MK8000 EVB Quick Start Guide

Revision History

Revision	Date	Description	Author
V0.1	2022-02-14	Initial version	Z. Xing

Table of Contents

Table of Figures

List of Tables

1. Overview

FCC ID: 2A7T8MK8000UWBA

This document provides a quick start guide on testing and evaluation of the MK8000 chipset [1] features and performance using the MK8000 evaluation kit.

MK8000 evaluation kit has two operation modes --- standalone and MKTool mode.

- Standalone mode
  - The EVB starts to work automatically once powered on. The measurement result is updated periodically in a Windows console through the serial port.
- MKTool mode
  - The EVB is controlled by the MKTool [2], and the test result will be shown in the GUI.

MK8000 evaluation kit has one firmware update mode --- ISP (In System Programming) mode.

- ISP mode
  - When EVB is in ISP mode, the firmware of MK8000 chipset can be updated using ISPTool[3].

2. What's in the box

The MK8000 evaluation kit includes the following items, as shown in Figure 1.

- Two MK8000 EVBs
- One 4-element linear array antenna with Anchor EVB
- One single element antenna with Tag EVB
- Four-wire flat ribbon cables
- Two USB-to-serial port adaptors

Figure 1 MK8000 evaluation kit

3. MKSemi EVB Hardware Setup

This chapter provides step-by-step instructions for setting up the evaluation kit.

3.1 Power supply connection

Figure 2 shows the front and back sides of the MK8000 EVB. J105 is the jumper for power supply. J105(+) connects to VCC and J105(-) connects to GND.

3.2 Power supply configuration

MK8000 EVB supports 1.8~3.6V and 3.6~5.5V power supplies. The default configuration is 1.8~3.6V.

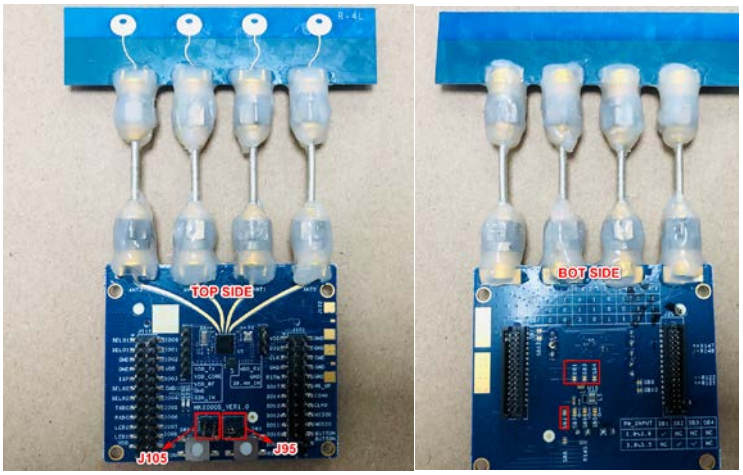

Figure 2 Top and Bot side of MK8000 EVB

Table 1 provides the details of the configuration of the jumpers and the resistor connections for these two supply voltage options.

Table 1 Jumper configuration for different supply voltage

Supply voltage	J95	SB1	SB2	SB3	SB4
1.8~3.6v	✓	✓	✕	✕	✕
3.6v~5.5v	✓	✕	✓	✓	✕
shorting or connect '✓' disconnect '✕'					

3.3 Function Description of Jumper Pins

The MK8000 EVB has two rows of jumpers that are connected to the I/Os of the chip to offer the flexibility of configuration and programming. Table 2 describes the functionality of the jumper pins on the MK8000 EVB.

Table 2 Jumper Pin Description

Function	Jumper	Pin	Description
SWD	J101	SWDIO	SWDIO
	J101	SWDCLK	SWDCLK
RESET	J101	RSTN	RESET (active low)
SPI0	J101	IO_14	CSN
	J101	IO_13	CLK
	J101	IO_12	MISO
	J101	IO_11	MOSI

ROLE-SELECT	J111	IO_02	Ranging Initiator (Tag): level high (not connect) Ranging Responder (Anchor): level low (short to GND)
ISP-BOOT	J111	IO_03	ISP (In System Programming). The chip enters ISP mode if ISP-BOOT is low when MK8000 is powered up.
UART0	J111	IO_05	UART0 TXD
	J111	IO_06	UART0 RXD

3.4 Standalone mode hardware setup

The MK8000 EVB standalone mode needs two MK8000 EVBs to perform the evaluation. One EVB is configured as an Anchor Role and connected to a 4-element linear array antenna, the other EVB is configured as a Tag role and connected to a single element antenna.

Both EVBs communicate with each other and perform the range and azimuth angle measurement continuously. The results are sent through the serial port and displayed in a command line terminal of the Windows PC.

EVB standalone mode has been pre-set and configured with proper configuration and does not need additional tools or software to control the EVB. It only needs serial port to display the ranging and angle measurement results at Anchor side.

3.4.1 Anchor hardware setup in standalone mode

Table 3 provides the detail of the Anchor side hardware connection in standalone mode and Figure 3 shows the Anchor after connection.

Table 3 Anchor side hardware connection in standalone mode

MK8000 EVB	USB-to-serial port adaptor	Operation
J105 (+)	VCC	Use flat ribbon wires to connect J105 (+) to VCC
J105 (-)	GND	Use flat ribbon wires to connect J105 (-) to GND
IO_05	RXD	Use flat ribbon wires to connect IO_05 to RXD
IO_06	TXD	Use flat ribbon wires to connect IO_06 to TXD
IO_02	--	Use flat ribbon wires to connect IO_02 to GND. With this setting, the EVB will be configured as Anchor (only the EVB with 4-element linear array antenna should use this setting)

