JN516x-EK003 Evaluation Kit
User Guide

JN-UG-3106
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Contents

Preface

This manual provides a guide to setting up a radio-frequency remote control system based on the NXP JN516x-EK003 ZigBee RF4CE Evaluation Kit. The manual describes how to run the supplied demonstration application on the system.

The demonstration application is based on the ZigBee RF4CE wireless network protocol. You can also use this evaluation kit along with NXP support software to produce your own ZigBee RF4CE remote control applications for the JN516x wireless microcontrollers.

You should work through this manual from beginning to end before attempting to develop your own ZigBee RF4CE applications.

Organisation

This manual consists of four chapters and five appendices, as follows:

- Chapter 1 introduces the JN516x-EK003 Evaluation Kit.
- Chapter 2 outlines certain key ZigBee RF4CE concepts needed to use the supplied remote control demonstration.
- Chapter 3 describes how to set up and run the remote control demonstration.
- Chapter 4 describes the available ZigBee RF4CE support software and user documentation for ZigBee RF4CE application development on the JN516x wireless microcontrollers.
- The Appendices contain the button layout of the remote control keypad, firmware re-programming instructions, procedures that may be useful when setting up the pre-loaded demonstration, and information on setting up a packet sniffer.

Conventions

Files, folders, functions and parameter types are represented in **bold** type.

Function parameters are represented in *italics* type.

Code fragments are represented in the `Courier New` typeface.

This is a **Tip**. It indicates useful or practical information.

This is a **Note**. It highlights important additional information.

*This is a **Caution**. It warns of situations that may result in equipment malfunction or damage.*

Acronyms and Abbreviations

API	Application Programming Interface
FTDI	Future Technology Devices International
RC	Remote Control
RF4CE	Radio Frequency for Consumer Electronics
SDK	Software Developer's Kit

Related Documents

JN-UG-3074	ZigBee RF4CE Stack User Guide
AN11676	ZigBee RF4CE OM15012 Application Template

Support Resources

To access online support resources such as SDKs, Application Notes and User Guides, visit the Wireless Connectivity TechZone:

www.nxp.com/techzones/wireless-connectivity

All NXP resources referred to in this manual can be accessed at the above address, unless otherwise stated.

Trademarks

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1. Introduction to the Evaluation Kit

Welcome to the JN516x-EK003 ZigBee RF4CE Evaluation Kit, which is based around the NXP JN5168 microcontroller for wireless network applications. The kit allows a radio-frequency remote control system to be quickly assembled and used with a pre-loaded demonstration application based on the ZigBee RF4CE wireless network protocol. The evaluation kit can also be used in conjunction with the NXP support software to develop new remote control applications.

This chapter introduces you to the evaluation kit by describing the:

- Contents of the kit - see Section 1.1
- Hardware features of the kit - see Section 1.2
- Software provided for the kit - see Section 1.3

Note: To order the JN516x-EK003 Evaluation Kit from NXP, the relevant ordering reference number is JN5168RF4/EVAL1.

1.1 Kit Contents

In the JN516x-EK003 Evaluation Kit, you will find the following components (numbers refer to Figure 1):

1. Remote Control Unit (OM15012), based on the JN5168 wireless microcontroller
2. JN5168 USB Dongle (DR1198), programmed as an RF4CE receiver - this dongle is indicated by a numbered sticker
3. JN5168 USB Dongle (DR1198), not programmed
4. Programming Dongle (DR1128) for Remote Control Unit
5. 'USB-A to Mini-B' cable
6. Pack of two AAA batteries for Remote Control Unit

Figure 1: JN516x-EK003 Evaluation Kit Components

The Remote Control Unit comes fitted with an adaptor on its firmware programming interface - this allows an easy connection to the Programming Dongle. This adaptor is shown in Figure 1 on the right of the unit, above a jumper that must be removed when programming is carried out. The adaptor can be removed when not in use.

The hardware components of the kit are detailed in Section 1.2. The software components available for the kit and described in Section 1.3.

1.2 Kit Hardware

This section details the hardware devices supplied in the JN516x-EK003 Evaluation Kit (see Section 1.1 for full kit contents):

- Remote Control Unit - see Section 1.2.1
- Programming Dongle - see Section 1.2.2
- USB Dongles - see Section 1.2.3

1.2.1 Remote Control Unit (OM15012)

The Remote Control Unit (part number: OM15012) is designed around the JN5168 device. The unit has the following features:

- 36 connected buttons on a 39-button keypad
- Two LEDs
- Powered by two AAA batteries
- Firmware programming via an interface which connects to a Programming Dongle (an adaptor to aid this connection is also provided)

Figure 2: OM15012 Remote Control Unit

The Programming Dongle (DR1128) is described in Section 1.2.2 and firmware re-programming of the Remote Control Unit is described in Appendix B.1.

1.2.2 Programming Dongle (DR1128)

The Programming Dongle (part number: DR1128) allows a wired connection to be made between the OM15012 Remote Control Unit and a PC or other computing device.

