NFCLink Standalone Getting Started

This guide assists users in the initial firmware setup and demonstration of Peer-to-Peer mode, Reader/Writer mode, and Card Emulation mode of the TRF7970A BoosterPack™ plug-in module with an MSP430F5529 LaunchPad™ development kit. The guide explains how to flash the example firmware that is provided by TI. Additionally, it describes how to implement the different modes with the NFCLink Standalone GUI.



Copyright © 2016, Texas Instruments Incorporated
Downloaded from www.Manualslib.com manuals search engine

Contents

1 Introduction 3
2 Getting Started 3
3 TI NFC Tool GUI 12
4 Summary 22

List of Figures

1 UniFlash Installation 4
2 Selecting .out File in UniFlash 5
3 Code Composer Studio™ IDE Installation 6
4 CCS Import Project Window 7
5 Device Manager With LaunchPad™ Development Kit Shown as an Other Device 8
6 Update Driver Software Using Device Manager 9
7 Browse Computer for Driver Software 10
8 Location Of CDC Driver in Installed Firmware Package 11
9 TI NFC Tool Auto Connect 12
10 TI NFC Tool Manual Connect 12
11 Antenna Location on DLP-7970ABP 13
12 Phone Correct and Incorrect Presentation to BoosterPack™ Plug-in Module 14
13 Tag Correct and Incorrect Presentation to BoosterPack™ Plug-in Module 15
14 BoosterPack™ Plug-in Module Correct and Incorrect Presentation to BoosterPack™ Plug-in Module 15
15 NFC Configuration Tab – P2P Configuration 16
16 Peer-to-Peer Tab 17
17 NFC Configuration Tab – RW Configuration 18
18 Reader/Writer Mode Tab 19
19 NFC Configuration Tab – CE Configuration 20
20 Card Emulation Tab 21
21 Advanced COM Tab 21

Trademarks

BoosterPack, LaunchPad, Code Composer Studio, MSP430 are trademarks of Texas Instruments. All other trademarks are the property of their respective owners.

Copyright © 2016, Texas Instruments Incorporated

Downloaded from www.Manualslib.com manuals search engine

1 Introduction

This guide has two main objectives: It describes how to download the NFCLink Standalone example code to an MSP-EXP430F5529LP, and it also describes how to use the TI NFC Tool GUI. The example code and GUI can be downloaded from http://www.ti.com/lit/zip/sloa227. This guide describes how to install and use two different flash programming options: Code Composer Studio™ IDE and UniFlash. The guide also describes how to use the TI NFC Tool GUI to interact with NFC tags and NFC enabled devices.

1.1 Prerequisites

The user should have the following items:

- DLP-7970ABP
- MSP-EXP430F5529LP
- An NFC tag or NFC enabled device
- A computer running Microsoft® Windows® 7 or XP operating systems

2 Getting Started

This section describes the required software and hardware setup for the DLP-7970ABP BoosterPack plug-in module and the MSP-EXP4305529LP LaunchPad development kit with the NFCLink Standalone example firmware.

2.1 Download and Install Software

Download the NFCLink Standalone GUI and example code from http://www.ti.com/lit/zip/sloa227.

Install the software package following the default options.

2.2 Hardware Setup

Attach the DLP-7970ABP to the MSP-EXP430F5529LP so that pin 1 of the BoosterPack plug-in module is aligned with the 3.3V pin of the LaunchPad development kit. Then connect the MSP-EXP430F5529LP to the PC using the provided USB cable.

2.3 Flash the Firmware

The NFCLink Standalone firmware requires either UniFlash or Code Composer Studio IDE (CCS) v6.1.1 or newer to download code to the LaunchPad development kit. If you have only the CCS free license, use UniFlash to download the example code. This is due to the maximum download capacity of CCS under the free license.

Copyright © 2016, Texas Instruments Incorporated
Downloaded from www.Manualslib.com manuals search engine

2.3.1 Option 1: UniFlash

2.3.1.1 Download and Install

Download and run the UniFlash installation wizard (version 3.4 or newer) from http://www.ti.com/tool/uniflash. Use the default settings until the Select Components selection (see Figure 1). The default option is install all components, but the minimum requirement is only to install the *MSP430 Ultra Low Power* component under *Microcontrollers*. Choose which components to install based on preferred disk usage. The installation of additional debug probes is optional. Follow the remaining installation instructions in the wizard to complete the installation process.