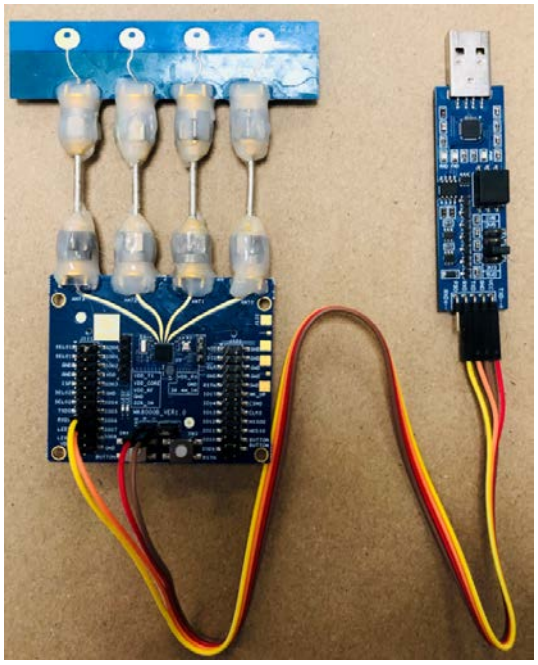

Figure 3 Anchor connection

3.4.2 Tag hardware setup in standalone mode

Table 4 shows the detail of the Tag hardware connection in standalone mode and Figure 4 shows the tag after connection. In standalone mode, the USB adapter at the tag side is used for power supply only.

Table 4 Tag side hardware connection in standalone mode

MK8000 EVB	USB-to-serial port adaptor	operation
J105 (+)	VCC	Use flat ribbon wires to connect J105 (+) to VCC
J105 (-)	GND	Use flat ribbon wires to connect J105 (-) to GND
IO_05	RXD	Use flat ribbon wires to connect IO_05 to RXD (optional)
IO_06	TXD	Use flat ribbon wires to connect IO_06 to TXD (optional)
IO_02	--	Leave IO_02 open. With this setting, the EVB will be configured as Tag

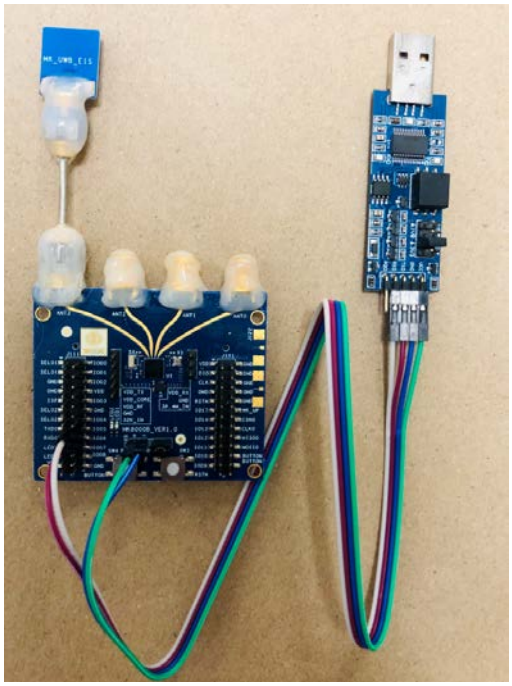

Figure 4 Tag connection

3.5 MKTool mode hardware setup

The MK8000 EVB MKTool mode needs two MK8000 EVBs and Windows laptops with MKTool software installed. MKTool is a Windows application program developed by MKSEMI and used to configure the chip and the EVB, perform and control the MK8000 chipset evaluation. It has a GUI interface for configuration and results display. Both EVBs need to download the MKTool firmware to perform the test.

MKTool application sends commands and receives responses and measurement results of MK8000 EVB through the serial port. Table 5 listed the details of the hardware connection in MKTool mode for both Anchor and Tag sides.

Table 5 hardware settings for MKTool mode

MK8000 EVB	USB-to-serial port adaptor	Operation
J105 (+)	VCC	Use flat ribbon wires to connect J105 (+) to VCC
J105 (-)	GND	Use flat ribbon wires to connect J105 (-) to GND
IO_5	RXD	Use flat ribbon wires to connect IO_05 to RXD
IO_6	TXD	Use flat ribbon wires to connect IO_06 to TXD

3.6 ISP mode hardware setup

Based on either section 3.4 or 3.5, use flat ribbon wires to connect IO_03 to GND and ensure that the IO_03 is low when the MK8000 EVB is powered on, the EVB enters ISP mode and the firmware can be updated through UART0.

4. Software setup

This chapter provides an overview of software setup of MK8000 EVB. Software setup is needed when MKTool mode is used in the testing and evaluation. There is no need to program the MK8000 EVB if Standalone mode is used in the test and evaluation.

4.1 MK8000 Device Description File Installation

MK8000 SDK supports Keil, IAR and GCC IDE platforms for code development and debugging. MK8000 software package includes device description files for all three platforms. For Keil and IAR platforms, device description files need to be installed before using the MK8000 EVB.

4.1.1 Keil Platform

The MK8000 software package includes a self-extract file “MKSEMI.MK800X_DFP.1.0.1.pack” for DFP file installation in Keil environment. By double click the file, the DFP file will be installed automatically.

4.1.2 IAR Platform

The installation of device description file for IAR system is different from that of Keil platform. First, the user needs to unpack the zip file into a temporary folder, then, copy the file in the “config” folder of the temporary folder into the installation directory of IAR, as shown in Figure 5. The device description file for IAR system is then installed.

