



User Manual

Description	AdapTag Development Kit User Manual
Date	2016/05/31
Doc. No.	8P002-00
Revision	03
Model Name	S1000CF121

龍亭新技股份有限公司 Pervasive Displays, Inc.
 4F, No. 28, Chuangye Rd., Tainan Science Park, Tainan City (74144), Taiwan (R.O.C.)
 Tel: +886-6-279-5399 / Fax: +886-6-505-5300 / <http://www.pervasivedisplays.com>

Copyright © 2016 by Pervasive Displays, Inc.

INTRODUCTION

Thank you for purchasing the AdapTag® Development Kit for low-power electrophoretic paper display (EPD) solutions from Pervasive Displays, Inc. This document provides an overview of the Kit and is organized into three main sections: the Kit contents and system requirements, setup and preparation, and working with the Kit to create a low-power AdapTag network. You will find a glossary of acronyms and references at the end of this document.

TABLE OF CONTENTS

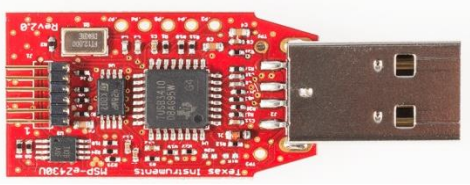

1. KIT CONTENTS and SYSTEM REQUIREMENTS	3
1.1 Hardware Included in the Kit	3
1.2 Software Included in the Kit (on enclosed CD)	5
1.3 System Requirements	5
2. GETTING STARTED	7
2.1 Installing AdapTag Manager	7
2.2 Hardware Setup for the AdapTag Host	7
2.3 Hardware Setup for AdapTag Slaves	8
3. WORKING WITH ADAPTAg MANAGER	10
3.1 Updating an EPD using the USB	11
3.2 Updating an EPD using Default AdapTag Network	11
3.3 AdapTag Manager Overview	11
3.3.1 Configuring the AdapTag Network	12
3.3.2 Adding Slaves to the AdapTag Network	14
3.3.3 Setting Transmission Mode	14
3.3.4 Polling Slaves on the AdapTag Network	14
3.3.5 Sending Images to AdapTag Slaves	14
3.3.6 Deleting Slaves from the AdapTag Network	15
3.3.7 Using AdapTag Manager as Protocol Analyzer	15
4. KNOWN ISSUES AND TROUBLESHOOTING	16
4.1 AdapTag Manager is not connecting to the host board	16
4.2 Slave XXXX is not connecting to the AdapTag network	16
4.3 Slave XXXX is not updating when an image is sent	17
5. GLOSSARY OF ACRONYMS	18
6. APPENDIX	19

1. KIT CONTENTS and SYSTEM REQUIREMENTS

1.1 Hardware Included in the Kit

(1) USB Dongle

There are two models:

Texas Instruments EZ430	PL-2303HX
	
PDI Part Number: A1939998-00	PDI Part Number: A1939997-00

Quantity: 1 piece

This device acts as the USB to UART interface. It connects to a computer’s USB port and an AdapTag board, which combine to form a host or “access point.”