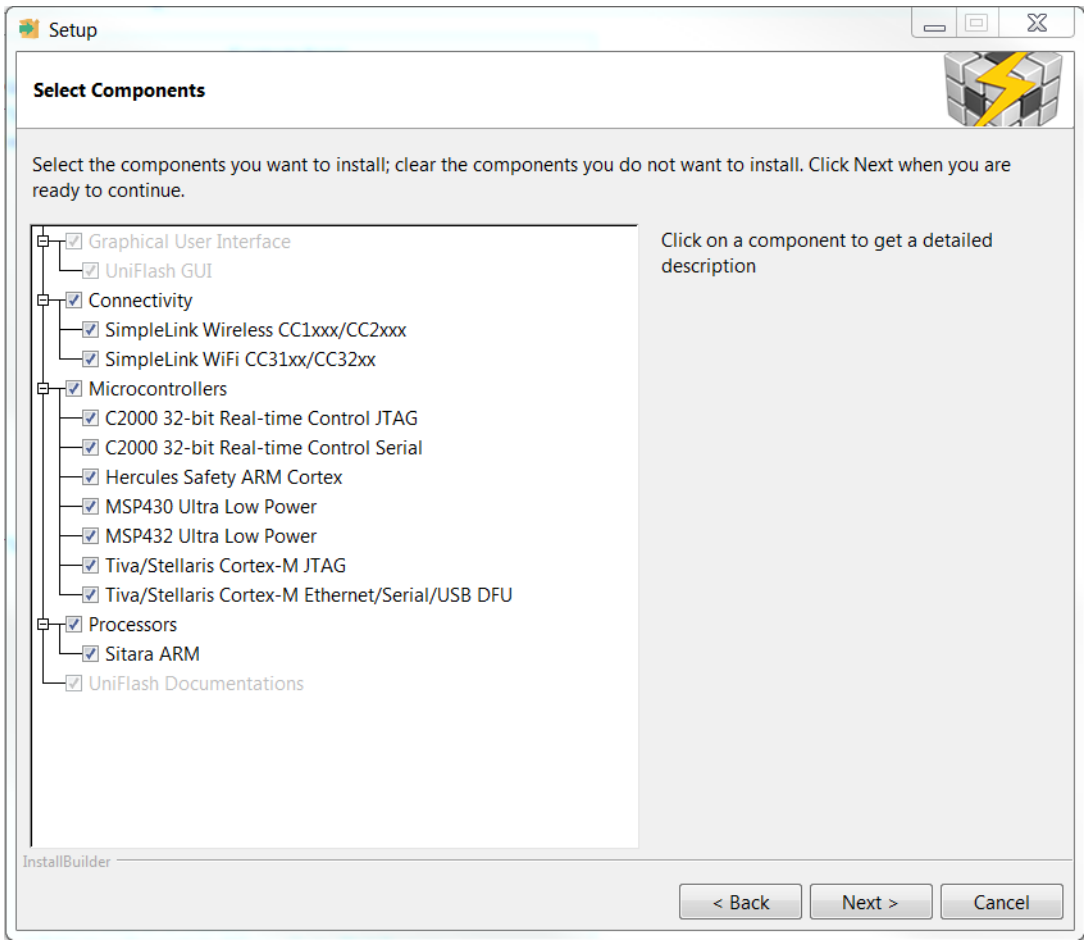


Figure 1. UniFlash Installation

Copyright © 2016, Texas Instruments Incorporated

Downloaded from www.Manualslib.com manuals search engine

2.3.1.2 Import and Configure Project

To use Uniflash to flash the NFCLink Standalone firmware to the MSP-EXP430F5529LP:

1. Open UniFlash.
2. Go to File → New Configuration.
3. Connection → MSP430 USB1 and Board or Device → MSP430F5529. Click Ok.
4. When connected, click Program → Load Program.
5. Select Browse and find the configuration file at *[Installed Path]\examples\boards\MSP-EXP430F5529LP\F5529LP_TRF7970A_ALL_NFC_MODES\Debug* and select the F5529LP_TRF7970A_ALL_NFC_MODES.out file (see Figure 2).
6. Click OK. The firmware should automatically begin to load into flash memory on the MSP-EXP4305529LP.
7. After the firmware is loaded, cycle the power to the LaunchPad development kit by unplugging the USB cable and then plugging it back in.