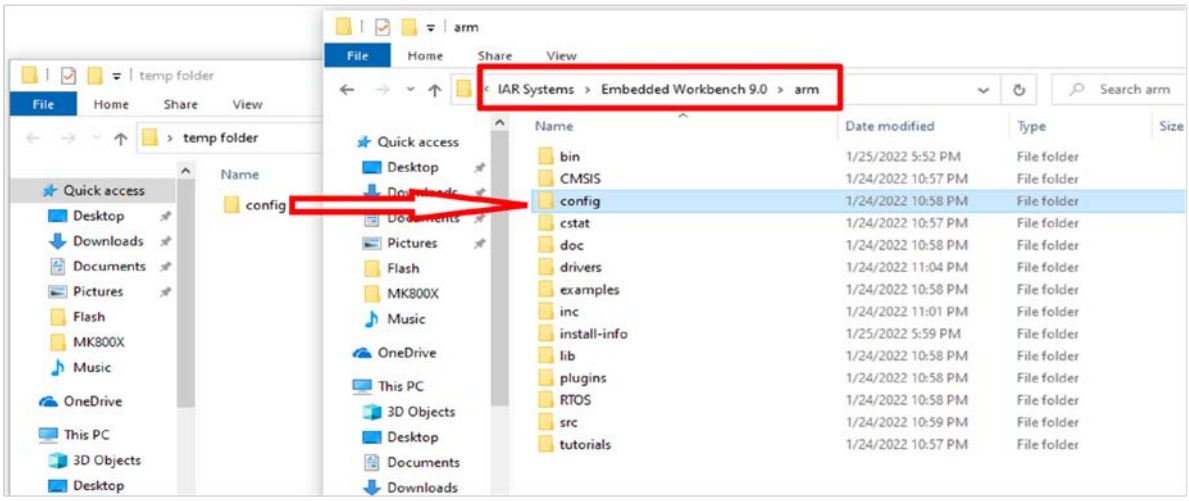

Figure 5 Installation of device description file for IAR System

4.1.3 GCC Platform

There is no need to install configuration or description file in GCC platform.

4.2 MK8000 Software Development Kit

MK8000 SDK package includes RTOS, device drivers, peripheral support as well as example codes. Figure 6 shows the SDK directory structure. Users can compile the codes in the example projects and load into the EVB to perform the testing and evaluation. MKSEMI ISPTool software is needed to download the firmware into the EVB. For detail, please refer to ISPTool User Guide [3].

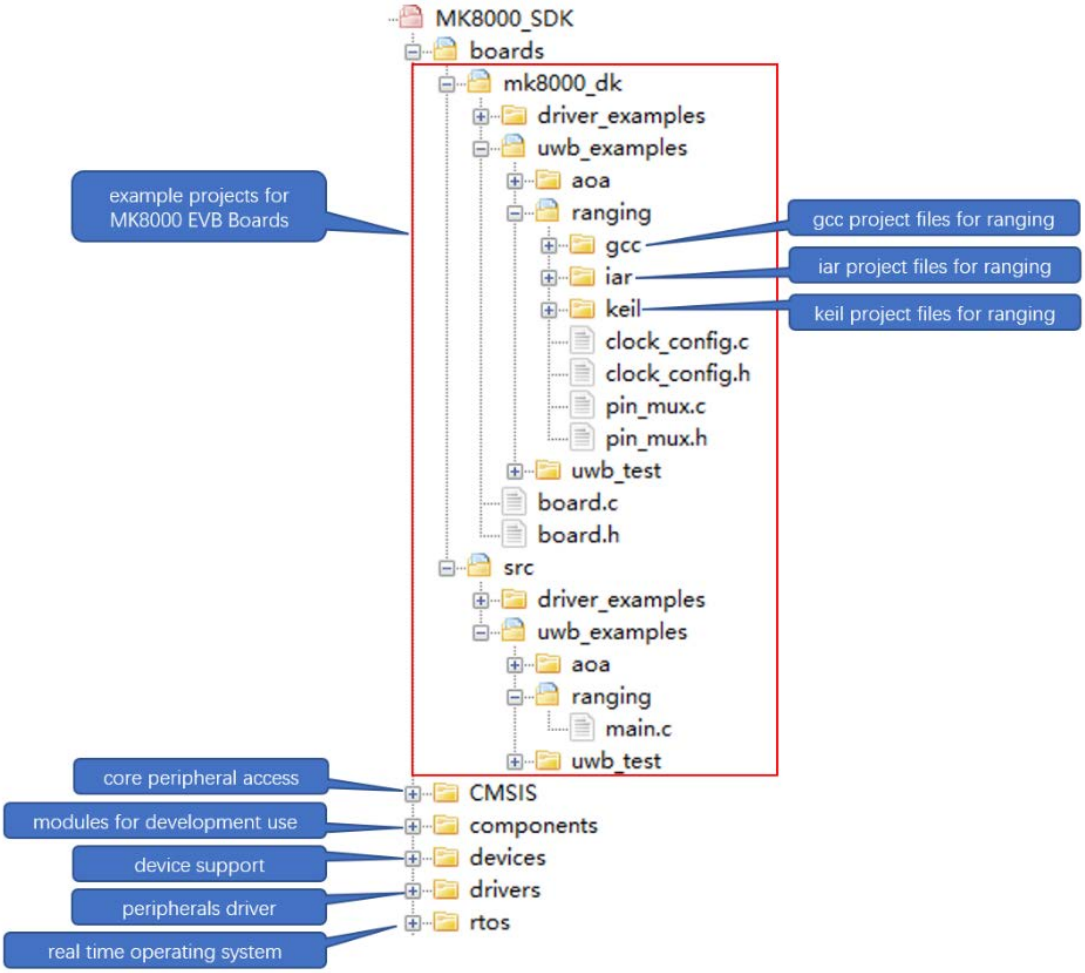

Figure 6 MK8000 SDK package

4.3 Firmware download

Before testing and evaluation, user needs to download the proper firmware into the MK8000 chipset. MKSEMI provides an application software, the ISPTool, to download the firmware.

To download the firmware, user needs to connect the EVB to the laptop and get a proper COM port number in Windows Device Manager for this device and launch the ISPTool application. Make sure the EVB is in ISP mode, then do the following steps In ISPTool:

1. Select the “UART” communication Mode.
2. select proper COM port number.
3. Click the “Connect” button to establish a data channel. The log browser end with info like “COM8 is connected successfully,921600”.
4. Select bin by the menu “File” → “open file”.
5. Click the “Download” to start download. The log browser end with “Download is successfully!”.

Figure 7 and Figure 8 also shows the steps of download.