- The Programming Dongle includes a 6-pin header which connects to the right six pins of an 8-pin socket at the bottom end of the Remote Control Unit. A black plastic adaptor is provided on the Remote Control Unit to aid this connection - the adaptor fits into the 8-pin socket on one side and accepts the 6-pin header on the other side. Note that to make this connection, a jumper must be removed that is adjacent to the connector on the Remote Control Unit.
- The Programming Dongle also includes a USB Mini-B socket which allows the dongle to be connected to a USB port of a PC using the supplied 'USB-A to Mini-B' cable. The dongle contains an FTDI FT232 driver chip for the USB connection. The first time you make this connection, you may be prompted to install the device driver for this chip - if this is the case, refer to Appendix C.

This wired connection allows the firmware on the Remote Control Unit to be programmed from a PC. It also allows information and debug messages from the Remote Control Unit to be displayed on the PC. Firmware programming of the Remote Control Unit is described in Appendix B.1.

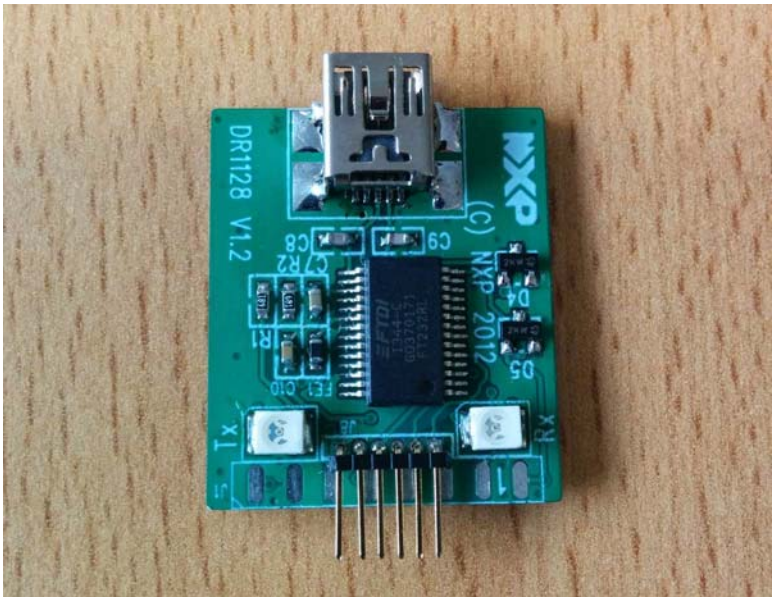

Figure 3: DR1128 Programming Dongle

1.2.3 USB Dongles (DR1198)

Two JN5168 USB Dongles (part number: DR1198) are supplied in the kit. One is intended for use in the remote control demonstration and the other can be employed in some other capacity, such as packet sniffing (see below).

The JN5168 USB Dongle has the following features:

- JN5168-001 wireless microcontroller (mounted directly on the board)
- Integrated PCB antenna
- FTDI FT232 driver chip for USB connection

The first time you connect one of the USB Dongles to your PC, you may be prompted to install the device driver for the FTDI chip in the dongle - if this is the case, refer to Appendix C.

Figure 4: DR1198 JN5168 USB Dongle

One of the two USB Dongles is pre-programmed as a ZigBee RF4CE receiver. In the demonstration, this dongle plugs into a USB port of a PC and acts as a target node, allowing the Remote Control Unit to communicate with the PC. This pre-programmed dongle is indicated by a circular numbered sticker on its underside.

The other dongle is not pre-programmed. It can be programmed with any JN5168 application - for example, as another ZigBee RF4CE receiver or as a packet sniffer. For information on using a dongle as a packet sniffer, refer to Appendix E.

Both dongles can be re-programmed with other applications. Firmware re-programming of the JN5168 USB Dongles is described in Appendix B.2.

1.3 Kit Software

The JN516x-EK003 Evaluation Kit is supplied with demonstration software which implements a simple remote control system consisting of a remote control and a target device:

- The Remote Control Unit is able to transmit radio signals to the target device.
- The target device is a USB Dongle which is able to receive radio signals from the Remote Control Unit and pass received commands to a PC (in which the dongle is plugged).

Application software for this demonstration has been pre-loaded in the Remote Control Unit and in one of the USB Dongles of the evaluation kit. The pre-programmed USB Dongle is indicated with a numbered sticker.

The demonstration requires the use of a terminal emulator, such as Tera Term, on the PC. Commands sent from the Remote Control Unit are displayed in the terminal emulator.

You will need to install an FTDI device driver on your PC in order to use the supplied USB Dongles and/or USB cable. You will be prompted to install this driver the first time you plug either of these USB components into your PC. Full installation instructions for the driver are provided in Appendix C.

Note: Setting up and operating the remote control demonstration is described in Chapter 3. Before attempting to use the demonstration, you are advised to familiarise yourself with the basic ZigBee RF4CE concepts described in Chapter 2.

2. Essential ZigBee RF4CE Concepts

ZigBee RF4CE (Radio Frequency for Consumer Electronics) is a wireless network standard defined by the ZigBee Alliance specifically for remote control (RC) products in the consumer electronics domain. This chapter introduces the essential ZigBee-RF4CE concepts needed to run the ZigBee RF4CE Demonstration supplied with the JN516x-EK003 Evaluation Kit.