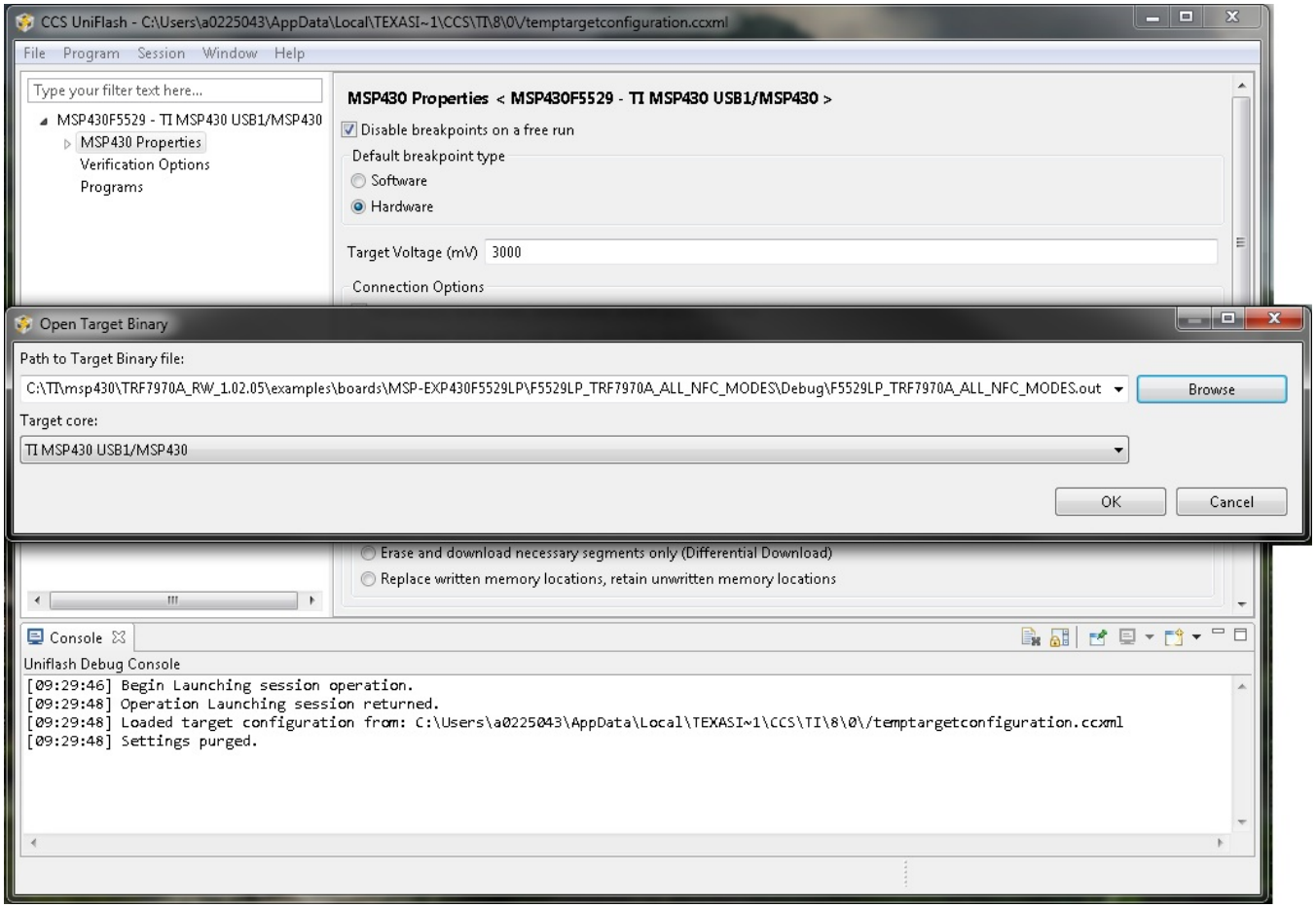


Figure 2. Selecting .out File in UniFlash

Copyright © 2016, Texas Instruments Incorporated
Downloaded from www.Manualslib.com manuals search engine