(2) AdapTag Board

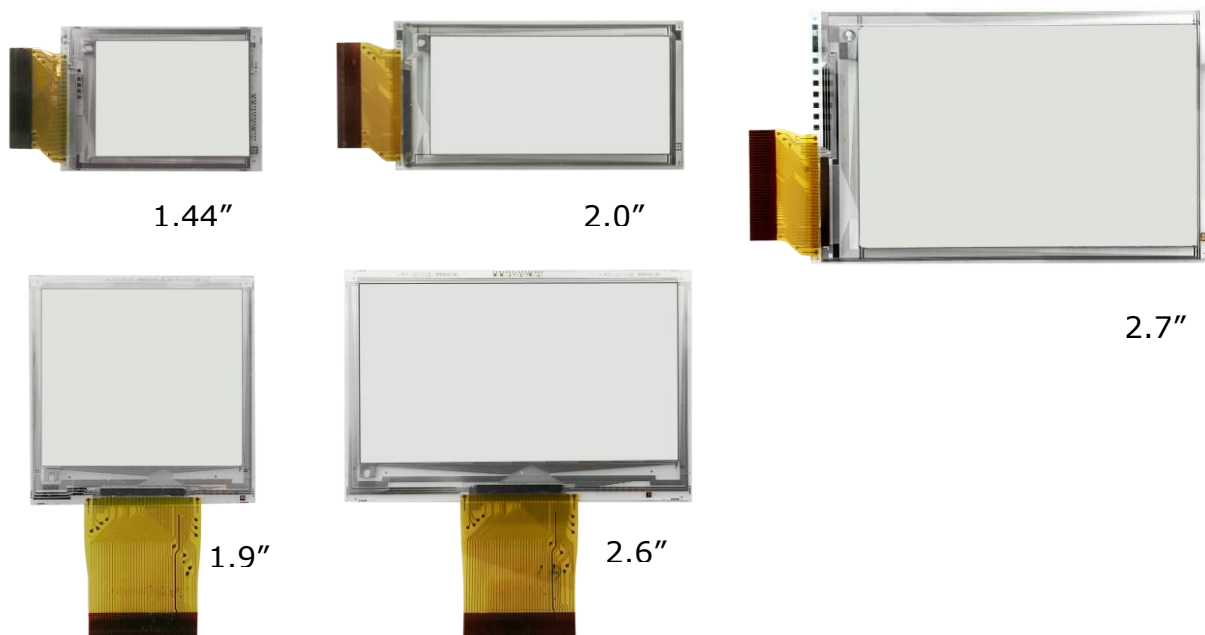


PDI Part Number: A1349998-00

Quantity: 4 pieces

Four AdapTag boards are included in the Kit. One board serves as the host at the network “access point.” The remaining three boards serve as slaves at the network “end points.” The access point board connects via an USB dongle to the computer’s USB port to transmit data via radio frequency (RF) to the network end points. Each end point board connects with an EPD and operates on a coin cell battery. The AdapTag boards feature a TI CC430 microcontroller, a two-colored LED, ZIF connector, debugger pins, and one reset button.

(3) PDI 1.44", 1.9", 2.0", 2.6" and 2.7" Electrophoretic Paper Displays (EPD)



Size	PDI Model Name	Material Film	In the kit
1.44"	E1144CS021	Aurora Mb(V231)	Yes
	EK014BS011	Aurora Ma(V230)	No
1.9"	E1190CS021	Aurora Mb(V231)	No
2.0"	E1200CS021	Aurora Mb(V231)	Yes
	EG020BS011	Aurora Ma(V230)	No
2.6"	E1260CS021	Aurora Mb(V231)	No
2.7"	E1271CS021	Aurora Mb(V231)	Yes
	EM027BS013	Aurora Ma(V230)	No

Quantity: 3 pieces (1.44", 2.0" and 2.7")

Each EPD panel connects with an AdapTag board to form the end point for receiving and displaying content. The end-user does not need to program different EPD driver codes onto CC430; the packets from the system contain EPD information and display content in the appropriate size format.

(4) CR2450 Coin Cell Batteries



PDI Part number: N/A

Quantity: 3 pieces

1.2 Software Included in the Kit

(1) AdapTag Manager Installer

You are able to download the installer from PDI [AdapTag Kit webpage](#).

The Installer is used for installing AdapTag Manager Software. This software provides a graphical user interface for the Development Kit and enables the user to load bitmap images to the EPDs and to create a fully functional, low-power AdapTag network for demonstration purposes.

1.3 System Requirements

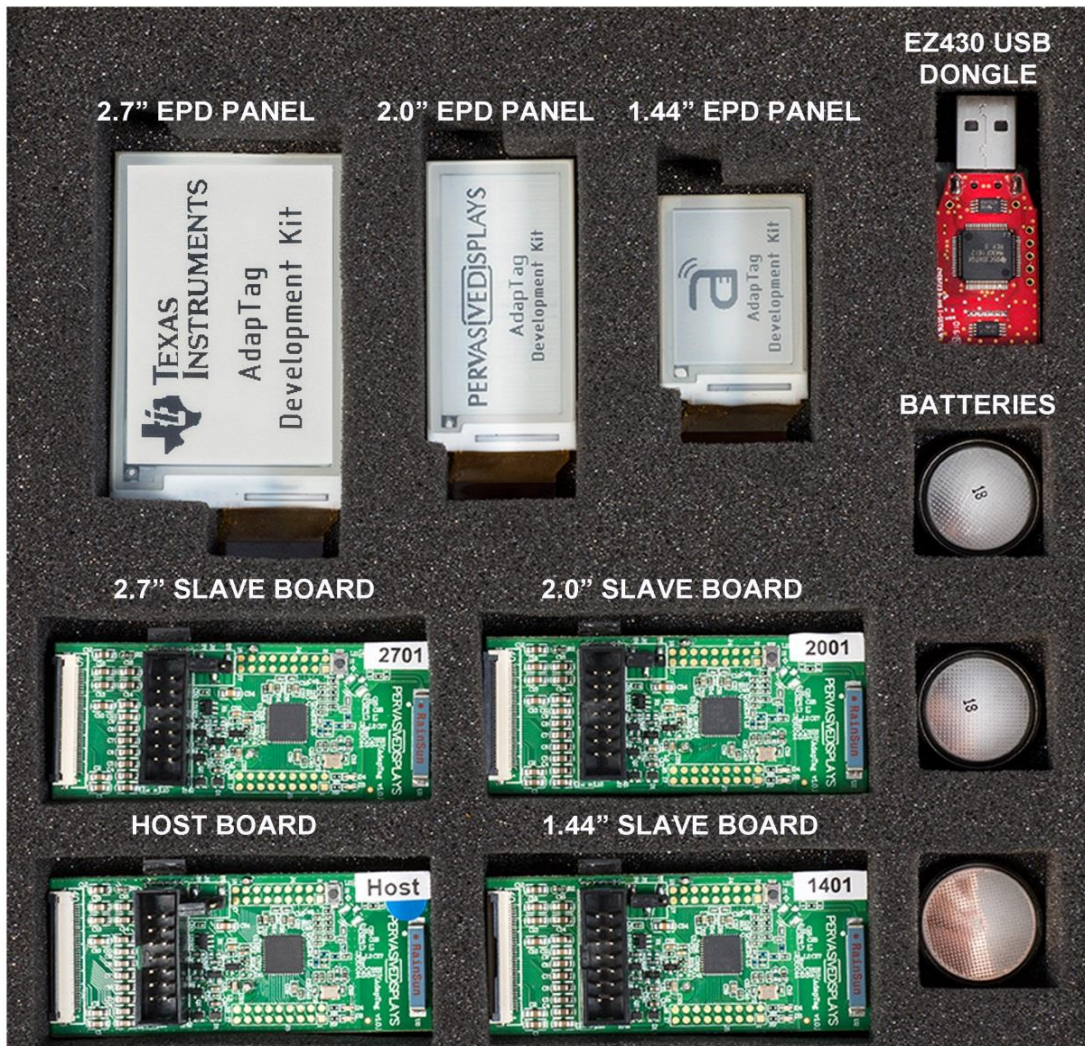
To use the AdapTag Manager software, the following hardware and software elements are required:

