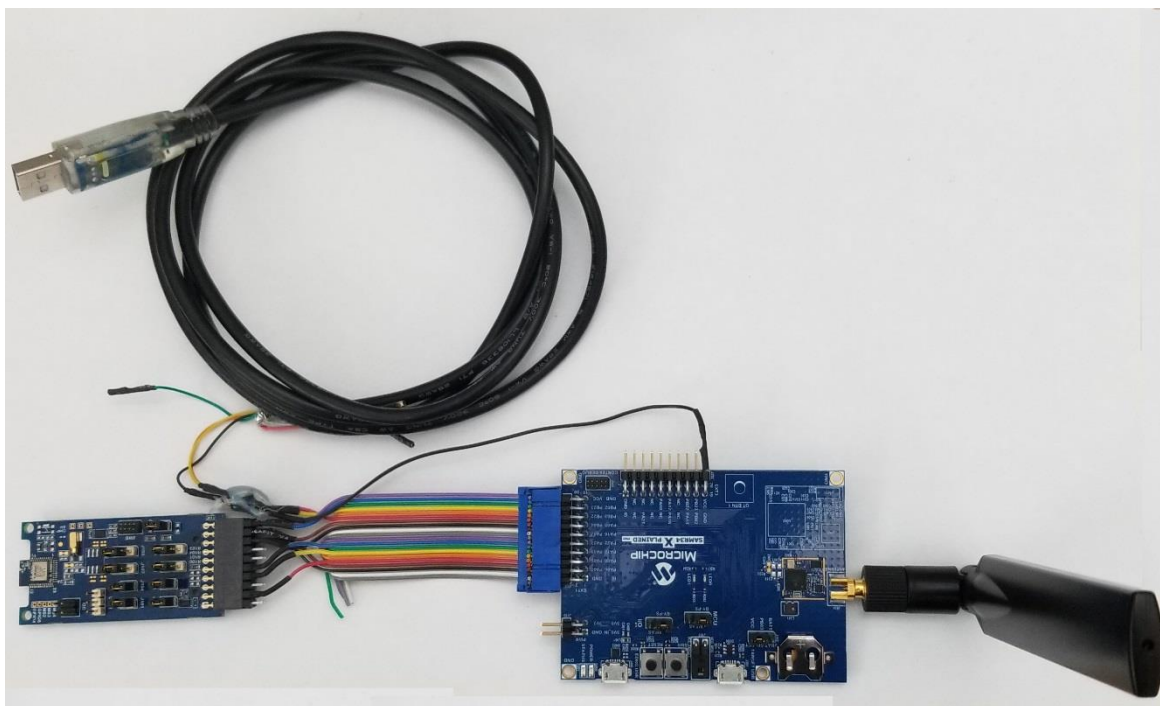


Figure 1: SAMR34 Xplained Pro with BTLC1000-XPro

1. Plugin BTLC1000-XPro board into EXT1 of SAMR34 Xplained Pro board as shown in Figure 1.
2. Interface between SAMR34 Xplained Pro board and BTLC1000-XPro board.

SAMR34 Xplained Pro - EXT1	BTLC1000-XPro Header	FTDI TTL-232R-3V3	Signal
3 (RTS)	16 (CTS)		BLE UART RTS/CTS
4 (CTS)	18 (RTS)		BLE UART CTS/RTS
13 (RXD)	15 (TXD)		BLE UART RXD/TXD
14 (TXD)	17 (RXD)		BLE UART TXD/RXD
5 (GPIO)	3 (WAKEUP PIN)		BTLC1000 WAKEUP
7 (GPIO)	7 (CHIP EN)		BTLC1000 CHIP EN
9 (IRQ)	9 (GPIO)		Host WAKEUP
15 (TXD)		RXD (Yellow)	CONSOLE UART TXD/RXD
17 (RXD)		TXD (Orange)	CONSOLE UART RXD/TXD
19 (GND)	19 (GND)		
20 (VCC)	20 (VCC)		

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3. Connect the SAMR34 Xplained Pro board to the host PC using micro USB cable.
4. Connect the FTDI cable to host PC.

1.2. Smart Phone Application

Install the MCHPLoRa.apk in Android phone. You can find the MCHPLoRa.apk file in the project folder.

Note: The MCHPLoRa APP requires Android version 8.0 or later.

1.3. Console

The LoRaWAN End-Device Provisioning Over BLE demo application uses the Universal Asynchronous Receiver/Transmitter (UART) interface to print the status messages. Any serial application (ex: TeraTerm) can be used to interact with SAMR34 Xplained Pro.

UART (COM port) settings,

Baud rate	115200
Data	8 bits
Parity	none
Stop	1 bit
Flow control	none

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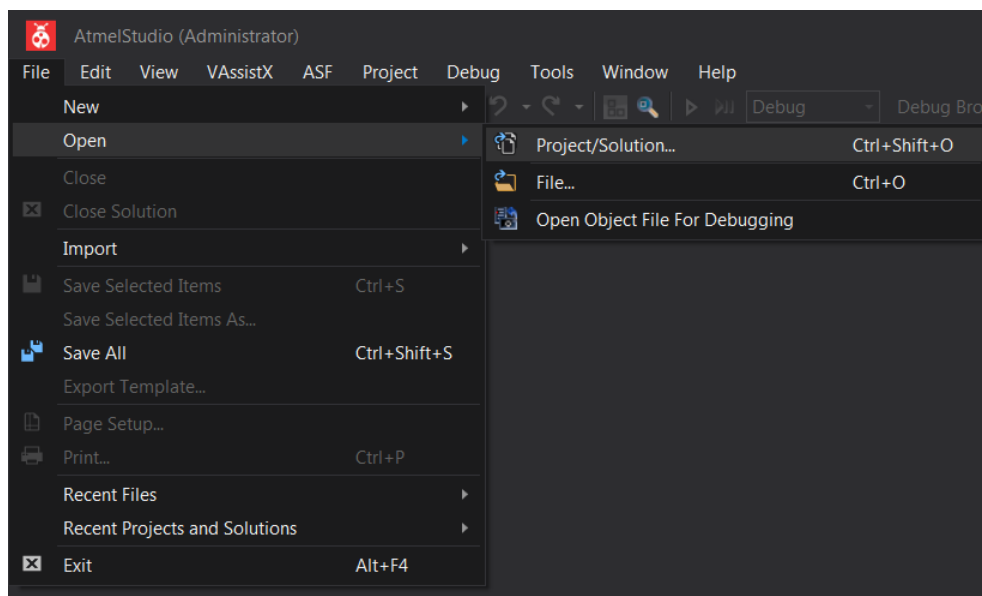
2. Build Procedure

This section describes the build procedure of SAMR34_LORA_PROVISIONING_OVER_BLE_APP application on Atmel Studio 7.