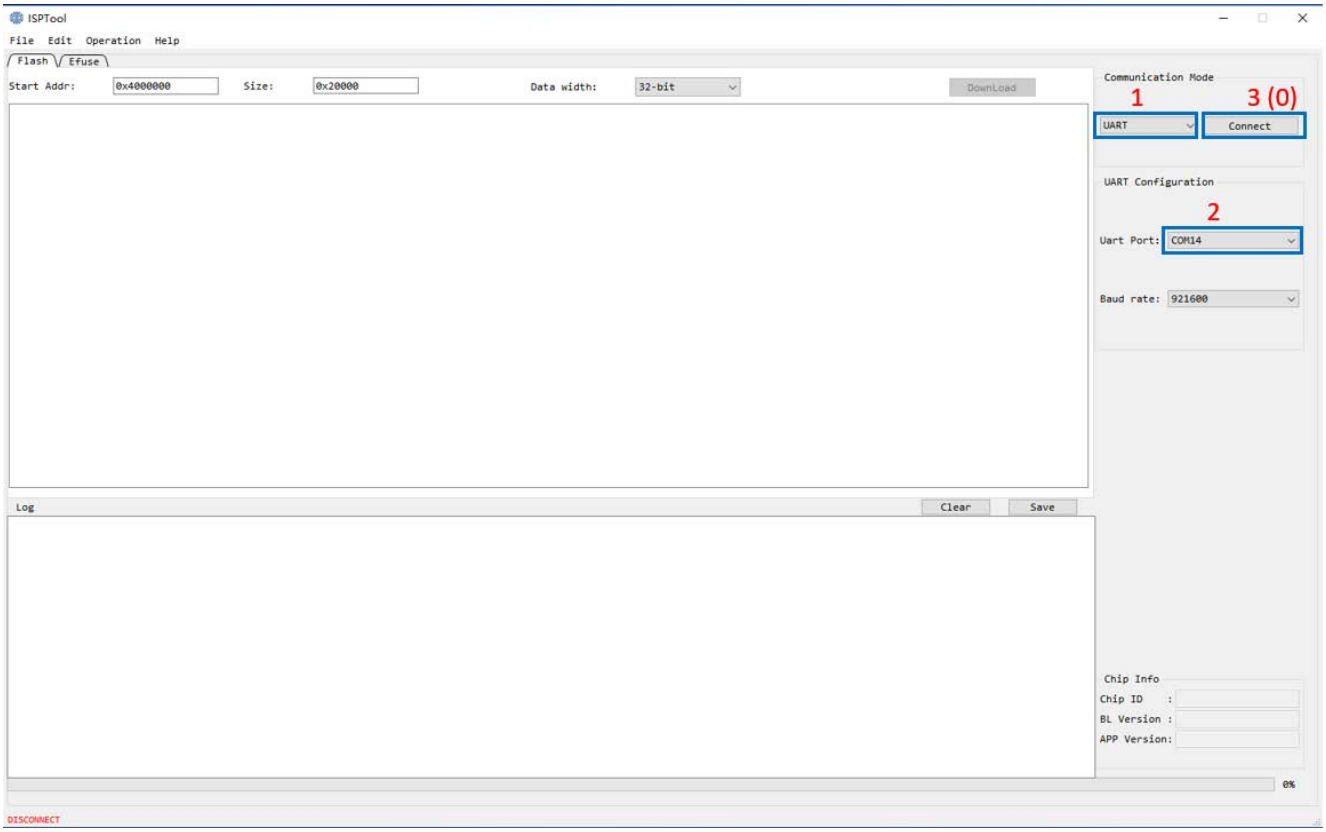

Figure 7 ISPTOOL update firmware - 0

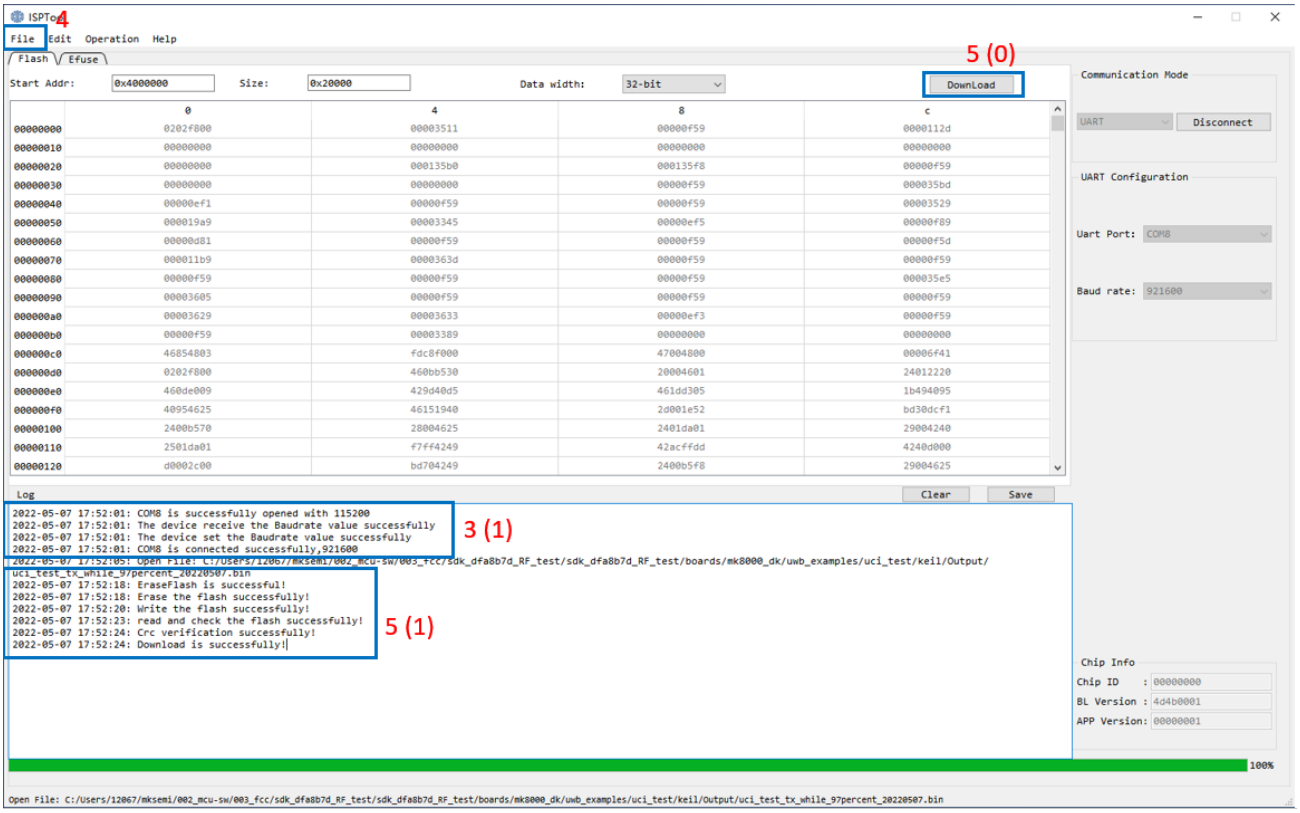

Figure 8 ISPTOOL update firmware – 1

5. Application examples

This chapter provides an introduction of procedures for two basic tests:

- Ranging and AoA
- Power consumption

5.1 Ranging and AoA test

At the beginning of test, the proper bin file should be downloaded to MK8000 EVBs. Get example project from the following locations then make the bin file or get bin file directly.