- (1) A computer running Microsoft® Windows® (XP or later) with the [Microsoft® .NET Framework 3.5 Service Pack 1 \(SP1\)](#) or a later version.

During the installation of AdapTag Manager, the Installer will check whether your computer has installed Microsoft® .NET Framework 3.5 or a later version.

- (2) From a hardware standpoint, a Windows® computer with at least one free USB port to connect with the USB dongle.

The picture below shows the device placement in the foam inside the package.



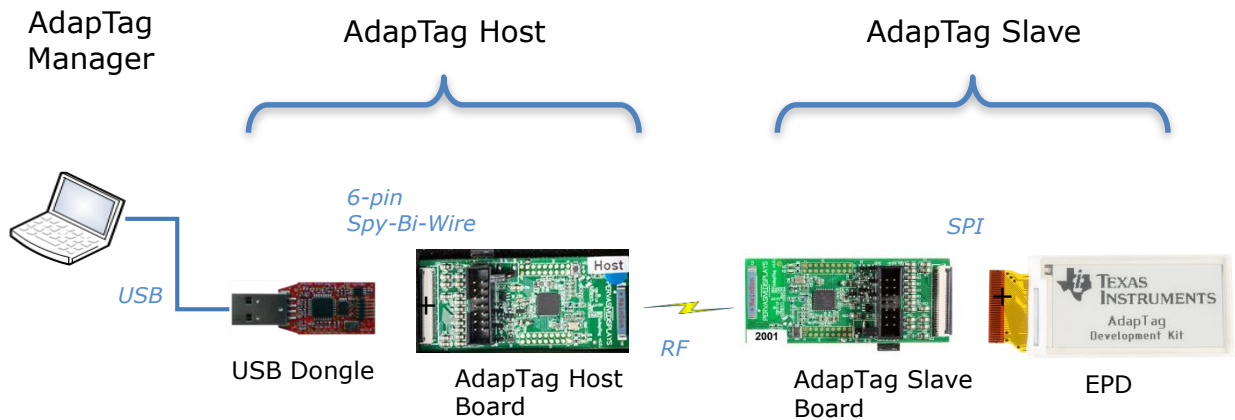
Note: The EPD panels included in the AdapTag Kit are not preloaded with images. (The images shown above are for demonstration only.)

2. GETTING STARTED

This section provides instructions to set up the AdapTag hardware and use the AdapTag Manager to create a low-power AdapTag network.

There are three steps to prepare the Kit:

1. **Installing the AdapTag Manager**
2. **Assembling the AdapTag Host**
3. **Assembling the AdapTag Slaves**



2.1 Installing AdapTag Manager

Locate the AdapTag Manager Installer on the included CD or download it from <http://www.pervasivedisplays.com/products/adaptag>. Double click the Installer to start the installation. Follow the instructions on the screen to install the program. The Installer will also install the driver for the eZ430 USB dongle to the computer.