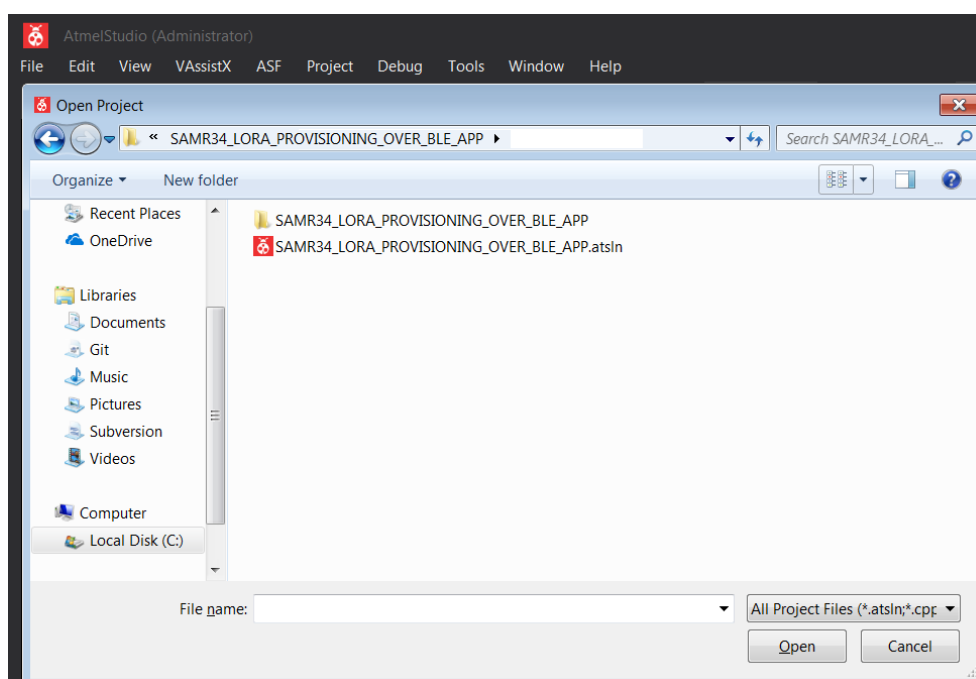
2.1. Open Atmel Studio 7

2.2. Open SAMR34_LORA_PROVISIONING_OVER_BLE_APP Application

1. Go to menu **File → Open → Project/Solution**



2. Select “SAMR34_LORA_PROVISIONING_OVER_BLE_APP.atsln” and press **Open**.

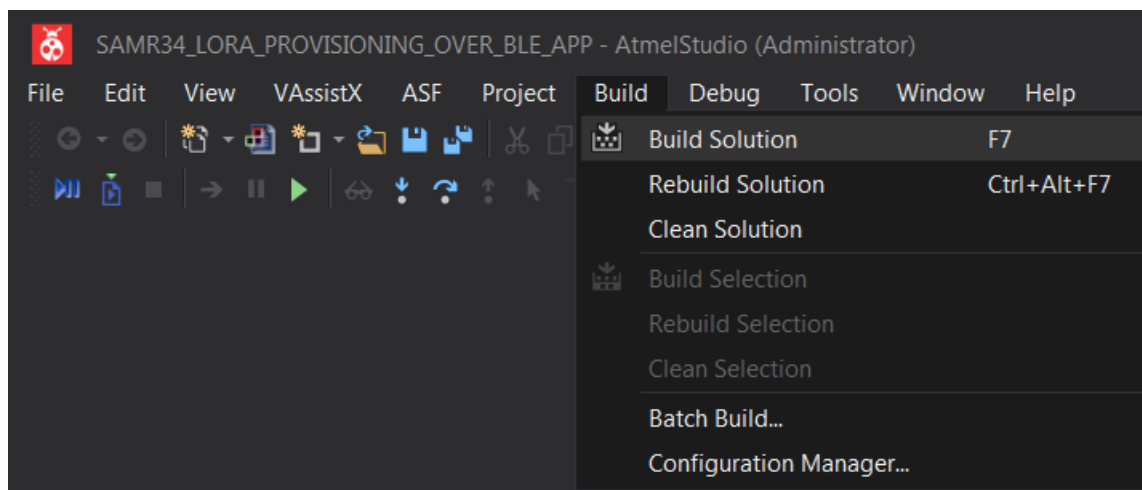


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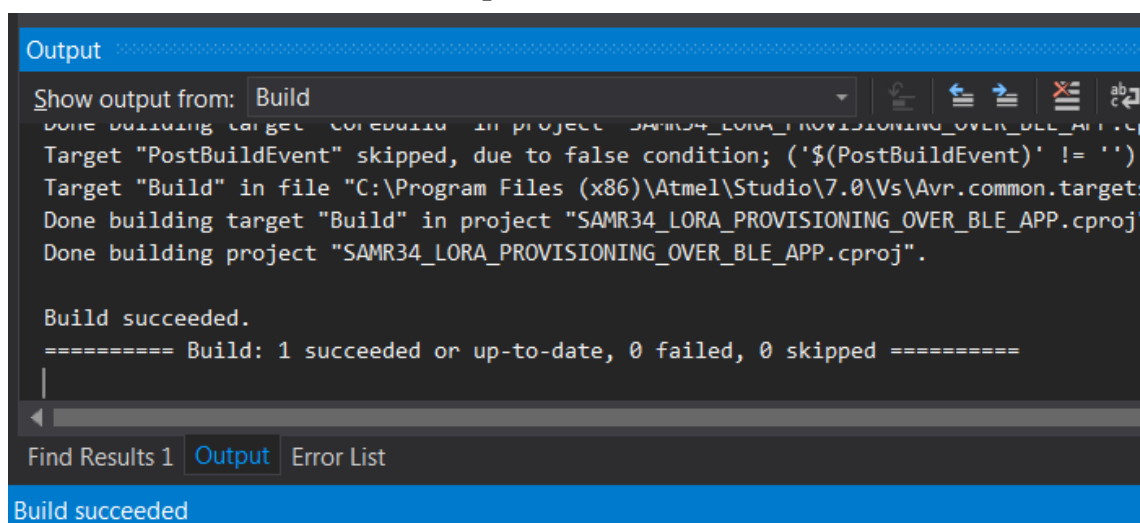
3. Once the project is opened, you can see the files attached to this project in Solution Explorer Window

2.3. Build SAMR34_LORA_PROVISIONING_OVER_BLE_APP Application

1. Go to menu **Build** → **Build Solution** or Press **F7**



2. Build status can be checked in **Output** window



3. You can find the Hex image in
“..\SAMR34_LORA_PROVISIONING_OVER_BLE_APP\Debug”.

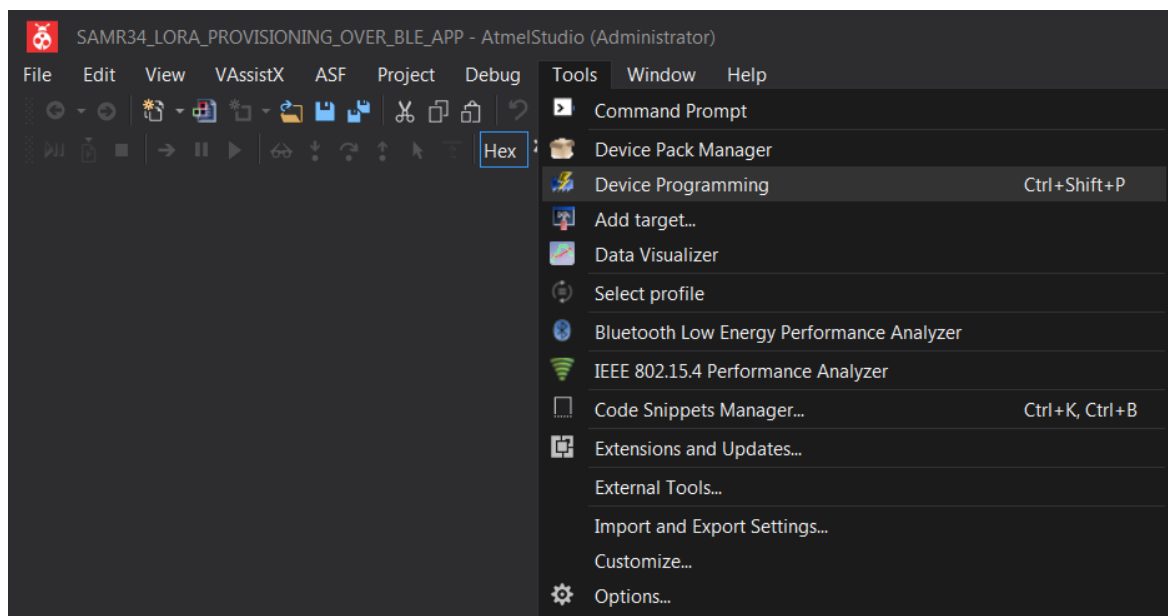
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3. Programming Firmware