Note: A full introduction to ZigBee RF4CE is provided in the *ZigBee RF4CE Stack User Guide (JN-UG-3074)*, available from NXP Wireless Connectivity TechZone.

2.1 Overview

In a ZigBee RF4CE network, one or more remote control units may be wirelessly networked to control one or more devices. For example, the standard can be used to achieve a comprehensive and flexible remote control solution for an audio-visual system that may include one or more of the following: TV, HDD recorder, Blu-ray player, DVD player, CD player, amplifier.

The features of the ZigBee RF4CE standard include:

- Operation in one of 3 channels of the 2.4-GHz radio band with frequency agility
- Service discovery and device pairing mechanisms
- Power saving mechanism
- Key-based security mechanism utilising industry-standard AES-128 scheme

2.2 Node Types and Networks

In the ZigBee RF4CE standard, two or more devices are organised into an RC Personal Area Network (PAN). An **RC PAN** consists of two node types:

- **Target node:** This node type is incorporated in a device to be controlled, e.g. a TV. The node acts as a PAN Co-ordinator and therefore creates a PAN. There must be only one Target node per RC PAN.
- **Controller node:** This node type sends or passes on control messages. It is incorporated in remote control units and in devices that relay control messages (e.g. a TV that passes control messages to a DVD player). An RC PAN can have multiple Controller nodes.

In the ZigBee RF4CE demonstration of the JN516x-EK003 Evaluation Kit, the Remote Control Unit is pre-programmed as a Controller node and a USB Dongle is pre-programmed as a Target node.

Example RC PAN

A simple RC PAN is illustrated in the figure below, consisting of a TV (Target node and PAN Co-ordinator) and a TV RC (Controller node).

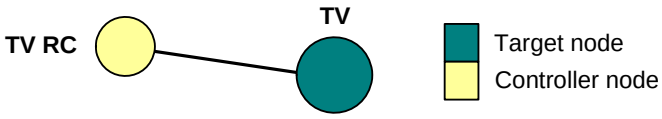

Figure 5: Example RC PAN

The supplied ZigBee RF4CE demonstration employs the above simple topology (but the target node is a USB dongle in a PC).

Example RC Network (containing two RC PANs)

Multiple RC PANs can form an **RC network**, allowing communication between PANs (as well as inside PANs).

Extending the example, the RC PAN (PAN 1) is combined with another RC PAN (PAN 2) consisting of a DVD player (Target Node and PAN Co-ordinator) and a DVD RC (Controller node), as illustrated in the figure below.

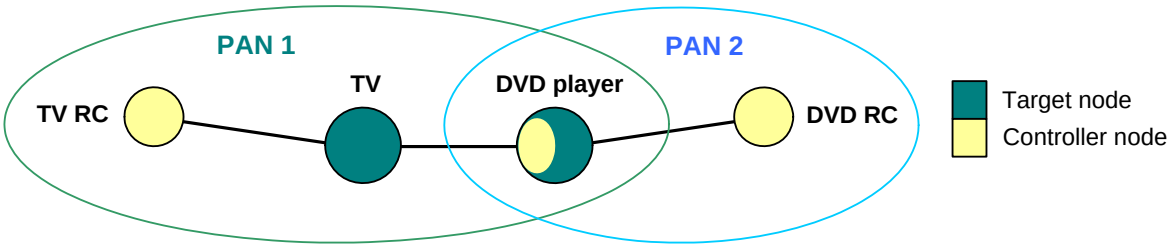

Figure 6: Example RC Network Formed from PAN 1 and PAN 2

In this RC network, the DVD player from PAN 2 also joins PAN 1 as a Controller node - this allows the DVD player to relay control messages from the DVD RC to the TV (for example, to use the DVD RC to adjust the volume level of the TV). Thus, the DVD player acts as a Target node (and PAN Co-ordinator) in PAN2 and as a Controller node in PAN 1.

The example can be extended further by adding more RC PANs - for a description, refer to the *ZigBee RF4CE Stack User Guide (JN-UG-3074).*

2.3 Radio Channel and PAN ID

The ZigBee RF4CE standard employs the 2.4-GHz radio frequency band, which is available in the IEEE 802.15.4 standard on which ZigBee RF4CE is built (see Section 2.6). However, only three of the sixteen channels in this band (numbered 11-26) are available for use in ZigBee RF4CE. The available channels are numbers 15, 20 and 25, which are centred on the frequencies 2425 MHz, 2450 MHz and 2475 MHz, respectively.

When a PAN Co-ordinator (Target node) forms a PAN, it will scan the three channels for activity and select the quietest channel for the PAN. The node will also generate a random 16-bit PAN ID that does not clash with the PAN IDs of any other detected PANs operating in the neighbourhood.

The RC PANs within an RC network can operate on different channels but it is possible for two or more RC PANs to operate on the same channel. In the latter case, the PANs are distinguished by their PAN IDs. If a node of an RC network is a member of two (or more) PANs that operate in different channels, it will be necessary for the common node to change channels when relaying control messages from one PAN to another.