- Standalone mode
  - project: “sdk_folder\boards\mk8000_dk\uwb_examples\aoa_loc”
  - bin file: “sdk_folder\boards\mk8000_dk\uwb_examples\bin_files\aoa_loc.bin”
- MKTool mode project:
  - project: “sdk_folder\boards\mk8000_dk\uwb_examples\uci_test”
  - bin file: “sdk_folder\boards\mk8000_dk\uwb_examples\bin_files\uci_test.bin”

5.1.1 Standalone Mode

Standalone mode provides a quick demonstration and evaluation of ranging and AoA capability of MK8000 chipset. Figure 9 shows a typical setup of measurement. The tag is set on a plastic stand vertically and connected to a portable battery. The Anchor is set on another plastic stand vertically and connected to a Windows laptop to display the test results by using a console application such as PuTTY. The detailed port configuration is listed in Table 6.

Figure 9 Example of setup of Ranging and AoA test in Standalone mode

Table 6 Serial port configuration

Speed	921600
Data bits	8
Parity	None
Stop bits	1
Flow control	None

Since both Anchor and Tag are pre-configured, the measurements will start automatically as soon as both boards are powered up. The console will show the measurement log as shown in Figure 10. The ranging measurement is based on Double-sided Two-way-Ranging protocol, and the angle measurement is based on Angle of Arrival (AoA) scheme.

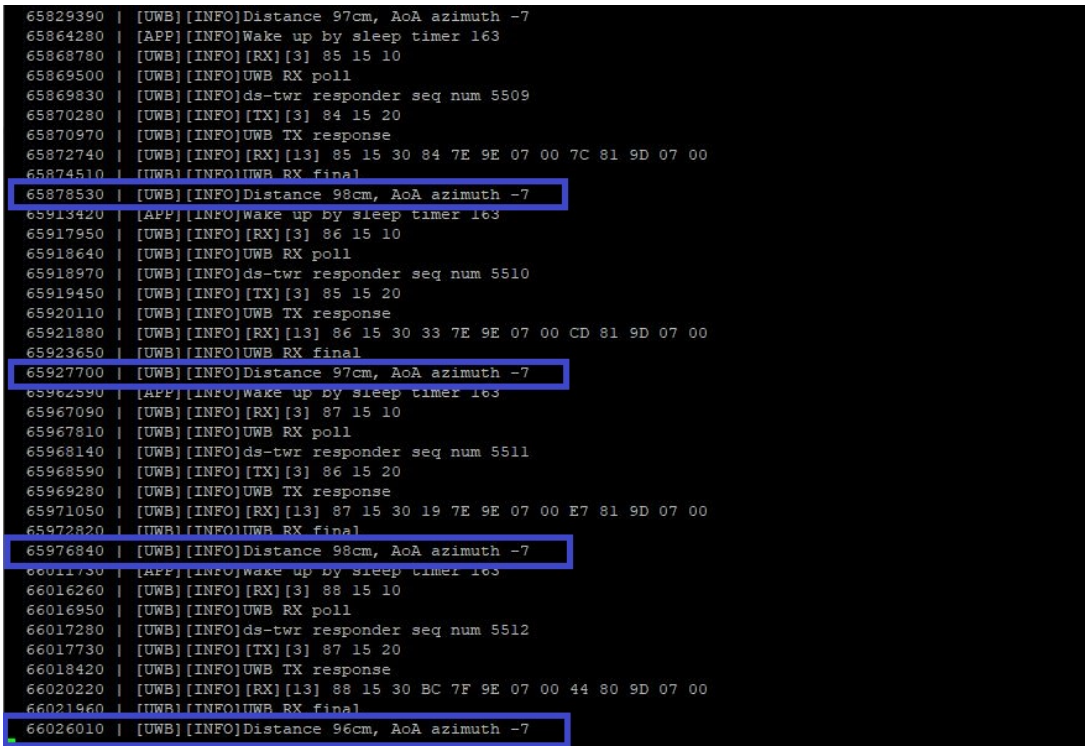

Figure 10 Example of datalog of Standalone test mode

5.1.2 MKTool Mode

MKTool mode provides a flexible capability to evaluate the MK8000 chipset. Before the measurement started, load the firmware of Ranging and AoA testing into both Anchor and Tag EVBs, also configure both roles by using the MKTool. Then the test will start and results will be shown in both graphical and data log mode.

5.1.2.1 Tag configuration

The tag is an MK8000 EVB which connects to single element antenna. To configure the tag, user needs to connect the EVB to the laptop and get a proper COM port number in Windows Device Manager for this device and launch the MKTool application. In MKTool, do the following steps:

1. Open proper COM port number. Com port will be shown at left-bottom corner.
2. Click the “Ranging” Tab at the top of the GUI manual.
3. Select the “Tag” Role.
4. Click the “Restart” button to start the device as a Tag role in the measurement.

Figure 11 also shows the steps of configuration.