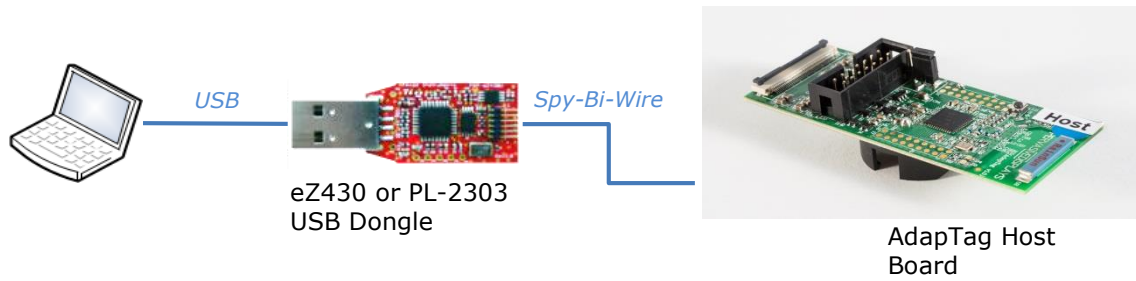


Note: If your packaging is with PL-2303 USB dongle, please download the install driver from AdapTag Kit webpage. Please install this driver before you proceed to next step.

2.2 Hardware Setup for the AdapTag Host

The AdapTag host board is marked with a label saying "Host," as shown on the adjacent image. Locate the AdapTag Host board in the package and connect it according to the diagram and instructions below.





- (1) Connect the 6-pin Spy-Bi-Wire connector of the USB dongle to the AdapTag host board. If your USB dongle is PL-2303 type, there is a cable to connect with.
- (2) Connect the USB side of the USB dongle to a USB port of the computer.
- (3) Verify that the green LED on the AdapTag host board is blinking.



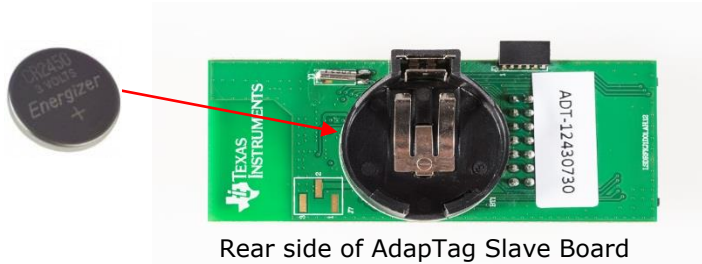
2.3 Hardware Setup for AdapTag Slaves

The AdapTag slave boards are marked with white labels with a 4-digit number (Slave ID). Connect the EPD panels to the slave boards according to the list below:

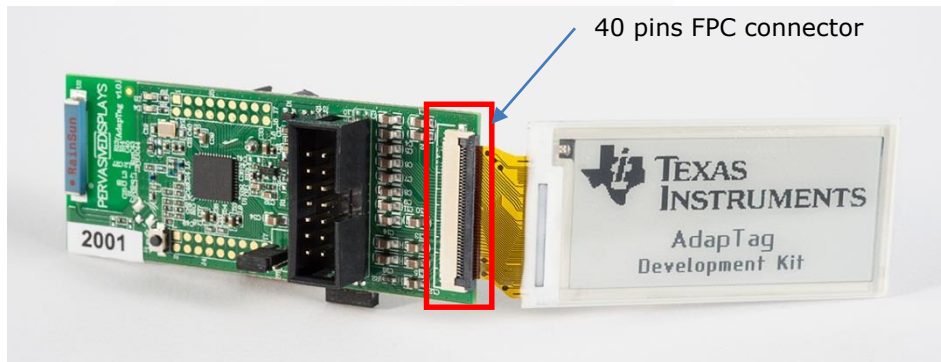
- 1.44" panel, Slave ID: 1401
- 2.0" panel, Slave ID: 2001
- 2.7" panel, Slave ID: 2701



Note: The first two digits in the default address of the AdapTag slave boards correspond to the panel size. For example, the 2001 AdapTag board should be connected to the 2.0" EPD panel.



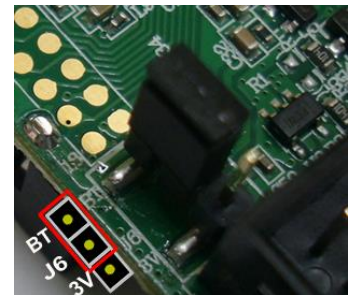
Rear side of AdapTag Slave Board



Topside of AdapTag Slave Board

To assemble the AdapTag slaves:

- (1) Insert one CR2450 battery into the battery holder of each slave board.
- (2) Using the 40-pin FPC connectors, attach each EPD panel to the respective AdapTag board according to the address.
- (3) The AdapTag board provides jumper pins (J6) to switch power sourcing from battery to USB dongle. When placing the jumper on 3V (or when no jumper is connected to the pins), the AdapTag board is powered by 3V from the USB. If the BT pins are connected by the jumper, the AdapTag board is powered by Lithium coin battery.
- (4) Verify that the green LED on the AdapTag slave board is blinking after placing the jumper on the BT pin.
- (5) The red LED flashes at the beginning of every frame cycle when the address is received. The red LED also flashes when receiving data.