2.4 RC PAN Formation

An RC PAN is created by a Target node, which acts as the PAN Co-ordinator. The created PAN goes through the following formation process:

1. Target node initialises itself as a Target node and PAN Co-ordinator, and then selects a radio channel and PAN ID (see Section 2.3).
2. Each Controller node initialises itself as a Controller node.
3. Target node or each Controller node performs a **service discovery** to find nodes with which it can be paired.
4. Target node or each Controller node **pairs** itself with suitable node(s) which it has discovered.

2.5 Power Saving

The nodes of an RC network need not be fully active all of the time. Principally, a battery-powered Controller node, such as a remote control unit, should not be permanently active as it may be required only occasionally and it is important to maximise battery life. Additionally, it is important to minimise the power consumption of a Target node, such as a TV, while in the stand-by state.

2.6 Software Stack Architecture

In order to run and use the supplied remote control demonstration, you do not need to be aware of details of the ZigBee RF4CE protocol stack which runs on the network nodes. However, the basic stack architecture is described below - for more detailed information, refer to the *ZigBee RF4CE Stack User Guide (JN-UG-3074).*

The ZigBee RF4CE protocol stack is structured as shown in Figure 7.

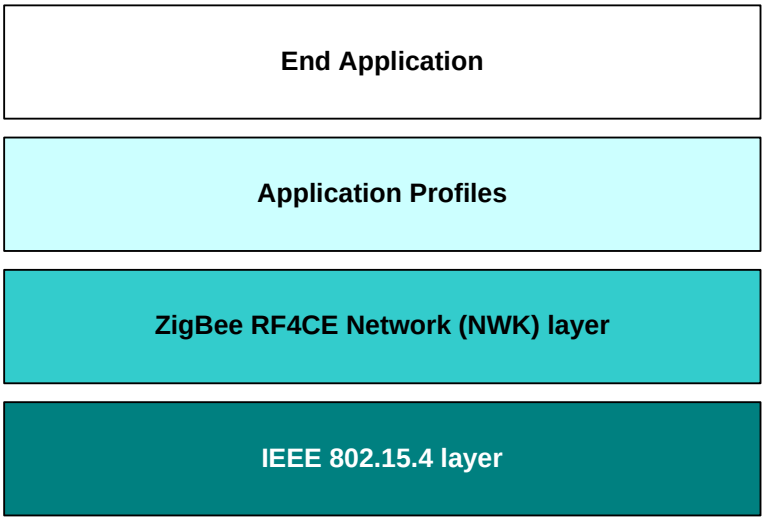

Figure 7: Basic ZigBee RF4CE Stack Architecture

The layers of the ZigBee RF4CE stack are described below (from top to bottom):

- **End Application:** This layer contains the vendor-designed applications that run on the node. An application gives the device its functionality. A single node may run several applications.
- **Application Profiles:** This layer contains one or more ZigBee RF4CE application profiles, each comprising commands that can be incorporated in control messages (e.g. increment TV channel). Profiles can be standard or vendor-specific - the default standard profile is the Consumer Electronics Remote Control (CERC) profile.
- **ZigBee RF4CE Network (NWK) layer:** This layer provides the ZigBee networking functionality and provides the application's interface to the IEEE 802.15.4 layer (see below).
- **IEEE 802.15.4 layer:** This layer is concerned with sending and receiving data frames over the physical transmission medium (radio, in this case).

3. Remote Control Demonstration

You are now going to set up a simple remote control system using the contents of the JN516x-EK003 Evaluation Kit and a PC, and run the pre-loaded ZigBee RF4CE demonstration. This application has been programmed into the Flash memory devices of the Remote Control Unit and and one of the USB Dongles (marked with a sticker).

This chapter guides you through the set-up and operation of the demo system, as follows:

- Section 3.1 provides an overview of the demo system, describing its functionality and its physical components.
- Section 3.2 details how to set up the demo system from the contents of the evaluation kit and run the demonstration.
- Section 3.3 describes the information sent from the Remote Control Unit that can be received by the USB Dongle and displayed in the terminal emulator on the PC.

3.1 Demo System Overview

The supplied ZigBee RF4CE demonstration uses the Remote Control Unit and a USB Dongle from the evaluation kit to form a simple remote control system. These evaluation kit components are pre-programmed as the following ZigBee RF4CE devices for the purpose of this demonstration:

- The Remote Control Unit is programmed as a Controller node.
- The USB Dongle is programmed as a Target node and the PAN Co-ordinator.

The USB Dongle is plugged into a PC and a terminal emulator application is run on the PC. The USB Dongle receives radio signals from the Remote Control Unit and passes the received commands to the terminal emulator on the PC, where they are displayed.

The demonstration system is illustrated in Figure 8 below.

Note: The application source code for this remote control demonstration is provided and described in the Application Note *ZigBee RF4CE OM15012 Application Template (AN11676)*, available from the NXP Wireless Connectivity TechZone. However, you are strongly advised to work through this manual and study the *ZigBee RF4CE Stack User Guide (JN-UG-3074)* before looking at the code.