This section describes the procedure to program

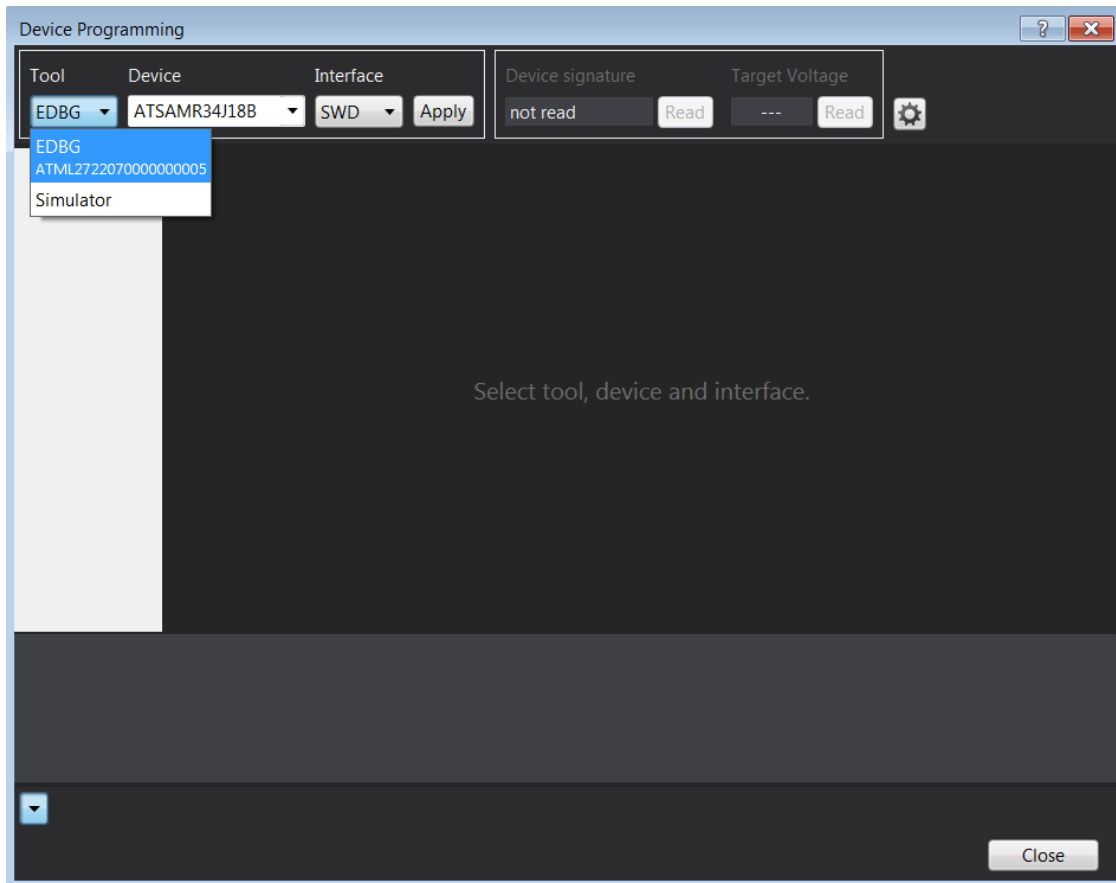
SAMR34_LORA_PROVISIONING_OVER_BLE_APP firmware on SAMR34 Xplained Pro board.

1. Connect the SAMR34 Xplained Pro board to the host PC using micro USB cable. Perform the following steps:
 - a. Verify that the virtual COM port is enumerated on the host PC.
 - b. Make sure that POWER LED (green) is solid ON.
2. To program the HEX files into the SAMR34, go to menu **Tools → Device Programming** or Press **Ctrl + Shift + P**.



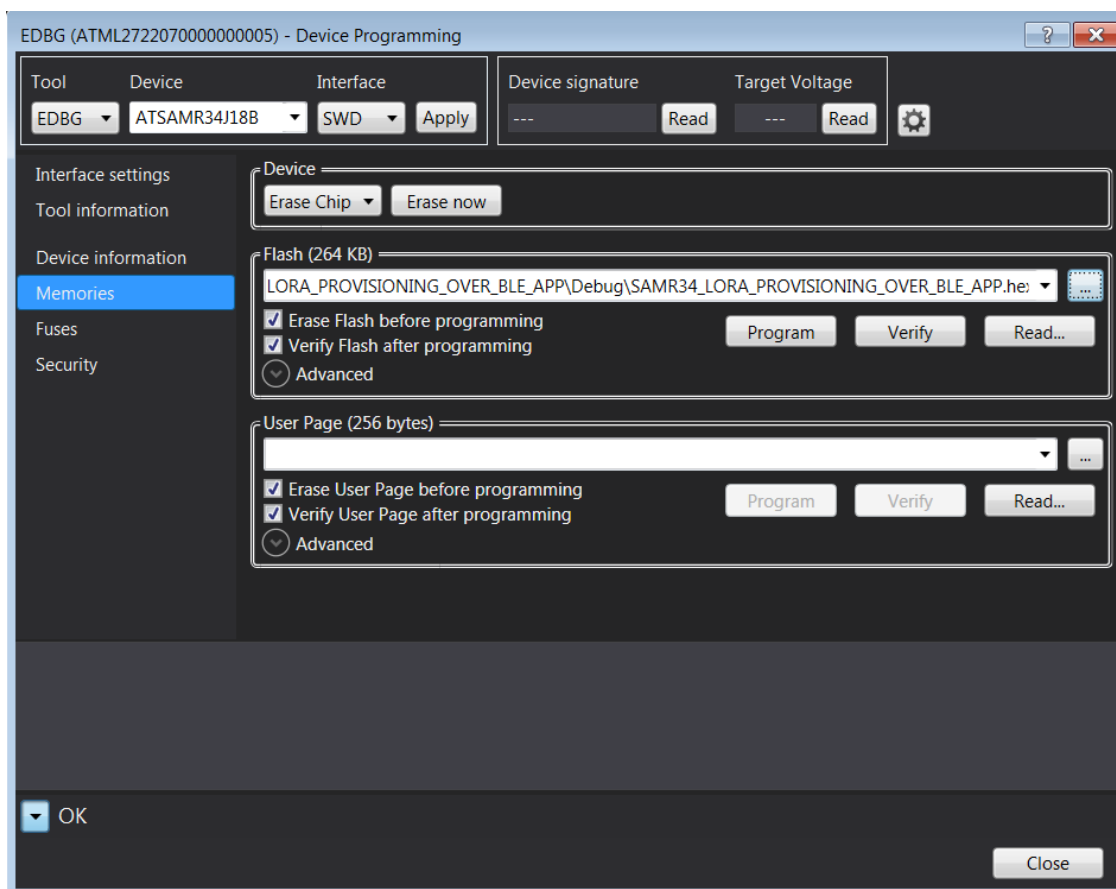
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3. Select the corresponding **EDBG** and press **Apply**.



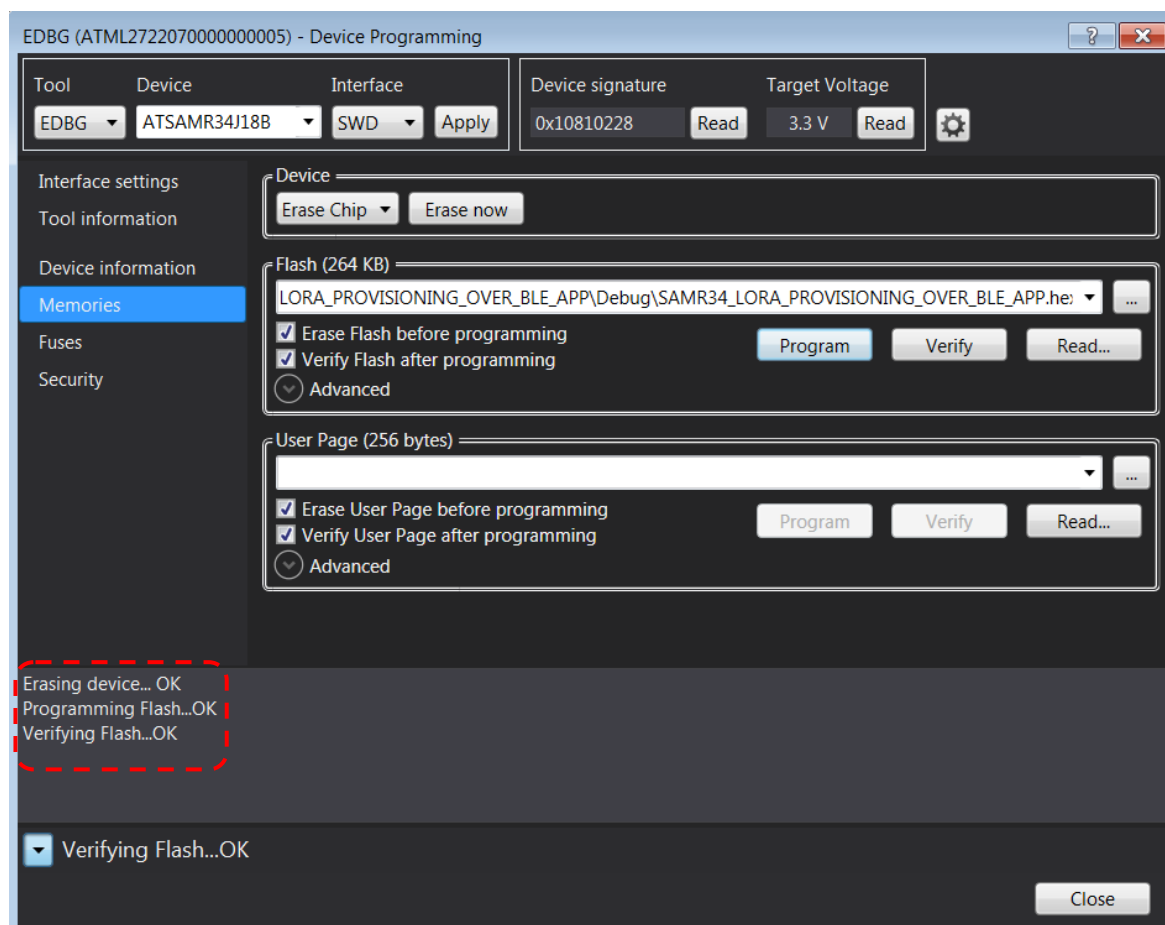
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4. Go to **Memories** Tab and select Hex file.