Note: When the AdapTag host and slave are synchronized, the green LED on the host and slave board will flash at the same time. The AdapTag Manager will update the slave list with the status of the tag.

Slave ID	RSSI RX	RSSI TX	Battery	Temp.	Last Update
<input checked="" type="checkbox"/> 2001	-43db	-43db	2.6v	28	10/30 17:40:13

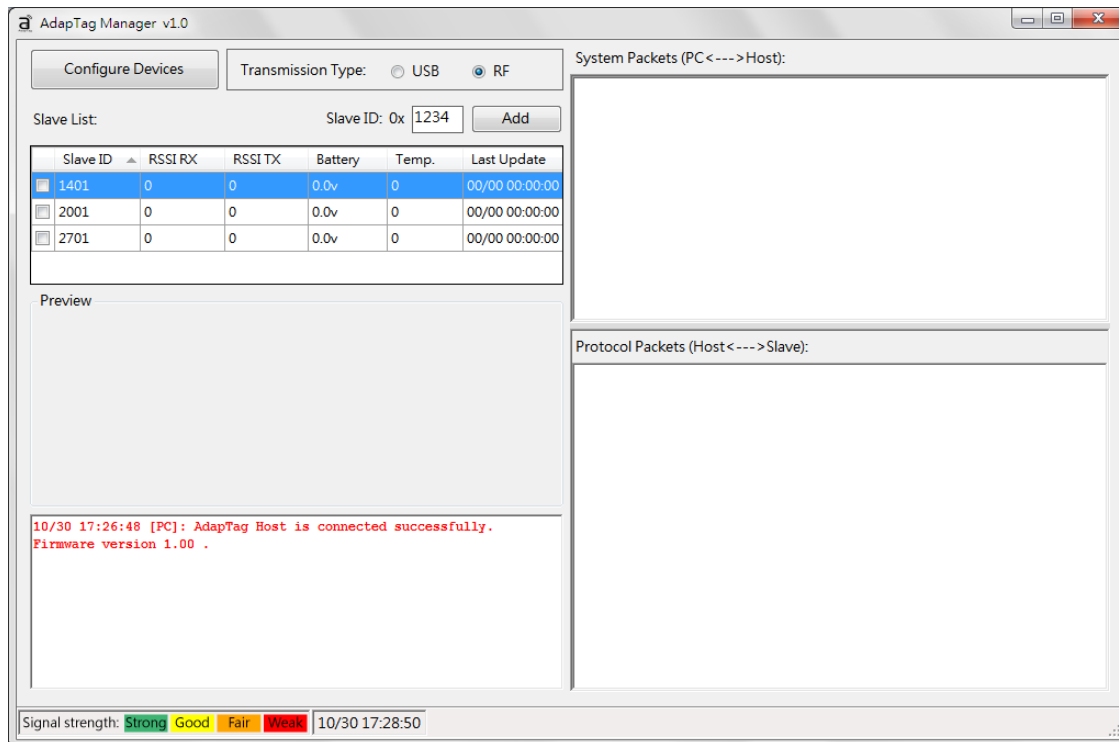
3. WORKING WITH ADAPTAG MANAGER

AdapTag Manager provides a graphic interface to configure and manage the low-power AdapTag network, update the EPD with new images, and poll the AdapTag slaves.

The AdapTag Manager has two operation modes:

1. USB Mode
In USB mode, the AdapTag Manager is used to load an image directly from the host board to a connected EPD.
2. RF Mode
In RF mode, the AdapTag Manager can be used to control and configure an RF network of AdapTag slaves. The AdapTag Manager also provides a method of loading images to the EPDs connected to the RF endpoints.

AdapTag Manager has three information panels. The first two panes provide data on the communications between the system and the host (access point) and between the RF endpoints and the access point. The third pane provides general information about system events.




Note: The AdapTag boards are preloaded with the default AdapTag network settings. During installation, a default AdapTag network is created using the addresses printed on the AdapTag boards. A complete list of the default AdapTag network settings is included in the Appendix of this manual.

3.1 Updating an EPD using the USB

AdapTag Manager supports updating the EPDs panels directly by USB.

- a. Select USB as "Transmission Type."
- b. Connect the desired panel size to the host board.
- c. Right-click the slave list and select "Send Image to Host."




 **Note:** Current leakage from the USB connection can result in undesired artifacts on the EPD such as stripes or a faded image.

3.2 Updating an EPD using Default AdapTag Network

The preconfigured AdapTag network makes it easy to send an updated image to an AdapTag slave.