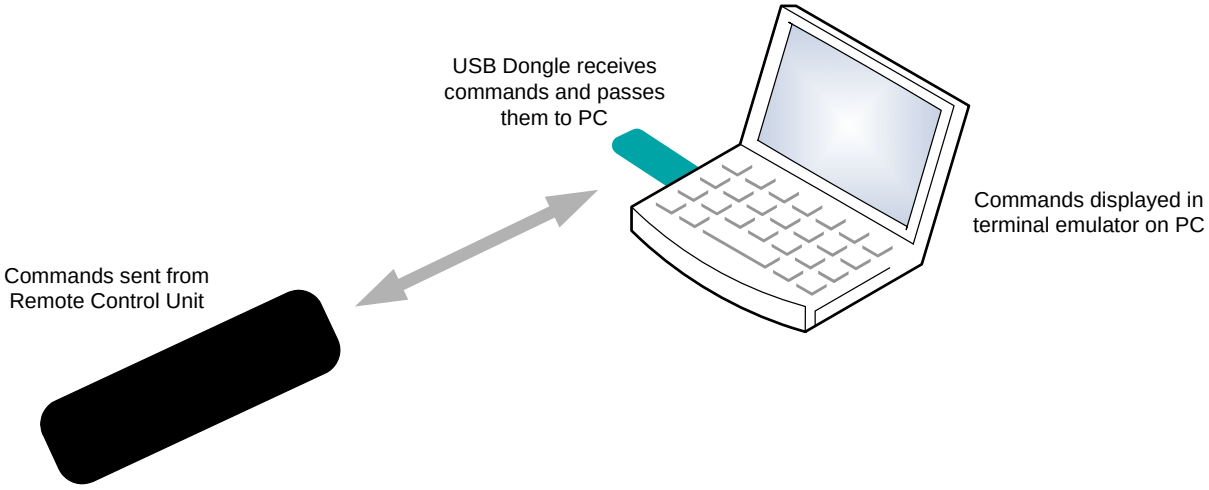

Figure 8: Remote Control Demo System

3.2 Setting Up and Running the Demo System

The procedure below describes how to set up and run the demonstration.

Note 1: The procedure described in this section assumes that the evaluation kit is being used for the first time. Therefore, the Remote Control Unit has not been previously paired with the USB Dongle.

Note 2: The demonstration requires a terminal emulator application, such as Tera Term, on your PC.

Note 3: The numbers and positions of the buttons on the Remote Control Unit are indicated in Appendix A.

Step 1 **Plug the USB Dongle into the PC**

Plug the pre-programmed USB Dongle into a USB port of the PC - the relevant dongle is indicated by a circular numbered sticker. This will become the target node. You may be prompted to install the device driver for the FTDI chip in the dongle - if this is the case, refer to Appendix C.

Step 2 **Find the COM port which corresponds to the USB Dongle**

Determine which COM port on the PC has been used for the USB Dongle connection (it will be labelled "USB Serial Port") and make a note of its number. Guidance is provided in Appendix D.

Step 3 **Run the terminal emulator on the PC**

Run a terminal emulator program (such as Tera Term) on the PC and configure it to use the COM port for the target node (port number as determined above, bits per second: 115200, data bits: 8, parity: none, stop bits: 1, flow control: none).

Step 4 **Ensure that the Remote Control Unit is powered**

Make sure that the batteries have been installed in the Remote Control Unit, but do not press any buttons yet.

Note: If the Remote Control Unit has previously been used in a network, erase previous pairing information already present in the unit by pressing and holding the CANCEL PAIRING button (K25).

Step 5 **Initiate pairing of the Remote Control Unit and USB Dongle**

To initiate pairing of the controller node (Remote Control Unit) and target node (USB Dongle), press the PAIR button (K21). When the target and controller nodes have paired, this will be indicated by a 'Paired' message in the terminal emulator on the PC.

Step 6 **Send commands from the Remote Control Unit to the PC**

Press buttons on the Remote Control Unit to send commands to the target node. The commands received by the target node will be displayed in the terminal emulator on the PC. The information that can be displayed in the terminal emulator is listed and described in Section 3.3.

Note: Alternatively, the Remote Control Unit can be connected to the PC via the DR1128 Programming Dongle, which connects via a cable to a USB port of the PC (same serial settings as for the target node connection above). This allows information and debug messages to be displayed in the terminal emulator. The required connections are as described for firmware re-programming in Appendix B.1. In this case, the unit is powered by the Programming Dongle (so remove the batteries, if present).