5. Press **Program**, the tool will program SAMR34. You can check the status of programming.

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- Once programming is done, close the Device Programming window.

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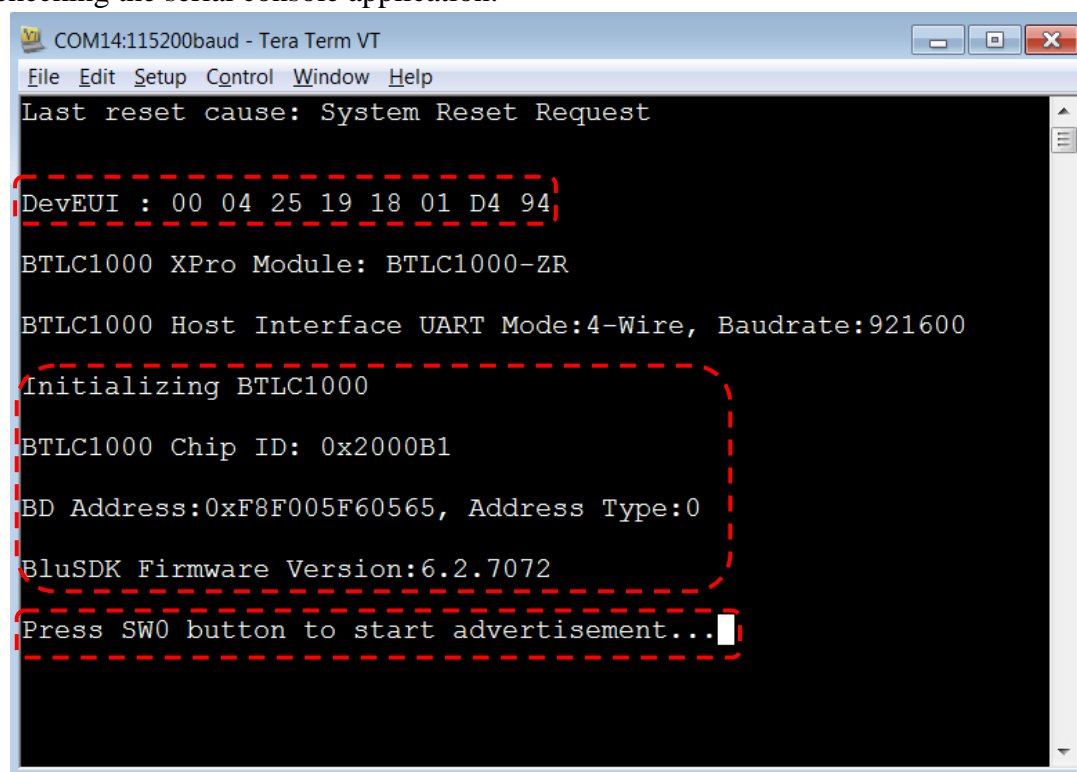
4. Running LoRaWAN Provisioning Over BLE Demo

This section describes the LoRaWAN Provisioning Over BLE demo procedures to work with Android MchpLORA.

1. Connect BTLC1000-XPro on EXT1 of SAMR34 Xplained Pro board.
2. Connect the SAMR34 EDBG to the host PC using micro USB cable.
3. Connect the FTDI cable to the host PC and do the following
 - a. Connect FTDI-RXD with PIN15 on EXT1 of SAMR34
 - b. Connect FTDI-TXD with PIN17 on EXT1 of SAMR34
 - c. Connect FTDI GND with SAMR34 Xplained Pro GND
 - d. Verify that the virtual COM port is enumerated on the host PC.
 - e. Open the enumerated COM port on a serial terminal application like TeraTerm with the following settings:

Baudrate	115200
Data	8 bits
Parity	none
Stop	1 bit
Flow control	none

- f. Make sure that POWER LED (green) on SAMR34 Xplained Pro board is solid ON.
 - g. Press Reset button on SAMR34 Xplained Pro board
4. Ensure that the SAMR34 is up and running and BTLC1000 is initialized properly by checking the serial console application.



The screenshot shows a Tera Term VT window titled 'COM14:115200baud - Tera Term VT'. The window contains the following text:

```
Last reset cause: System Reset Request
DevEUI : 00 04 25 19 18 01 D4 94
BTLC1000 XPro Module: BTLC1000-ZR
BTLC1000 Host Interface UART Mode:4-Wire, Baudrate:921600
Initializing BTLC1000
BTLC1000 Chip ID: 0x2000B1
BD Address:0xF8F005F60565, Address Type:0
BluSDK Firmware Version:6.2.7072
Press SW0 button to start advertisement...
```

Red dashed boxes highlight the DevEUI, the initialization sequence (from 'Initializing BTLC1000' to 'Press SW0 button to start advertisement...'), and the final instruction.

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5. Open **MchpLORA APP** on Android phone
6. Press **Select Peripheral** on MchpLORA APP

MICROCHIP

Lora Provisioning App

Select Peripheral

Frequency band:
Select a band ...

LoraWAN Class:
Select a class ...

Join Method:
Select a method ...

DevEUI:

Multicast:
Enable Multicast? ...

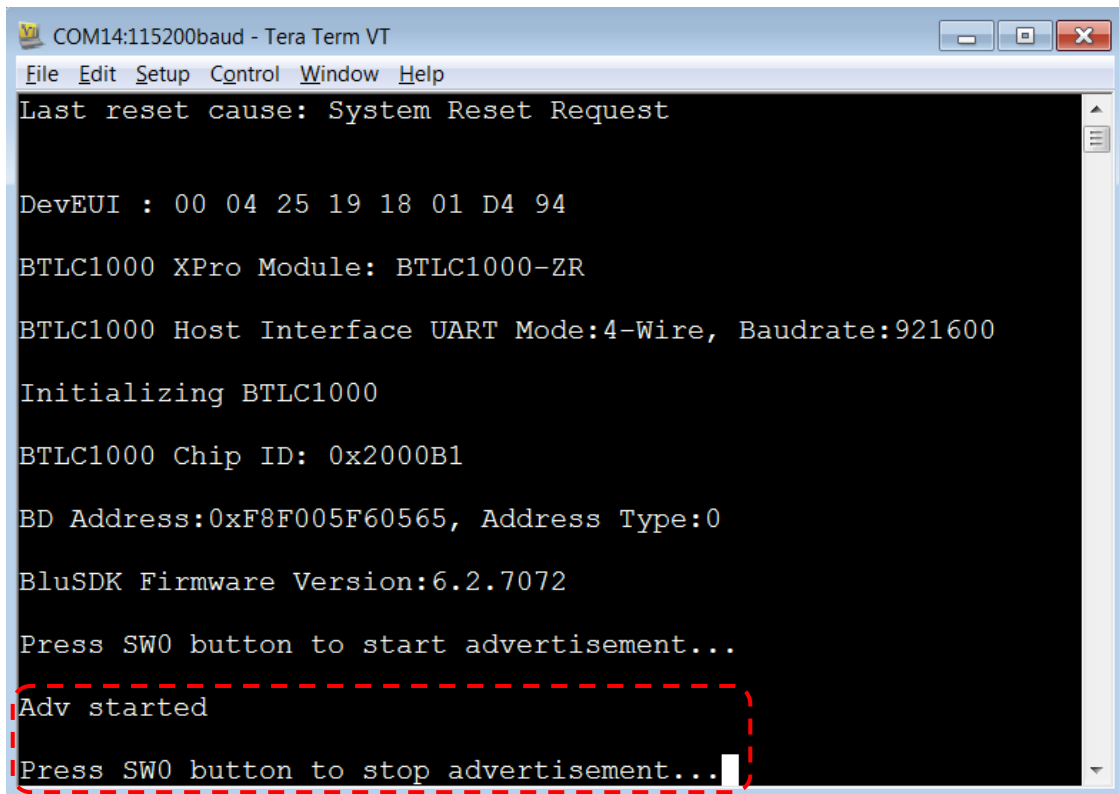
SEND PROVISION COMPLETED

RESET TO FACTORY DEFAULT

Disconnected.