- a. Select RF as the "Transmission Type."
- b. Click the appropriate "check box" for the selected slave in the AdapTag slave list (e.g. 2001).
- c. Right-click, select the appropriate "Send Image to Slave," and browse to the selected image (e.g. Send 2.0" Image to Slave).

 **Note:** It is important that the correct size image is selected to avoid errors. The selected slave should display the new image within seconds.

3.3 AdapTag Manager Overview

AdapTag Manager provides the following options and information presentation panes:

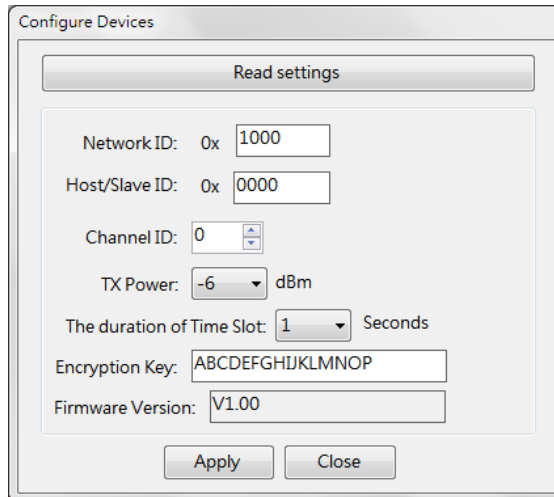
- ✧ **Configure Devices:**
Provides options to configure the Host or Slave Network ID, Host/Slave Address ID, Channel ID, Tx Power, the Duration of Time Slot, and Encryption Key.
- ✧ **Transmission Type:**
There are two options: USB and RF. This option determines the communications method with the host or slaves.
- ✧ **Slave ID:**
Additional AdapTags can be added to the network by entering their Network IDs (Slave ID).
- ✧ **Slave List:**
This table lists the slaves that can be controlled. It will update the RSSI, battery capacity, ambient temperature, and the last update time after the slave returns

packet information to host. A check box is provided for each slave. You must check a slave in the list before sending any commands. The zero value will be updated after this slave returns packets.

	Slave ID ▲	RSSI RX	RSSI TX	Battery	Temp.	Last Update
<input type="checkbox"/>	1401	0	0	0.0v	0	00/00 00:00:00
<input checked="" type="checkbox"/>	2001	-60db	-60db	2.6v	28	10/30 17:32:19
<input type="checkbox"/>	2701	0	0	0.0v	0	00/00 00:00:00

- ✧ **Preview:**
Use this option to preview the image that will be sent to a slave.
- ✧ **Command Textbox:**
The text box under the preview area. It shows the command history that the user ordered on the slave list.
- ✧ **System Packets:**
This area shows the UART communication packets between AdapTag Manager and the host.
- ✧ **Protocol Packets:**
This area shows the RF communication packets between the host and slave(s).
- ✧ **Status Bar:**
This option shows the reference color of radio signal strength that the slaves return to AdapTag Manager. A clock is provided to indicate the latest update time for each slave.

3.3.1 Configuring the AdapTag Network



- (1) After clicking the [Configure Devices] button, a dialogue box pops up, as shown above. Click [Read settings] to get current configurations of the device (host or slave).
- (2) You can change any value of Network ID, Host/Slave ID, Channel ID, Tx Power, Time Slot Duration, and Encryption Key. To apply the new ID or value, click [Apply] button. You can click the [Read settings] button again to check if the new value works or not.

- (3) **Network ID:**
A collection of associated and cooperating slaves shares the same address space. A 2-byte value is used to uniquely define a network. Slaves make the decision on what radio networks to join based on their Network ID and Channel ID. The value is from 0x0000 to 0xFFFF (Hex format), with a default value of 0x1000. Both the host and slave must be assigned to the same Network ID.
- (4) **Host/Slave ID:**
The address of a node within a network. A 2-byte value is used to uniquely define a slave in a Network ID. The value is from 0x0000 to 0xFFFF (Hex format), with a default value of 0x1234. A 0x0000 value is used for the Host ID. The three slave boards were preconfigured with default values of 1401, 2001 and 2701, depending on size. If you have more slave boards, assign each a different ID and add them to the slave list.
- (5) **Channel ID:**
Channel ID is a portion of the RF spectrum. The host and slave must work in the same Channel ID to avoid interference with others. The value is from 0 to 15 (excluding the value 8) for a total of 15 channels. The default value is 0. Both the host and slaves must be assigned to the same Channel ID.
- (6) **Tx Power:**
Transmission Power of a device is typically measured in dBm. Greater transmission distances can be achieved with greater Tx Power. The value can be selected from -6, 0, 5 and 10 dBm. The default value is -6.
- (7) **The Duration of Time Slot:**
The default Time Slot is 1 second, with configuration options that allow the user to select values of 0.5, 1, 2 or 4 seconds. If you are connecting a 2.7" EPD with the slave board, you must select 1 second or greater. The 1.44" and 2.0" EPDs can work at 0.5 second or greater durations.
- (8) **Encryption Key:**
Provides a form of security that turns packets into unreadable cipher by applying a set of complex algorithms to the original material. The Encryption Key is designed to translate the data into 16 alphanumeric characters. Both the host and slave must be assigned to the same Encryption Key.
- (9) **Firmware Version:**
Click [Read settings] to obtain the current firmware version of the device.