3.3 Information Displayed in Terminal Emulator

In the demonstration, the terminal emulator on the PC is used to display certain system information. The displayed information includes:

- `ColdStart` after a power-up, if no previous pairing or ZigBee RF4CE network membership is found or after a factory-new reset on the target node
- `WarmStart` after a power-up, if a previous pairing ZigBee RF4CE network membership is found, or after a normal reset on the target node
- `<Running>` when the target node enters the running mode
- `<AutoDiscovery>` when the target node is in pairing mode (within the next 5 seconds, by default, a pairing operation can be performed - see below)
- `<Pairing>` during a pairing operation
- `<Unpairing>` during an unpairing operation
- `Paired` when a pairing has been successfully completed (a pairing reference and the IEEE/MAC address of the paired controller node are also displayed)
- `<NetworkInPowerSaveMode>` when network layer power-saving mode is enabled on the target node
- `UserControlPressed` on receiving a UserControlPressed command (the pairing reference of the sender and the received command code are also displayed)

On receiving a `UserControlPressed` command with the DISPLAY_INFO command code, the target node's pairing table is displayed (within the next 5 seconds, by default, a pairing operation can be performed - see above).

An example of the information displayed in the terminal emulator is shown below.

```
<AutoDiscovery> <Pairing> <Running-1>
Paired: PairRef 0; MAC 0xAD02000000000000
UserControlPressed: PairRef 0; CmdCode [0x20]
UserControlPressed: PairRef 0; CmdCode [0x21]
<AutoDiscovery> <Pairing> <Running-1>
Paired: PairRef 1; MAC 0xAD01000000000000
UserControlPressed: PairRef 1; CmdCode [0x20]
UserControlPressed: PairRef 1; CmdCode [0x21]

|--------PairingTable----------------|
| PairRef | MAC Address           |
|---------------------------------------|
|    0    | 0xAD02000000000000|
|    1    | 0xAD01000000000000|
|---------------------------------------|
Press '0' to select next PairRef for removal within next 5 seconds:
Press '1' to remove PairRef 0
Press '1' to remove PairRef 1
```



```
Press '1' to remove PairRef 0
Press '1' to remove PairRef 1
<Unpairing-1> <Running-4>
UserControlPressed: PairRef 0; CmdCode [0x20]

|--------PairingTable----------------|
| PairRef | MAC Address           |
|---------------------------------------|
|    0    | 0xAD02000000000000|
|---------------------------------------|
Press '0' to select next PairRef for removal within next 5 seconds:
Press '1' to remove PairRef 0
<Running-5>
```

4. Where Next?

Once you have set up and run the supplied ZigBee RF4CE demonstration, you may wish to begin developing your own remote control applications. This chapter helps you to get started in this application development, as follows:

- Section 4.1 outlines the software from the JN516x Software Developer's Kit (SDK) that you must install in order to develop your application
- Section 4.2 directs you to the relevant user documentation

4.1 Software Developer's Kit (SDK)

NXP provide Software Developer's Kits (SDKs) to facilitate the development of JN516x wireless network applications on a PC. These SDKs include Application Programming Interfaces (APIs) and have associated development tools.

For ZigBee RF4CE, you will need the following two software packages:

- JN516x SDK Toolchain (JN-SW-4041) - see Section 4.1.1
- JN516x ZigBee RF4CE SDK (JN-SW-4060) - see Section 4.1.2

Installers for the above packages can be obtained free-of-charge via the NXP Wireless Connectivity TechZone (see "Support Resources" on page 6). The toolchain must be installed first. Installation instructions are provided in the *SDK Installation and User Guide (JN-UG-3064).*

The contents of these packages are outlined in the sub-sections below.

4.1.1 JN516x SDK Toolchain (JN-SW-4041)

This toolchain is essential for ZigBee RF4CE application development for the JN516x devices.

The installer includes the following:

- Eclipse IDE (Integrated Development Environment)
- JN51xx compiler for use by the Eclipse platform to build applications
- JN51xx Flash programmer to load built applications into nodes
- Cygwin CLI (Command Line Interface)

ZigBee RF4CE application development for JN516x devices is intended to be conducted in the Eclipse Integrated Development Environment (IDE), which is supplied in this toolchain. It is, however, possible to develop your application code using another editor and to build it from the command line using makefiles.

The toolchain must be installed before the SDK libraries. Installation instructions are provided in the *SDK Installation and User Guide (JN-UG-3064).*

4.1.2 JN516x ZigBee RF4CE SDK (JN-SW-4060)

The JN516x ZigBee RF4CE SDK includes the ZigBee RF4CE stack software and the following components:

- ZigBee RF4CE API for developing wireless remote control applications
- ZigBee Remote Control (ZRC) application profile API
- ZigBee Input Device (ZID) application profile API
- 802.15.4 Stack API
- JN516x Integrated Peripherals API for interacting with on-chip peripherals

This SDK package must be installed after the SDK toolchain. Installation instructions are provided in the *SDK Installation and User Guide (JN-UG-3064).*

4.2 User Documentation

This section describes the user documentation that is available to help developers of ZigBee RF4CE remote control applications for the JN516x wireless microcontrollers. This documentation is available from the NXP Wireless Connectivity TechZone (see "Support Resources" on page 6).

A complete list of the user documentation relevant to ZigBee RF4CE is provided in Table 1. In addition, a visual guide to using the essential ZigBee RF4CE documentation is provided in Figure 9.

When starting your ZigBee RF4CE application development:

1. First study Part I of the *ZigBee RF4CE Stack User Guide (JN-UG-3074)* to familiarise yourself with essential ZigBee RF4CE concepts.
2. During application development, you should refer to the above User Guide for details of the API resources to use.