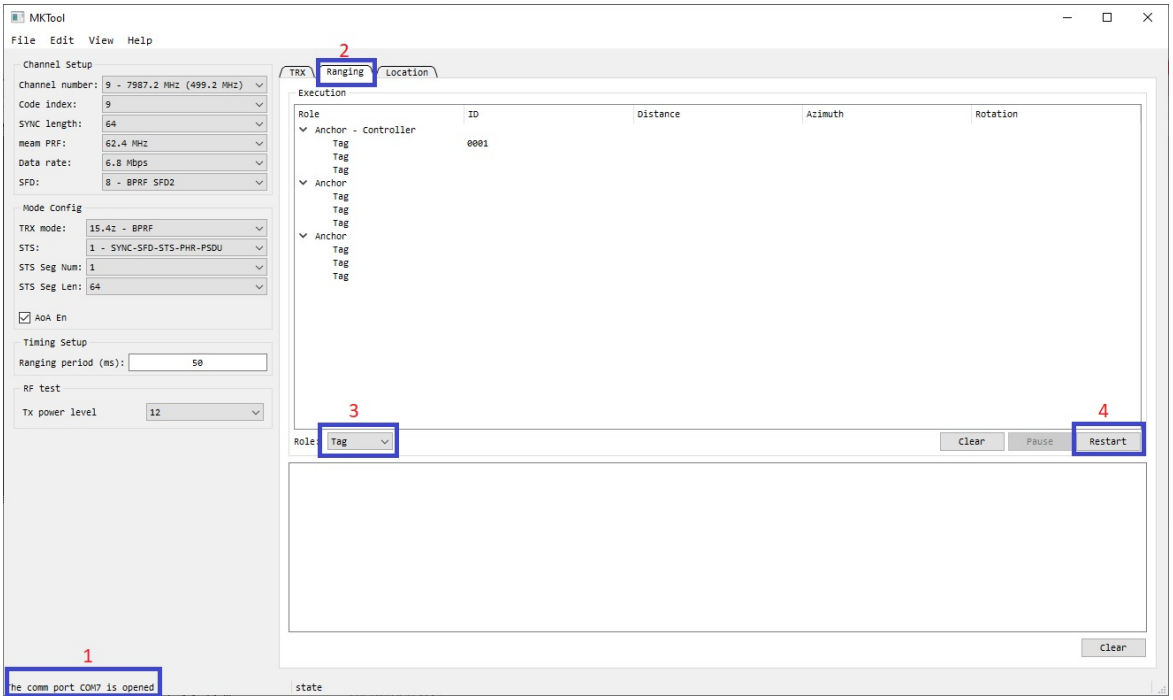

Figure 11 MKTool Mode Tag side configuration

5.1.2.2 Anchor configuration

The Anchor is an MK8000 EVB which connects to 4-element linear array antenna. To configure the anchor, user needs to connect the EVB to the laptop and get a proper COM port number in Windows Device Manager for this device and launch the MKTool application. In MKTool, do the following steps:

1. Open proper COM port number. Com port will be shown at left-bottom corner.
2. Click the “Ranging” Tab at the top of the GUI manual.
3. Select the “Anchor” Role.
4. Click the “Restart” button to start the EVB as an Anchor.
5. Click the “Location” Tab to show the measurement results dynamically.

Figure 12 also shows the steps of configuration.

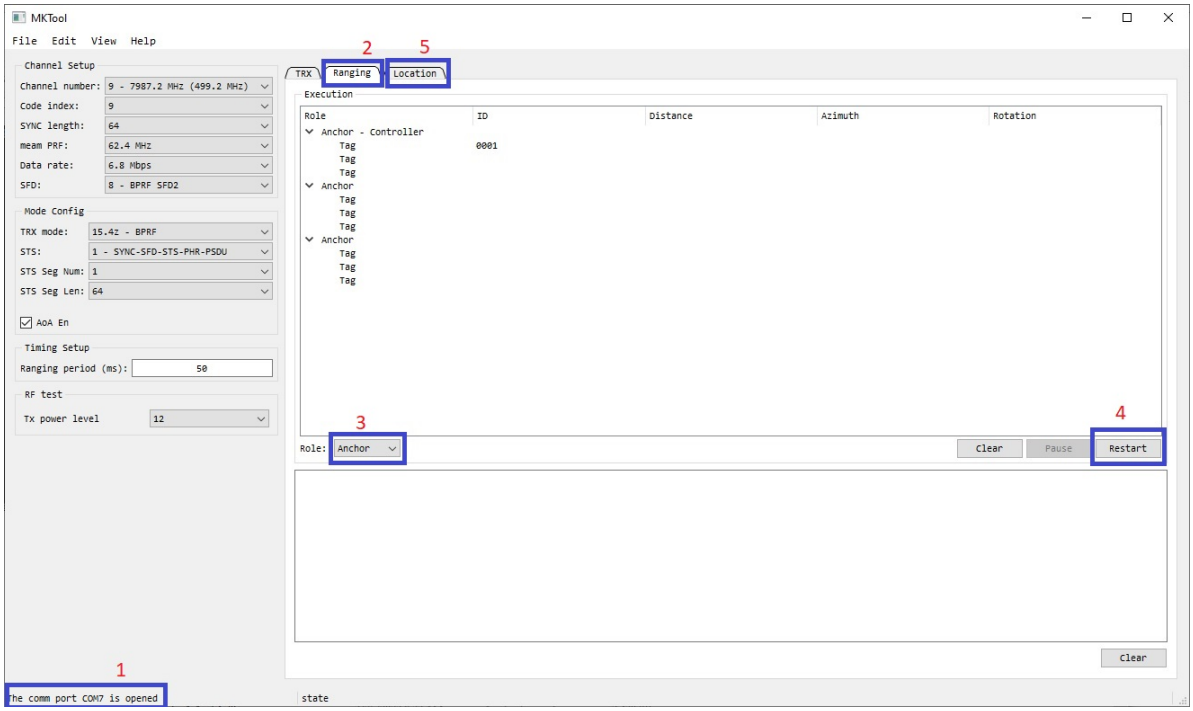

Figure 12 MKTool Mode Anchor side configuration

5.1.2.3 Measurement setup and examples

Figure 13 shows the typical measurement setup of using MKTool mode. Both the Anchor and the tag are set on plastic stands vertically and connected to laptop PCs. Figure 14 shows typical measurement results.