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7. Start a BLE advertisement by pressing SW0 button on SAMR34 Xplained Pro board



COM14:115200baud - Tera Term VT

File Edit Setup Control Window Help

Last reset cause: System Reset Request

DevEUI : 00 04 25 19 18 01 D4 94

BTLC1000 XPro Module: BTLC1000-ZR

BTLC1000 Host Interface UART Mode:4-Wire, Baudrate:921600

Initializing BTLC1000

BTLC1000 Chip ID: 0x2000B1

BD Address:0xF8F005F60565, Address Type:0

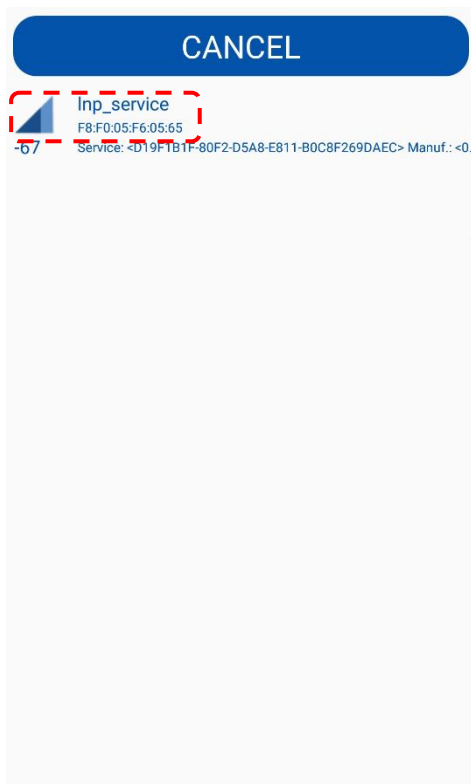
BluSDK Firmware Version:6.2.7072

Press SW0 button to start advertisement...

Adv started

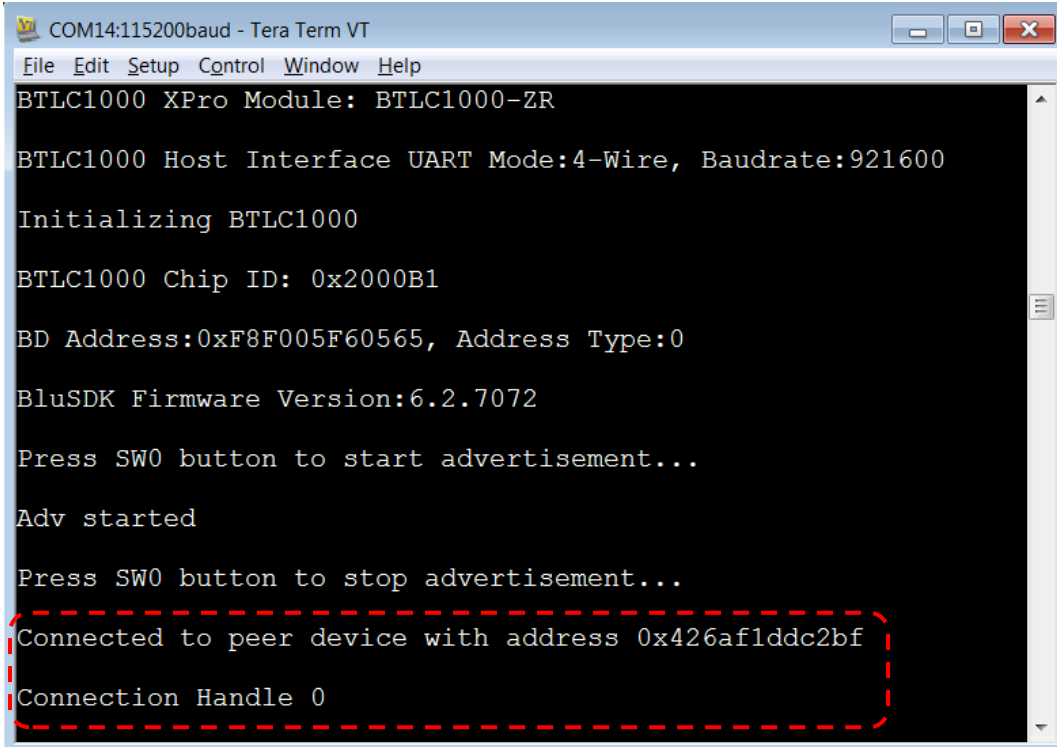
Press SW0 button to stop advertisement...

8. To connect, click on **lnp_service** in the MchpLORA APP scan list which matches BD Address with your BTLC1000 device.



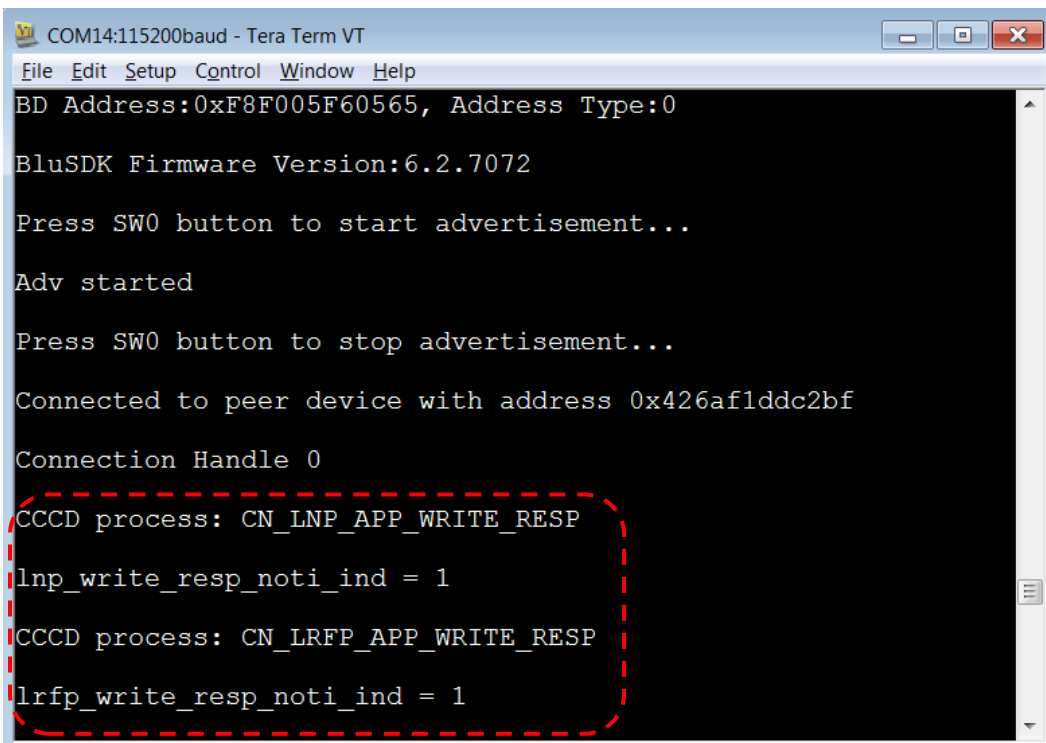
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9. After successful connection, SAMR34 prints the connection details in console.



```
COM14:115200baud - Tera Term VT
File Edit Setup Control Window Help
BTLC1000 XPro Module: BTLC1000-ZR
BTLC1000 Host Interface UART Mode:4-Wire, Baudrate:921600
Initializing BTLC1000
BTLC1000 Chip ID: 0x2000B1
BD Address:0xF8F005F60565, Address Type:0
BluSDK Firmware Version:6.2.7072
Press SW0 button to start advertisement...
Adv started
Press SW0 button to stop advertisement...
Connected to peer device with address 0x426af1ddc2bf
Connection Handle 0
```