In addition, you can use the Application Note *ZigBee RF4CE OM15012 Application Template (AN11676)* as a basis for your ZigBee RF4CE application development with this evaluation kit.

Part Number	Document Title	Description
Application Coding		
JN-UG-3074	ZigBee RF4CE Stack User Guide	Introduces essential ZigBee RF4CE concepts and details the ZigBee RF4CE APIs for developing applications.
AN11676	ZigBee RF4CE OM15012 Application Template	Application Note containing software template that can be used as a basis for ZigBee RF4CE application development with this evaluation kit.
JN-UG-3087	JN516x Integrated Peripherals API User Guide	Details the JN516x Integrated Peripherals API, used in application code to interact with on-chip peripherals.
Development Tools		
JN-UG-3064	SDK Installation and User Guide	Describes how to install the Software Developer's Kit (SDK) and how to use the Eclipse development platform.
JN-UG-3007	JN51xx Flash Programmer User Guide	Describes how to use the JN51xx Flash Programmer.

Table 1: ZigBee RF4CE User Documentation

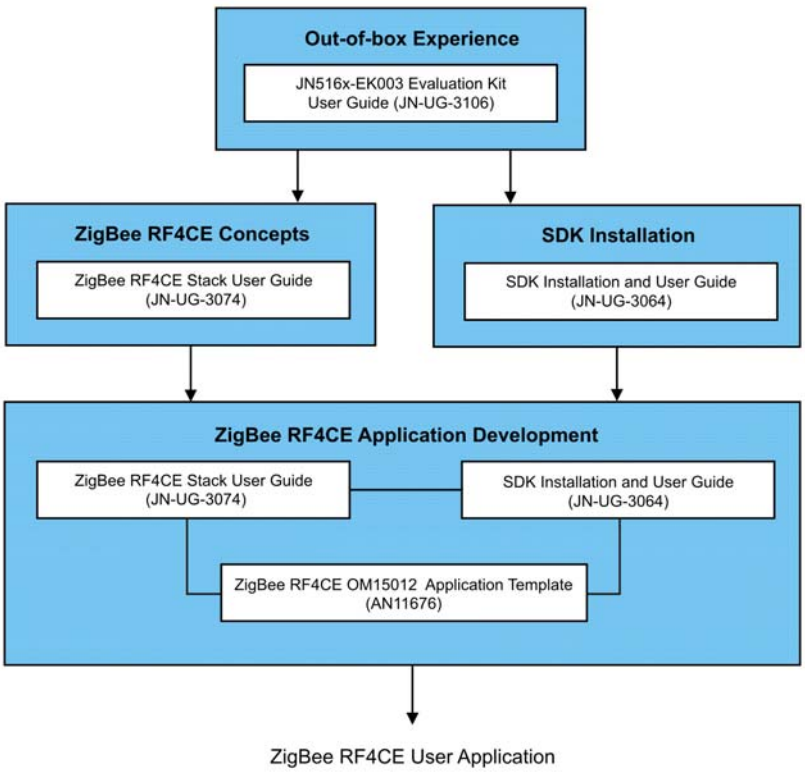

Figure 9: Guide to Essential ZigBee RF4CE Documentation

Appendices

A. Remote Control Keypad Layout and Numbering

The numbers and positions of the buttons on the OM15012 Remote Control Unit are indicated in Figure 10.

Figure 10: OM15012 Remote Control Button Numbers and Postions

NC = Not Connected

B. Firmware Re-programming

The following components of the JN516x-EK0013Evaluation Kit are supplied already programmed with a ZigBee RF4CE demonstration application but can be re-programmed with other applications:

- Remote Control Unit - see Appendix B.1
- JN5168 USB Dongle - see Appendix B.2

The firmware re-programming described in the sub-sections below require the use of of the JN51xx Flash Programmer (JN-SW-4007), available from the NXP Wireless Connectivity TechZone and described in the *JN51xx Flash Programmer User Guide (JN-UG-3007*).

B.1 Re-programming Remote Control Unit

The firmware of the OM15012 Remote Control Unit can be re-programmed using the supplied DR1128 Programming Dongle. The connection arrangement is shown in Figure 11. The connection and re-programming are conducted as follows:

1. Prepare the Remote Control Unit for firmware re-programming, as follows:
   - **a)** Remove the batteries from the unit.
   - **b)** Remove the jumper from the bottom of the unit (so that this does not obstruct the subsequent connection of the Programming Dongle).
   - **c)** Ensure that the black plastic adaptor is fitted to the 8-pin socket at the bottom of the unit.
2. Insert the 6-pin header of the Programming Dongle into the adaptor at the bottom of the Remote Control Unit, such that the six header pins are aligned to the right of the connector (see Figure 11).
3. Use the supplied ‘USB-A to Mini-B’ cable to connect the USB Mini-B port on the Programming Dongle to a USB port of your PC. You may be prompted to install the device driver for the FTDI chip which is located on the dongle - if this is the case, refer to Appendix C.
4. Use the JN51xx Flash Programmer utility (JN-SW-4007) on your PC to load the new firmware image into the Remote Control Unit. There is no need to reset the Programming Dongle and put it into programming mode, since this is done automatically.
5. Once programming has completed, remove the Programming Dongle, and replace the batteries and jumper in the Remote Control Unit.