2.3.2 Option 2: Code Composer Studio™ IDE (CCS)

2.3.2.1 Download and Install

Download and run the Code Composer Studio IDE version 6.1.1 or newer (CCS) installation wizard from http://processors.wiki.ti.com/index.php/Download_CCS. Online and offline installation options are available. If any issues occur with the online installer, then try the offiline installer instead. Use the default installation options up until Processor Support (see Figure 3). The minimum requirement is to select only *MSP Ultra Low Power MCUs* for processor support. Additional processor support can be added based on preferred disk usage. Follow the remaining installation instructions in the wizard to complete the installation process.

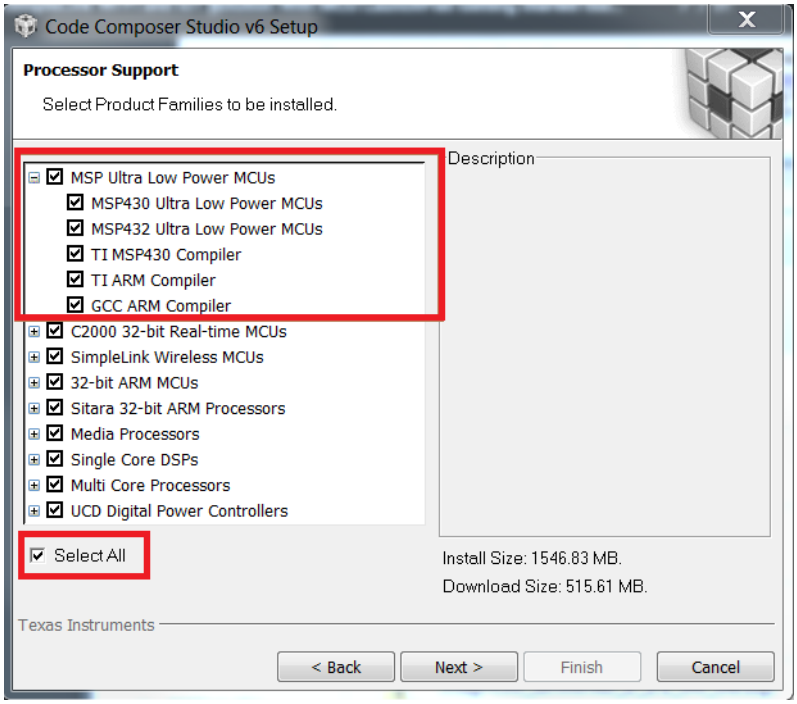


Figure 3. Code Composer Studio™ IDE Installation

2.3.2.2 Import and Configure Project

To use Code Composer Studio IDE version 6.1.1 to flash the NFCLink Standalone firmware to the MSP-EXP430F5529LP, follow these steps:

1. Open Code Composer Studio IDE.
2. Go to Project → Import CCS Projects…
3. Click Browse and select the directory: [Installed Path]\examples\boards\MSP-EXP430F5529LP\F5529LP_TRF7970A_ALL_NFC_MODES.
4. Import the F5529LP_TRF7970A_ALL_NFC_MODES project (see Figure 4).
5. Select the imported project in the Project Explorer window and then click the debug icon to build the project and download the example firmware to the device.
6. Click the terminate button in the debugging window.
7. Cycle the power to the LaunchPad development kit by unplugging the USB cable and then plugging it back in.
8. The firmware on the LaunchPad development kit now operates in stand-alone mode and reads NFC/RFID tags by default.