Note: If you want to configure another AdapTag board, remove the USB dongle and configured device from the computer's USB port and then re-connect the dongle to the USB port with another AdapTag board.

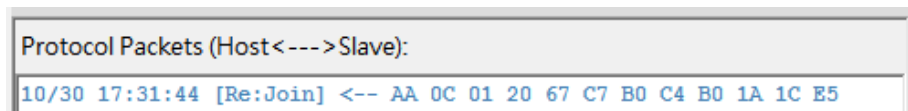
3.3.2 Adding Slaves to the AdapTag Network

- (1) Type the address ID (Slave ID, Hex format) in the text box. Click [Add] button to add it to the list. You can add more slaves to the list for future management.

Slave List: Slave ID: 0x

	Slave ID ▲	RSSI RX	RSSI TX	Battery	Temp.	Last Update
<input type="checkbox"/>	1401	0	0	0.0v	0	00/00 00:00:00
<input checked="" type="checkbox"/>	2001	-43db	-43db	2.6v	28	10/30 17:40:13
<input type="checkbox"/>	2701	0	0	0.0v	0	00/00 00:00:00

- (2) Once the coin battery is inserted into the AdapTag slave board, you will see a [Re:Join] message under Protocol Packets as indicated below:



3.3.3 Setting Transmission Mode

There are two types: USB and RF.

- (1) **USB:** This Kit allows content updating directly on an EPD via the AdapTag host board without utilizing RF. To do so, connect an EPD with the AdapTag host board and USB dongle to the computer’s USB port. When a “Send xx inch Image to Slave” command is subsequently sent, the EPD will be updated immediately.
- (2) **RF:** This option will allow host to slave communication via RF signal.

3.3.4 Polling Slaves on the AdapTag Network

- (1) Select “Poll Slave” to send “Poll” command to selected slave.
- (2) Select “Poll All Slaves” to send “Poll” command to all the slaves in the list.



Note: Before sending image to any slave, you can right click on the slave list to select “Poll Slaves” menu to check the selected slaves are working.

3.3.5 Sending Images to AdapTag Slaves

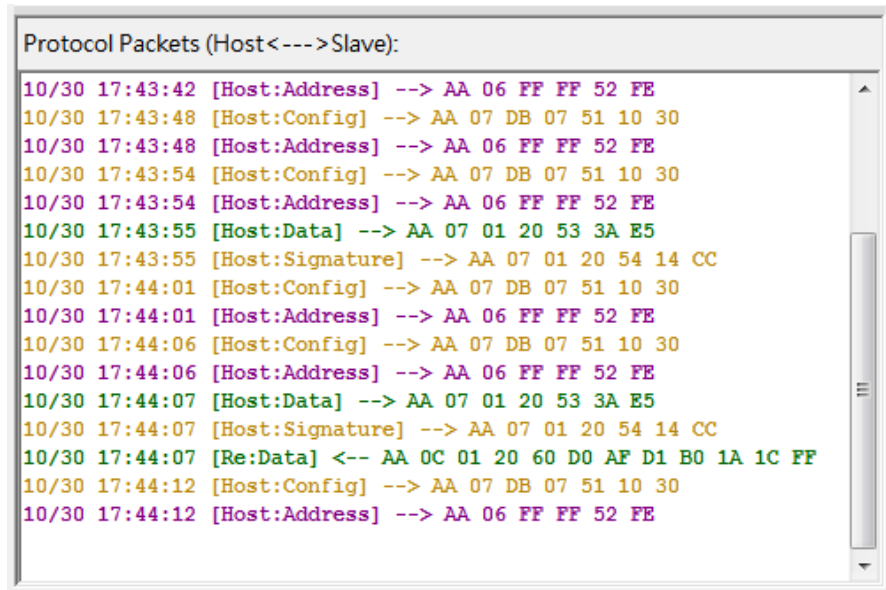
- (1) Send 1.44” Image to Slave: Select a 1.44” image and send it to a selected slave. It will convert any selected image to 1.44” size and one bit bitmap image format.
- (2) Send 2” Image to Slave: Select a 2.0” image and send it to a selected slave. It will convert any selected image to 2.0” size and one bit bitmap image format.
- (3) The same selection to the 1.9”, 2.6” and 2.7” accordingly.