Figure 11: OM15012 Remote Control Re-programming

B.2 Re-programming JN5168 USB Dongles

In order to re-program the Flash memory of the supplied JN5168 USB Dongles, you must plug the dongle into a USB port of a PC. To perform the re-programming from your PC, you must use the JN51xx Flash Programmer utility (JN-SW-4007).

When you make the USB connection for the first time, you may be prompted to install the device driver for the FTDI chip which is located on the dongle - if this is the case, refer to Appendix C.

C. Installing the FTDI Device Driver for USB Connections

The first time that you make a USB connection between your PC and a kit component which features the FTDI FT232 chip, you may be prompted to install the device driver for the chip on your PC. This driver is provided in the toolchain JN-SW-4041 that is used with the NXP JN516x ZigBee RF4CE SDK (JN-SW-4060). You can alternatively obtain the device driver from the FTDI web site.

Installing Driver from the Toolchain

The installation of the driver from the JN-SW-4041 toolchain is described below (although you will not need this procedure if Windows automatically finds the required driver on the Internet).

1. When you make the USB connection, check whether **Found new hardware wizard for TTL232r-3v3** is displayed on your PC.

   If this appears, you must install the driver by following the rest of this procedure. Otherwise, the driver is already installed.

2. Fill in the screen **Install from a specific location**, as follows:

   a) Select the radio button **Search for the best driver in these locations**.

   b) Tick the checkbox **Include this location in the search**.

   c) Using the **Browse** button, navigate to the directory **FTDI_drivers** in the installed SDK on your PC. If the SDK has been installed on drive C of your PC, the path will be: **C:\Jennic\Tools\Drivers\FTDI_drivers**

   d) Click **OK**.

   The wizard will automatically fill in the details in the drop-down search box.

3. In the **Found new hardware wizard** screen, click **Next**.

4. Wait for the wizard as it searches for and installs the new driver. On completion, it will display the message "Completing the Found new hardware wizard". Click **Finish** to complete.

   In some cases, you may need to repeat the procedure from Step 2, depending on your hardware configuration.

   Finally, the **Found new hardware** bubble will indicate that the hardware is installed and ready for use.

Installing Driver from the Internet

You can alternatively obtain the FTDI FT232 chip's device driver for your operating system from the VCP drivers page of the FTDI web site: **www.ftdichip.com/Drivers/VCP.htm**. Download the required driver to your desktop and double-click on its icon to install. *To perform the installation, a device or cable containing an FTDI chip must be connected to a USB port of your PC*.

D. Identifying the PC Communications Port Used

When connecting a device to your PC via a USB port, you need to find out which serial communications port your PC has allocated to the connection, as described below.

1. In the Windows **Start** menu, follow the menu path:

   Start > Control Panel > System

   This displays the **System Properties** screen.

2. In the **System Properties** screen:

   a) Select the **Hardware** tab.

   b) Click the **Device Manager** button

   This displays the **Device Manager** screen.

3. In the **Device Manager** screen:

   a) Look for the **Ports** folder in the list of devices and unfold it.

   b) Identify the ports used by USB connections - each will be labelled ‘USB Serial Port’.

   c) Right-click on each one and select **Properties** from the pop-up menu - the relevant port will have NXP as the device manufacturer.

   Make a note of the name/number of this port (e.g. COM3).

E. Installing a Packet Sniffer

One of the JN5168 USB Dongles (DR1198) supplied in the kit is not pre-programmed and can be used as a packet sniffer (this dongle is not labelled with a sticker). Either dongle may be programmed as a sniffer. For more information on the JN5168 USB Dongles, refer to Section 1.2.3.

To use a dongle as a sniffer, you must program an NXP sniffer application into the JN5168 Flash memory on the dongle and also install the Ubiqua Protocol Analyzer software on the PC from which the packet sniffing will be conducted. Proceed as follows:

1. Plug the JN5168 USB Dongle into the PC.
2. Program the sniffer application binary into the JN5168 device on the dongle:
   - The sniffer binary file **JennicSniffer_JN5168_1000000_HP.bin** is provided in the JN516x ZigBee RF4CE Software Developer's Kit (SDK)
   - For information on re-programming a JN5168 USB Dongle, refer to Appendix B.2
3. Download the Ubiqua Protocol Analyzer software and install it on the PC:
   - You can obtain the Ubiqua Protocol Analyzer software from the following web site: **www.ubilogix.com/products/ubiqua** (a free trial version is available, for which you must register to obtain an activation code)
   - Run the downloaded installer and follow the on-screen installation instructions
4. Start the Ubiqua Protocol Analyzer (ensure that the PC is connected to the Internet).

User documentation for the Ubiqua Protocol Analyzer is available from the above Ubiqua web site.

Revision History

Version	Date	Comments
1.0	18-June-2015	First release

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