Copyright © 2016, Texas Instruments Incorporated

Downloaded from www.Manualslib.com manuals search engine

9. If the CDC driver for the LaunchPad development kit is installed on the host PC, then the LaunchPad development kit is ready to connect to the TI NFC Tool GUI. See Section 2.4 for details on how to determine if the CDC driver is installed.

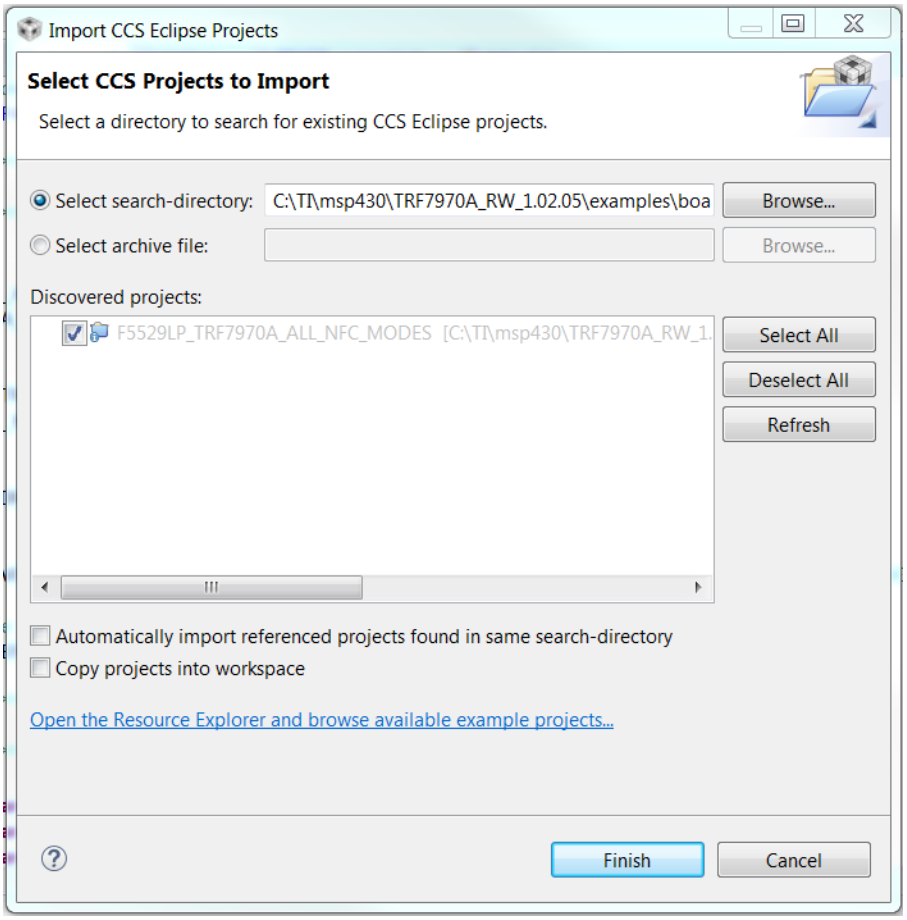


Figure 4. CCS Import Project Window

Copyright © 2016, Texas Instruments Incorporated
Downloaded from www.Manualslib.com manuals search engine

2.4 Install the MSP430™ CDC Driver

To determine if the CDC driver for the MSP-EXP430F5529LP is installed, run Device Manager on the PC after the firmware example has been flashed to the LaunchPad development kit. For Windows users, this can be done by going to Control Panel → Device Manager → Other Devices.

It is mandatory that the firmware be flashed on the MSP-EXP430F5529LP first. This is because it is the firmware example that attempts to enumerate the CDC port to the COM port list, and there is no way to tell if the CDC driver is installed or not unless the firmware attempts that CDC port enumeration.

If the MSP430 LaunchPad development kit appears as an Other or Unknown device with a caution symbol (see Figure 5), then the CDC driver is not installed.