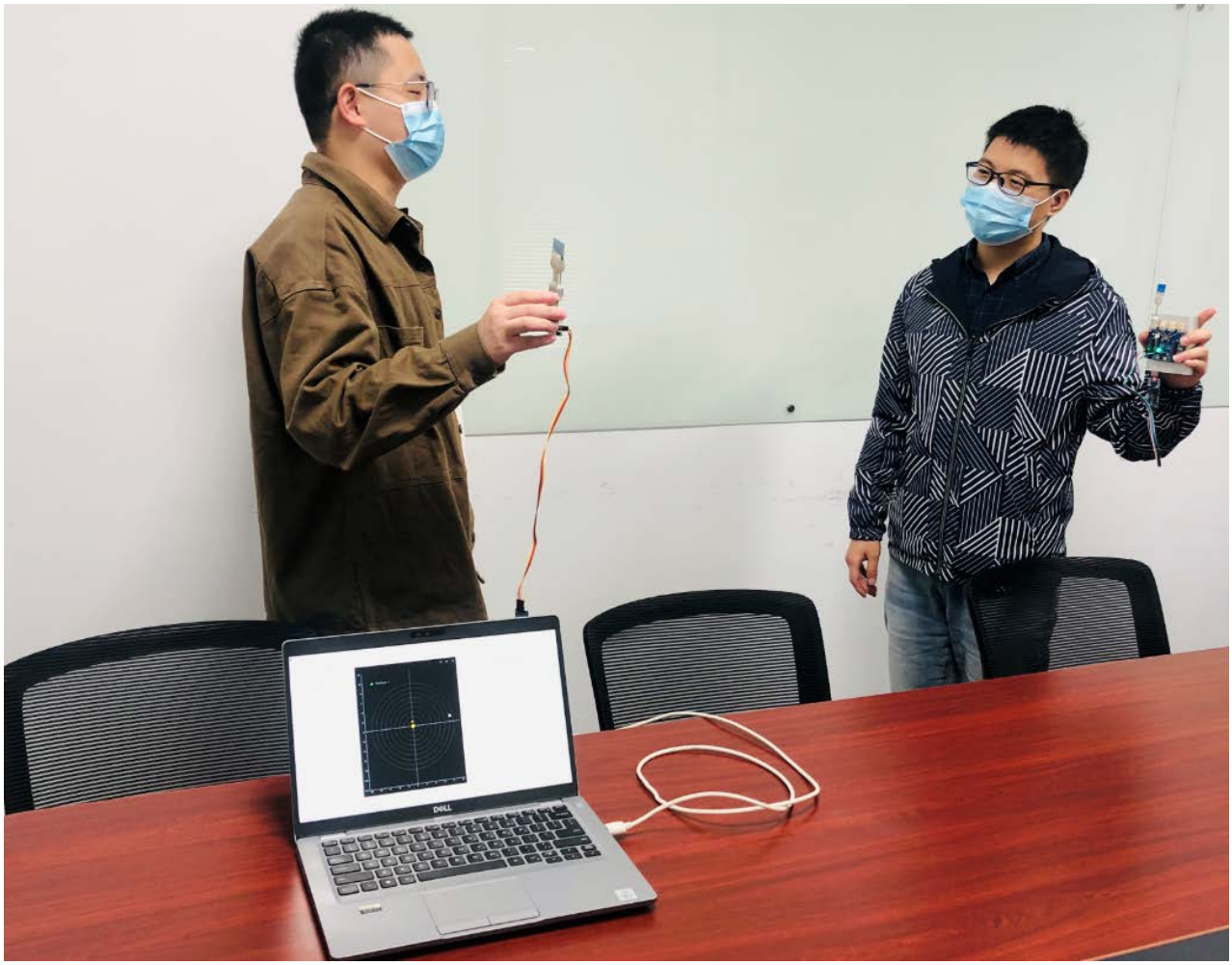

Figure 13 Example of setup of Ranging and AoA test in MKTool Mode

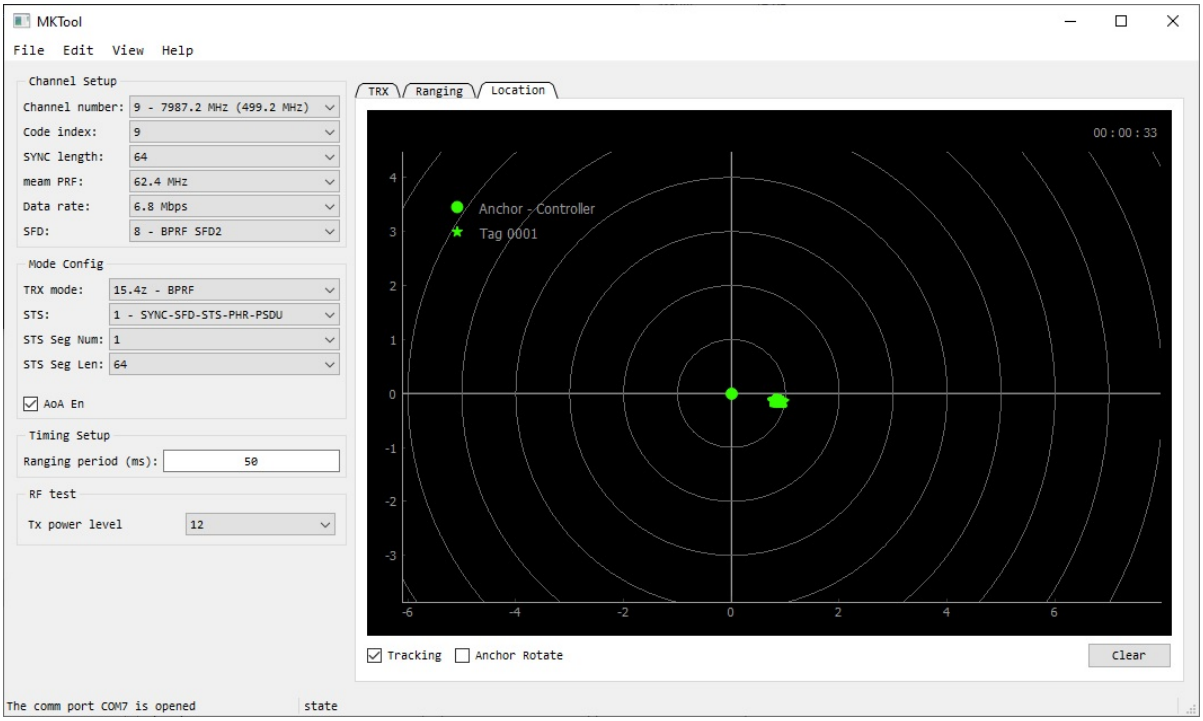

Figure 14 Example of Ranging and AoA test GUI in MKTool mode

5.2 Current consumption measurement

The MK8000 EVB has dedicated circuits for MK8000 chipset current consumption testing. Figure 15 shows the schematic of related portion. User can use a multimeter and J95 to perform a coarse test, and an oscilloscope and J95 to perform an accurate test.