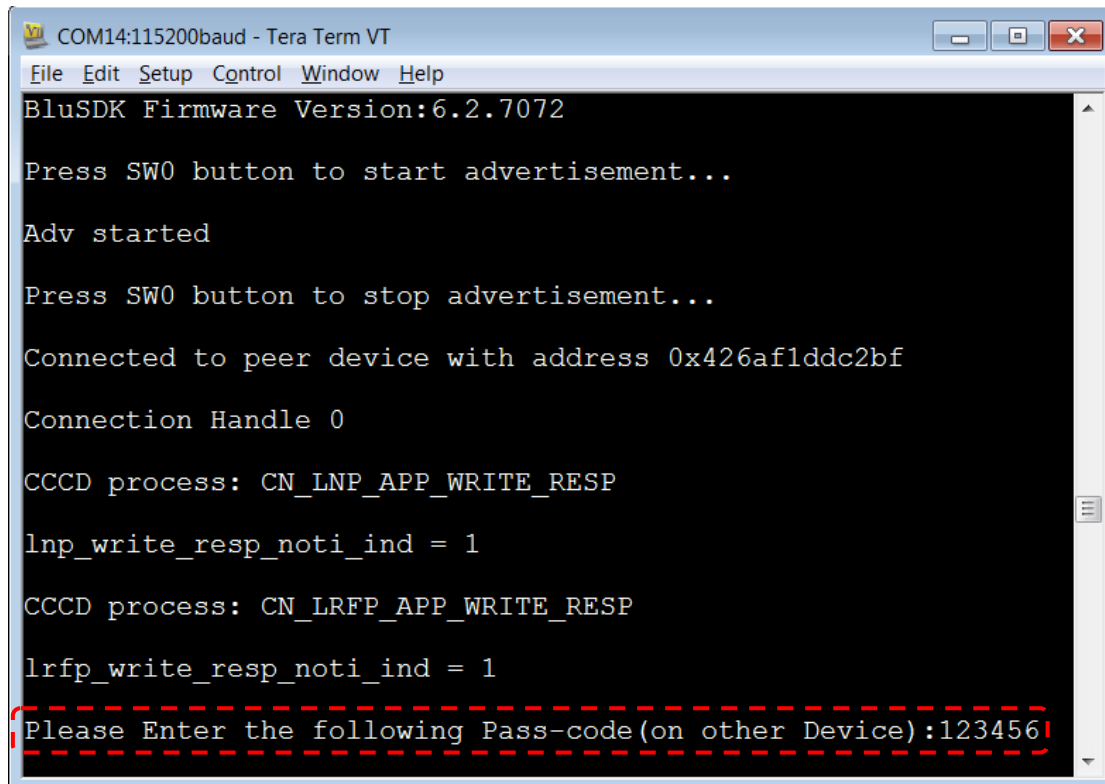
10. Once connected, the MCHPLoRa App discovers the AppWriteResponse characteristic in LoRaWAN Provisioning service and LoRaWAN RF Parameter service and enable notifications.



```
COM14:115200baud - Tera Term VT
File Edit Setup Control Window Help
BD Address:0xF8F005F60565, Address Type:0
BluSDK Firmware Version:6.2.7072
Press SW0 button to start advertisement...
Adv started
Press SW0 button to stop advertisement...
Connected to peer device with address 0x426af1ddc2bf
Connection Handle 0
CCCD process: CN_LNP_APP_WRITE_RESP
lnp_write_resp_noti_ind = 1
CCCD process: CN_LRFP_APP_WRITE_RESP
lrfp_write_resp_noti_ind = 1
```

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11. Once connected, the pairing will be initiated and the user has to enter the pin code 123456 in MCHPLoRa APP.



COM14:115200baud - Tera Term VT

File Edit Setup Control Window Help

BluSDK Firmware Version:6.2.7072

Press SW0 button to start advertisement...

Adv started

Press SW0 button to stop advertisement...

Connected to peer device with address 0x426af1ddc2bf

Connection Handle 0

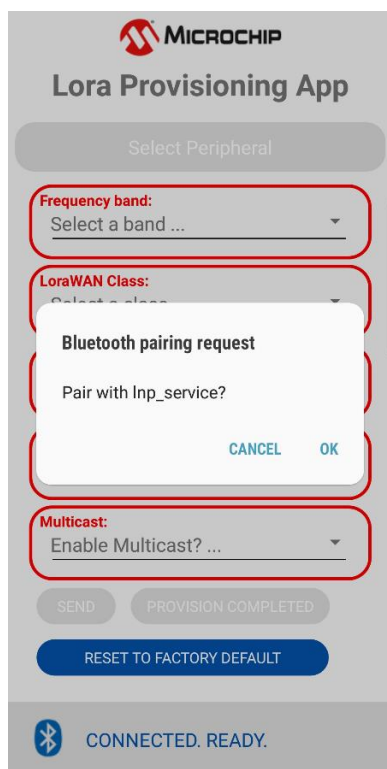
CCCD process: CN_LNP_APP_WRITE_RESP

lnp_write_resp_noti_ind = 1

CCCD process: CN_LRFP_APP_WRITE_RESP

lrfp_write_resp_noti_ind = 1

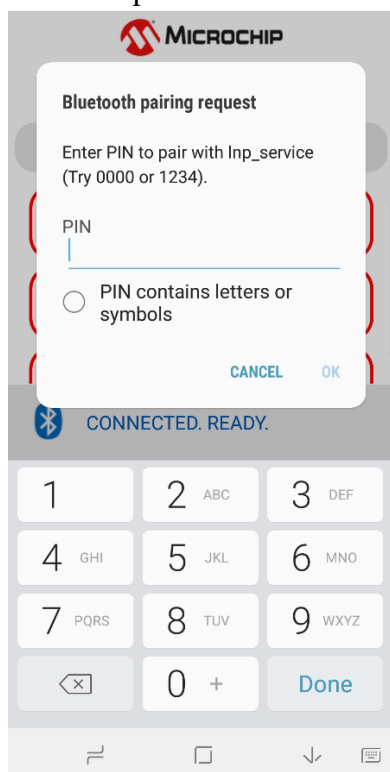
Please Enter the following Pass-code (on other Device):123456



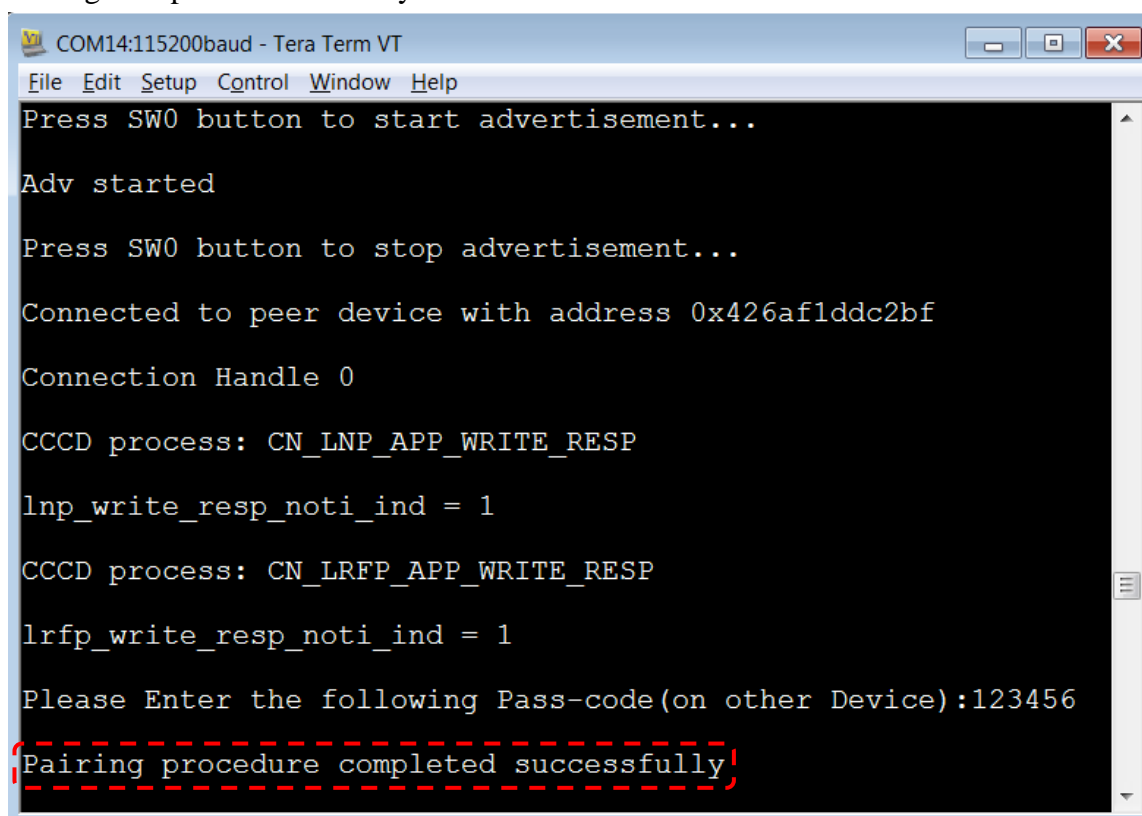
12. Press OK

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13. Enter the pin code in 123456

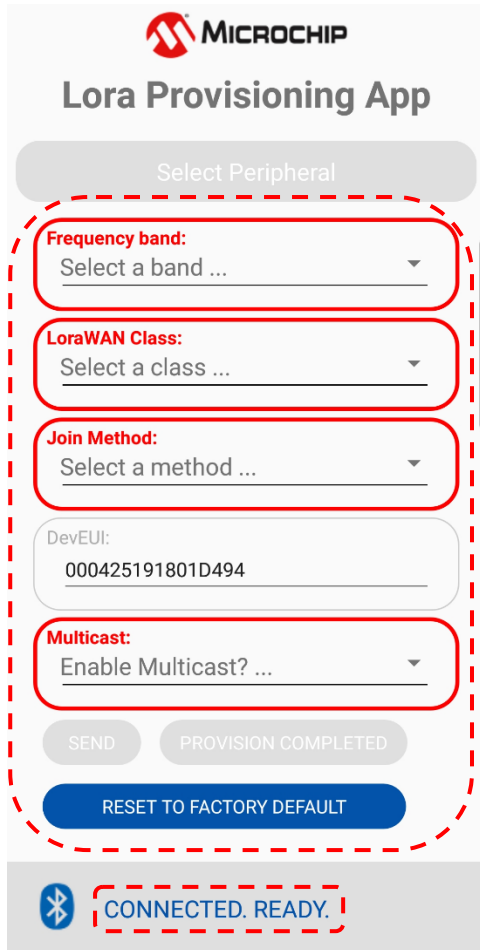


14. Pairing Completed successfully



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15. Once connected and paired the MCHPLoRa App will show the status as **CONNECTED. READY.** It will also list down the provisioning parameters (characteristics).