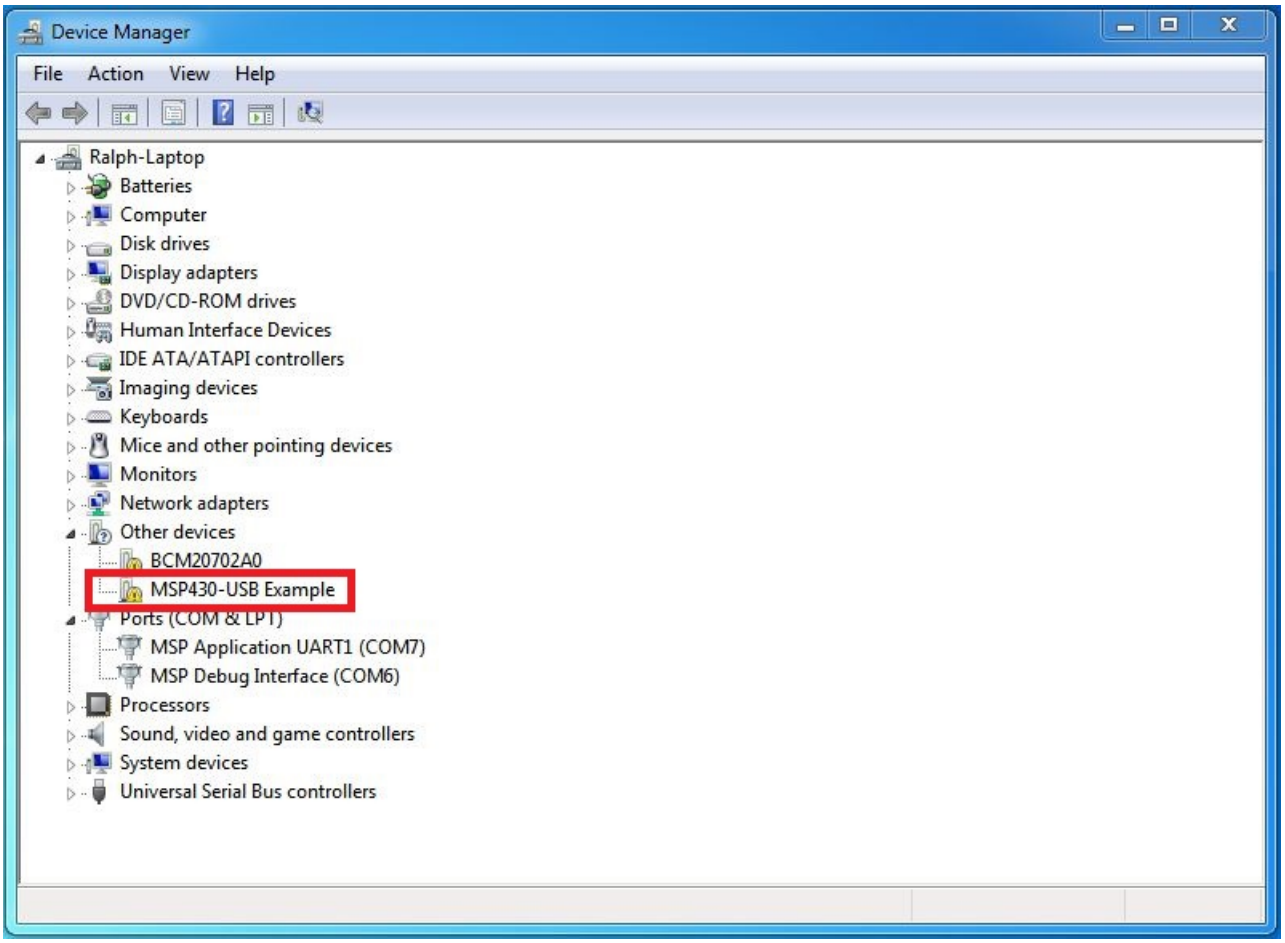


Figure 5. Device Manager With LaunchPad™ Development Kit Shown as an Other Device