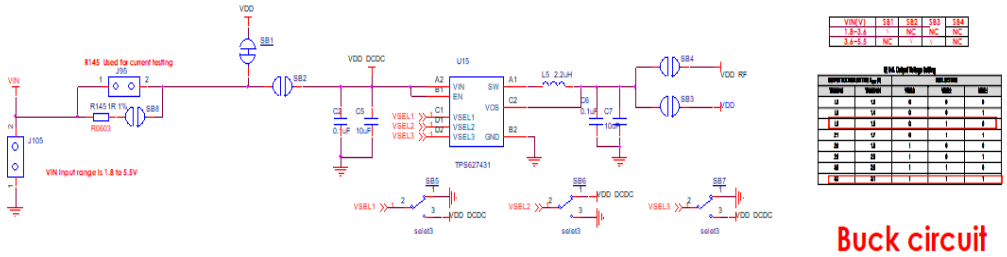

Figure 15 schematics associated with current measurement

5.2.1 Coarse measurement of current consumption

This test uses the following the steps with a multimeter to measure the current of MK8000 EVB.

1. Power off the MK8000 EVB
2. Leave the J96 at the disconnect state and short the J95
3. Set the Multimeter to the current test state, connect the pin of J96 near the power supply to the positive node of Multimeter, connect the other pin of J96 to the negative node of Multimeter
4. Power on the EVB by J105

5.2.2 Fine measurement of current consumption

This test uses the following steps with an oscilloscope to measure the fine current consumption of MK8000 EVB. The current consumption is equal to the voltage measured by the scope / the resistance of R145 (default value 1Ohm)

1. Power off the MK8000 EVB
2. Leave the J95 at the disconnect state and short the J96
3. Connect the two pins of J95 to the oscilloscope and each pin connect to a channel
4. Power on the EVB by J105

6. Conclusion

The MK8000 chipset is UWB technology based feature rich wireless SoC. This document provides a step-by-step guidance to help users starting the testing and evaluation of MK8000 chipset. There are two example tests that had been described in this document.

The MK8000 EVB mainly serves as a testing and evaluation platform for MK8000 chipset. For PoC and prototype development of UWB based applications, MK8000 DK (design kit) is recommended. For advanced functionality and performance test as well as the information of MK8000 DK, please contact the customer support at sales@mksemi.com .

7. Reference

[1] MK8000 Datasheet v0.82

[2] MKTool User Manual v0.5

[3] ISP user manual v0.5

8. FCC regulatory compliance statement

§ 15.19 Statement

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, and (2) this device must accept any interference received, including interference that may cause undesired operation.

§ 15.519(a) Statement

This device is approved under Part 15.519 for handheld use only

§ 15.21 Information to user

Warning: changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

§ 15.212 and FCC KDB publication 996369 D04 Statement

This Module restrictions under limited modular certification in accordance with 15.212 and FCC KDB publication 996369 D04.

(i)This Module complies with FCC radiation exposure limits must be such that there is a minimum separation distance of 20 cm (or possibly greater than 20 cm) between the antenna radiating structures and nearby persons. The host manufacturer is obligated to confirm the use conditions of the host product to ensure that the distance specified in the instructions is met. In this case the host product is classified as either a mobile device or a fixed device for RF exposure purposes;

(ii)Please notice that if the FCC and IC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. For FCC, this exterior label should follow "Contains FCC ID: "2A7T8MK8000UWBA".

(iii) The Module comply with the antenna and transmission system requirements of §§ 15.203, 15.204(b) and 15.204(c). The antenna is permanently attached to the module and cannot be removed without permission.

Labelling Instruction for Host Product Integrator

Please notice that if the FCC and IC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. For FCC, this exterior label should follow "Contains FCC ID: "2A7T8MK8000UWBA".

FCC regulatory compliance statement (cont.)

§ 15.19 Labelling requirements shall be complied on end user device.

Labelling rules for special device, please refer to § 2.925, § 15.19 (a)(5) and relevant KDB publications. For Elabel,

please refer to § 2.935.

Installation Notice to Host Product Manufacturer

The OEM integrator is responsible for ensuring that the end-user has no manual instruction to remove or install module.

The module is limited to installation in mobile application, a separate approval is required for all other operating

configurations, including portable configurations with respect to § 2.1093 and difference antenna configurations.
Antenna Change Notice to Host manufacturer
If you desire to increase antenna gain and either change antenna type or use same antenna type certified, a Class
II permissive change application is required to be filed by us, or you (host manufacturer) can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.
FCC other Parts, Part 15B Compliance Requirements for Host product manufacturer
This modular transmitter is only FCC authorized for the specific rule parts listed on our grant, host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the

modular transmitter grant of certification.

This device is approved under Part 15.519 for handheld use.
The use of antennas mounted on outdoor structures, e.g., antennas mounted on the outside of a building or on a telephone pole, or any
fixed outdoors infrastructure is prohibited. Antennas may be mounted only on the hand held UWB device.
UWB devices may not be employed for the operation of toys. Operation onboard an aircraft, a ship or a satellite is prohibited.
Host manufacturer in any case shall ensure host product which is installed and operating with the module is in compliant with Part 15B
requirements.
Please note that For a Class B or Class A digital device or peripheral, the instructions furnished the user manual of the end-user product
shall include statement set out in §15.105 Information to the user or such similar statement and place it in a prominent location in the text of host product manual. Original texts as following:

For 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, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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 in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

For Class A

Note: This equipment has been tested and found to comply with the limits for a Class A 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