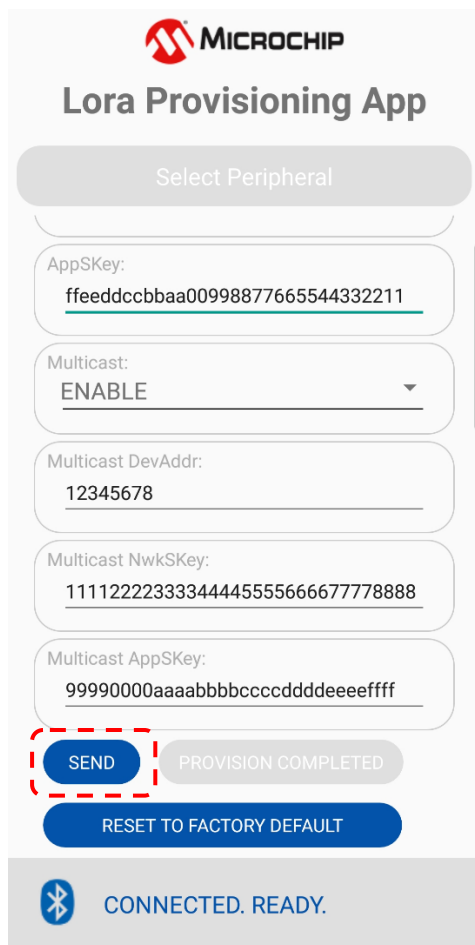


16. By default, the MCHPLoRa APP will list the following parameters,
- Frequency Band
 - LoRaWAN Class
 - Join Method
 - DevEUI
 - Multicast
17. By default, both SEND and PROVISION COMPLETED buttons will be disabled and RESET TO FACTORY DEFAULT button will be enabled.
18. The MCHPLoRa APP will read the DevEUI and display it in DevEUI field
19. Select an appropriate Frequency band
20. The Frequency sub band parameter will be enabled if the Frequency band supports it.
- For example, selecting the frequency band NA915 will enable Frequency sub band
21. Select an appropriate Frequency sub band

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22. Select LoRaWAN class type
23. Select Join method
24. If Join method is OTAA then following parameters will be enabled
 - a. AppEUI: Enter valid application EUI
 - b. AppKey: Enter appropriate application Key
25. If Join method is ABP then following parameters will be enabled
 - a. DevAddr: Enter valid device address
 - b. NwkSKey: Enter appropriate network session key
 - c. AppSKey: Enter appropriate application session key
26. Select whether Multicast is **ENABLE/DISABLE**
27. If Multicast is **ENABLE**, then the following fields will be enabled (only one set of multicast info can be provisioned from current version of MCHPLoRa APP)
 - a. Multicast DevAddr: Enter valid multicast group address
 - b. Multicast NwkSKey: Enter appropriate multicast network session key
 - c. Multicast AppSKey: Enter appropriate multicast application session key
28. Once entered all the parameters, press **SEND** button

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MICROCHIP

Lora Provisioning App

Select Peripheral

AppSKey:
ffeeddccbbaa00998877665544332211

Multicast:
ENABLE


Multicast DevAddr:
12345678

Multicast NwkSKey:
11112222333344445555666677778888

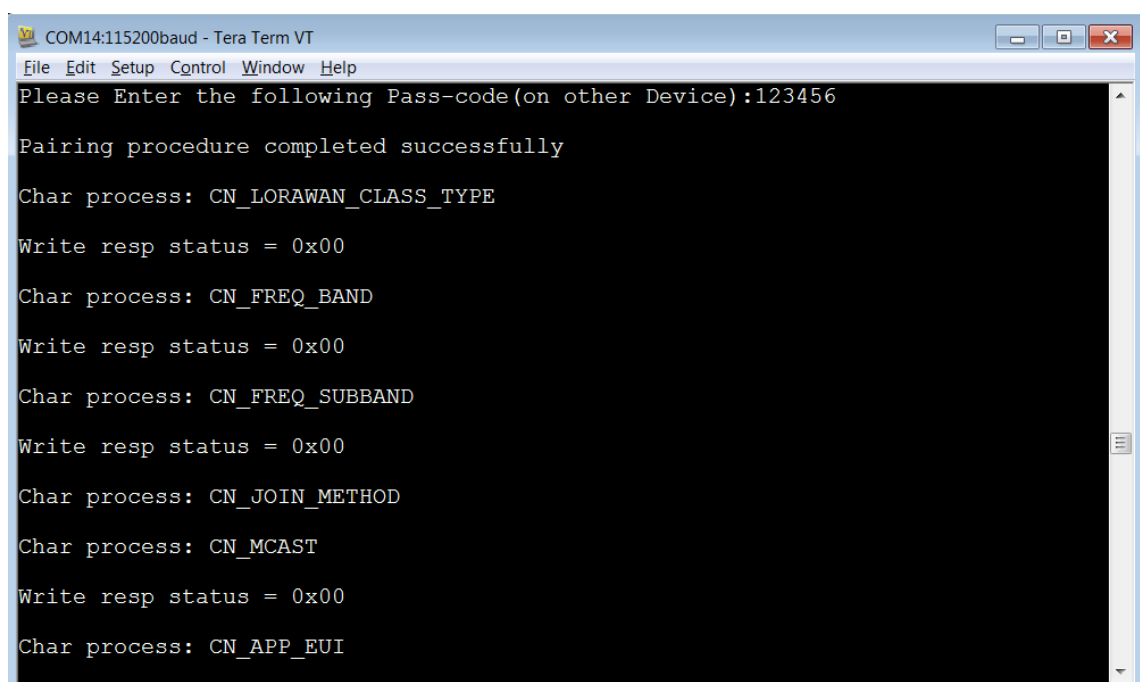
Multicast AppSKey:
99990000aaaabbbbccccdddeeeeffff