3.3.6 Deleting Slaves from the AdapTag Network

To delete an endpoint/slave from the AdapTag network, right click on the slave in the slave list and select "Delete Slave" from the menu.

3.3.7 Using AdapTag Manager as Protocol Analyzer

- (1) Detail protocol: When selected, this option will show detailed packet information in the Protocol Packets textbox. If not selected, simple packet information will be reported.



- (2) You can right-click on "Command," "System Packets," or "Protocol Packets." To bring up a pop-up submenu to clear the text or save the text to a .txt file.

For more information about the AdapTag network settings and the ALPS protocol, go to: www.pervasivedisplays.com/products/adaptag

4. KNOWN ISSUES AND TROUBLESHOOTING

RF communications between the host and the slaves are not optimized and have a limited range. If the slaves have difficulty communicating with the host, decrease the distance between the devices.

For a complete and up-to-date list of known issues, see: www.pervasivedisplays.com/products/AdapTag

4.1 AdapTag Manager is not connecting to the host board

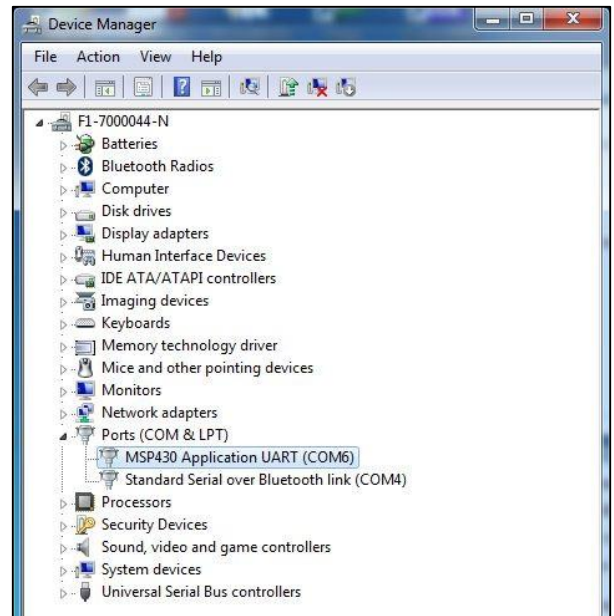
When the USB dongle is plugged into the computer's USB port, Windows® should recognize the new hardware as an "MSP430 Application UART." (The device name may be different from the one shown here.)

When the USB interface is installed and ready to use, the Device Manager lists a new entry as shown below for "MSP430 Application UART (COM##)".

If your USB dongle is PL-2303 type, the Device Manager lists a new entry as "Prolific USB-to-Serial Comm Port (COM##)".

... Prolific USB-to-Serial Comm Port (COM26)

Look also for a connect message in the AdapTag Manager information pane on the bottom left.



```
10/30 17:26:48 [PC]: AdapTag Host is connected successfully.
Firmware version 1.00 .
```

4.2 Slave XXXX is not connecting to the AdapTag network

First ensure that the host board is recognized and then reset AdapTag Manager by pressing the reset button or a power cycle. Look for the "Join" message in the Protocol information pane.

```
Protocol Packets (Host<--->Slave):
10/30 17:31:44 [Re:Join] <-- AA 0C 01 20 67 C7 B0 C4 B0 1A 1C E5
```


4.3 Slave XXXX is not updating when an image is sent

First ensure that the host board is connected to the AdapTag Manager as in Section 5.1. Then ensure that the slave is connected to the AdapTag network as in Section 5.2. Finally, verify that the check box for the Slave ID is marked and that the signal strength is green or yellow.

Slave List: Slave ID: 0x

Slave ID ▲	RSSI RX	RSSI TX	Battery	Temp.	Last Update
<input type="checkbox"/> 1401	0	0	0.0v	0	00/00 00:00:00
<input checked="" type="checkbox"/> 2001	-43db	-43db	2.6v	28	10/30 17:40:13
<input type="checkbox"/> 2701	0	0	0.0v	0	00/00 00:00:00

5. GLOSSARY OF ACRONYMS

ALPS	Advanced Low-Power Star network protocol
CCS, CCStudio	Texas Instruments' Code Composer Studio™ IDE development tool
COG	Chip on glass
MCU	Microcontroller unit
PDI	Pervasive Displays, Inc.
RF	Radio frequency
RSSI	Received Signal Strength Indicator
SPI	Serial Peripheral Interface
TI	Texas Instruments Corporation

6. APPENDIX

- ✧ Default configuration of AdapTag Host and Slaves

	Host	Slave 1	Slave 2	Slave 3
Network ID (hex)	1000			
Host/Slave ID (hex)	0000	1401	2001	2701
Channel ID	0			
Tx Power (dBm)	0			
The Duration of Time Slot (seconds)	1			
Encryption Key	ABCDEFGHIJKLMN			