SEND PROVISION COMPLETED

RESET TO FACTORY DEFAULT

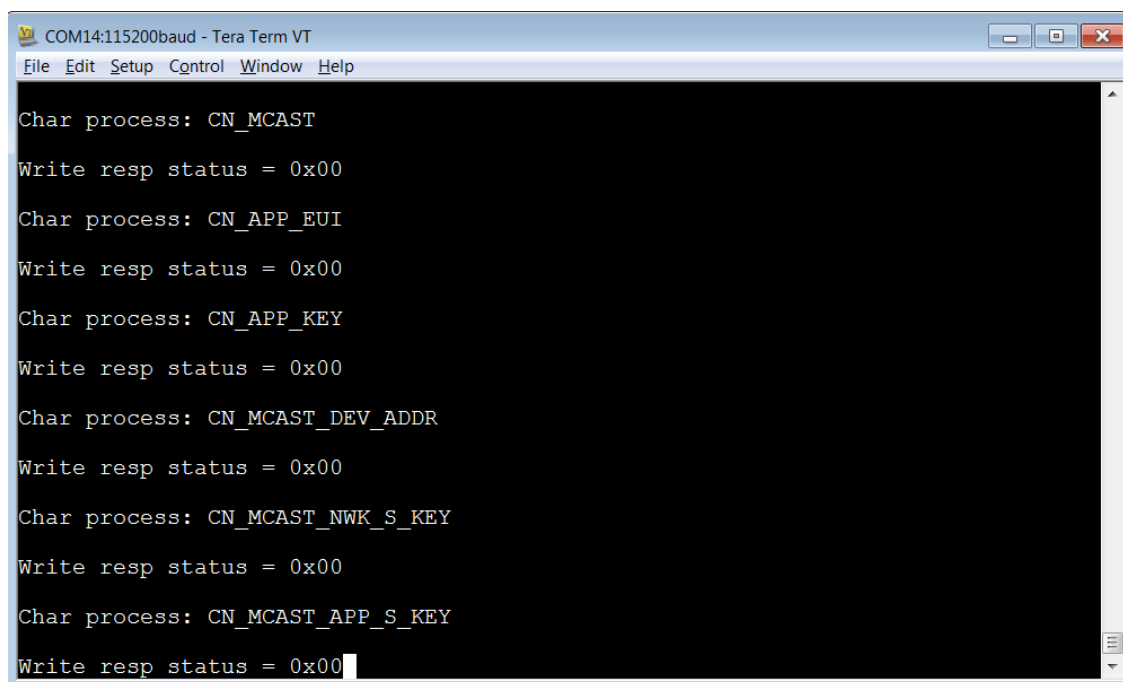
 **CONNECTED. READY.**

29. MCHPLoRa APP will send all the parameters to LoRaWAN End-Device.



```
COM14:115200baud - Tera Term VT
File Edit Setup Control Window Help
Please Enter the following Pass-code(on other Device):123456
Pairing procedure completed successfully
Char process: CN_LORAWAN_CLASS_TYPE
Write resp status = 0x00
Char process: CN_FREQ_BAND
Write resp status = 0x00
Char process: CN_FREQ_SUBBAND
Write resp status = 0x00
Char process: CN_JOIN_METHOD
Char process: CN_MCAST
Write resp status = 0x00
Char process: CN_APP_EUI
```

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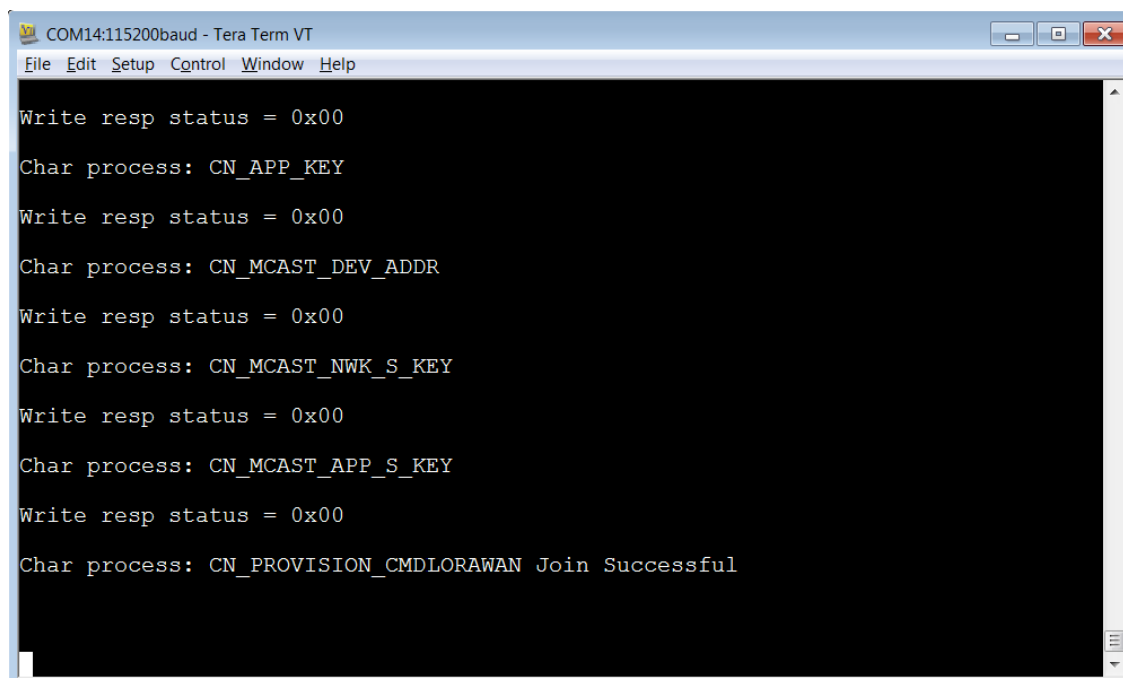


A screenshot of a Tera Term VT terminal window titled "COM14:115200baud - Tera Term VT". The window has a menu bar with "File", "Edit", "Setup", "Control", "Window", and "Help". The terminal displays the following text:

```
Char process: CN_MCAST
Write resp status = 0x00
Char process: CN_APP_EUI
Write resp status = 0x00
Char process: CN_APP_KEY
Write resp status = 0x00
Char process: CN_MCAST_DEV_ADDR
Write resp status = 0x00
Char process: CN_MCAST_NWK_S_KEY
Write resp status = 0x00
Char process: CN_MCAST_APP_S_KEY
Write resp status = 0x00
```

30. Once all the parameters are successfully sent to LoRaWAN End-Device, the MCHPLoRa APP will enable the **PROVISION COMPLETED** button.

31. Press **PROVISION COMPLETED** button.

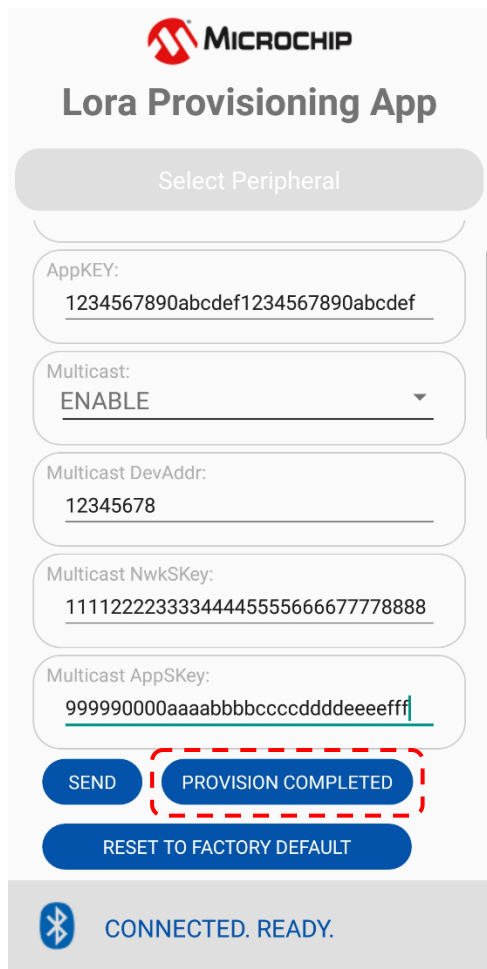


A screenshot of a Tera Term VT terminal window titled "COM14:115200baud - Tera Term VT". The window has a menu bar with "File", "Edit", "Setup", "Control", "Window", and "Help". The terminal displays the following text:

```
Write resp status = 0x00
Char process: CN_APP_KEY
Write resp status = 0x00
Char process: CN_MCAST_DEV_ADDR
Write resp status = 0x00
Char process: CN_MCAST_NWK_S_KEY
Write resp status = 0x00
Char process: CN_MCAST_APP_S_KEY
Write resp status = 0x00
Char process: CN_PROVISION_CMDLORAWAN Join Successful
```

32. The End-Device will print the LoRaWAN join status in the console.

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MICROCHIP

Lora Provisioning App

Select Peripheral

AppKEY:
1234567890abcdef1234567890abcdef


Multicast:
ENABLE

Multicast DevAddr:
12345678

Multicast NwkSKey:
11112222333344445555666677778888


Multicast AppSKey:
999990000aaaabbbbccccdddeeefff

SEND PROVISION COMPLETED RESET TO FACTORY DEFAULT

 CONNECTED. READY.

33. Pressing PROVISION COMPLETED button will write a value 1 on the ProvisionCompleted characteristic and it will trigger an End-Device to store all the provisioning parameter in Persistence Data Server (PDS) and start LoRaWAN join procedure.
34. Pressing RESET TO FACTORY DEFAULT button will reset all the provisioning parameters in End-Device to its default value and it will reset the LoRaWAN stack.

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 **MICROCHIP**

Lora Provisioning App

Select Peripheral

AppKEY:
1234567890abcdef1234567890abcdef

Multicast:
ENABLE

Multicast DevAddr:
12345678


Multicast NwkSKey:
11112222333344445555666677778888

Multicast AppSKey:
999990000aaaabbbbccccdddeeeefff

SEND

PROVISION COMPLETED

RESET TO FACTORY DEFAULT

 **CONNECTED. READY.**

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