Copyright © 2016, Texas Instruments Incorporated

Downloaded from www.Manualslib.com manuals search engine

1. To install the CDC driver, right click the MSP430 device and select *Update Driver Software…* (see Figure 6).

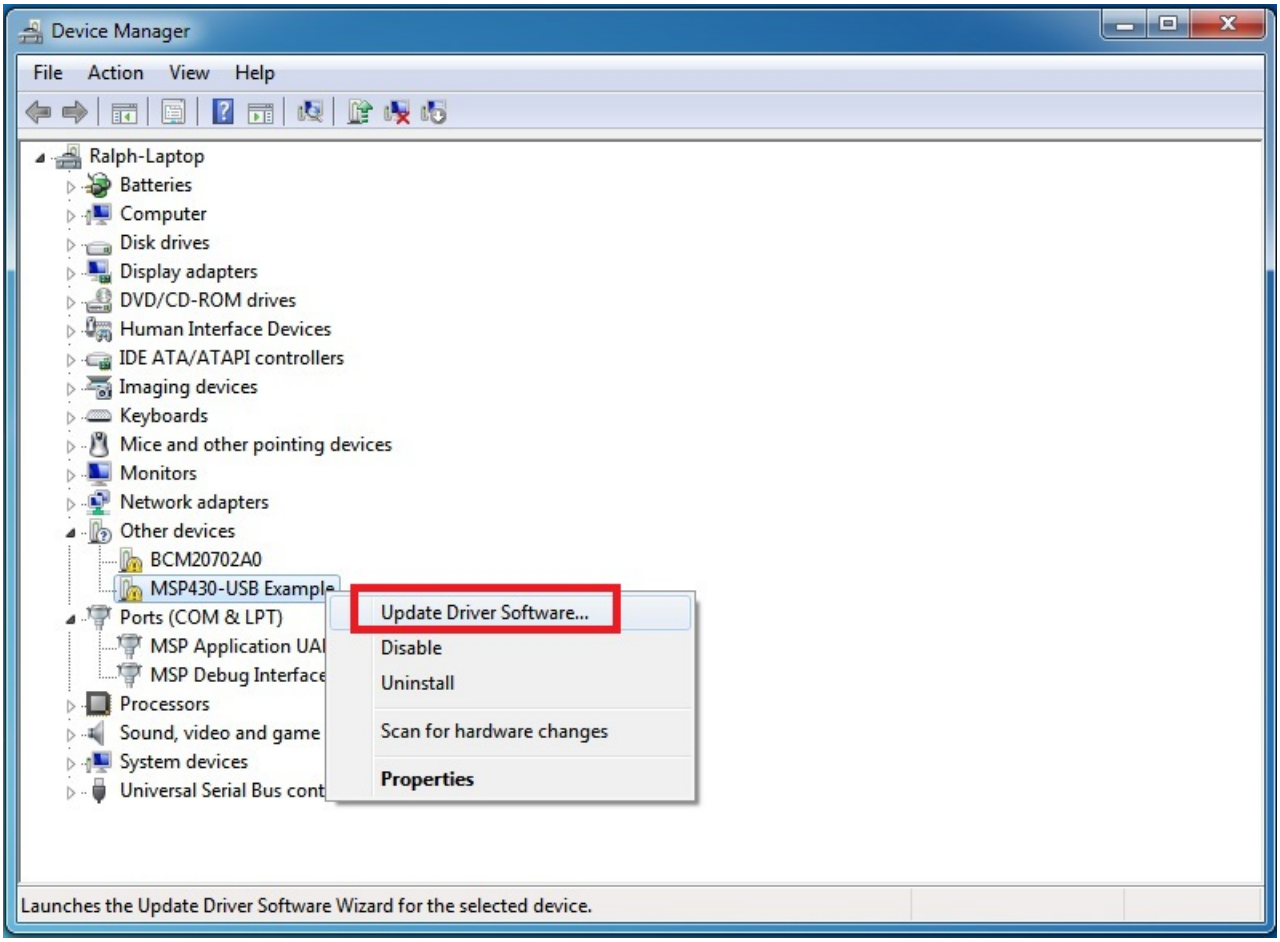


Figure 6. Update Driver Software Using Device Manager

Copyright © 2016, Texas Instruments Incorporated
Downloaded from www.Manualslib.com manuals search engine

2. Select *Browse my computer for driver software* option (see Figure 7).

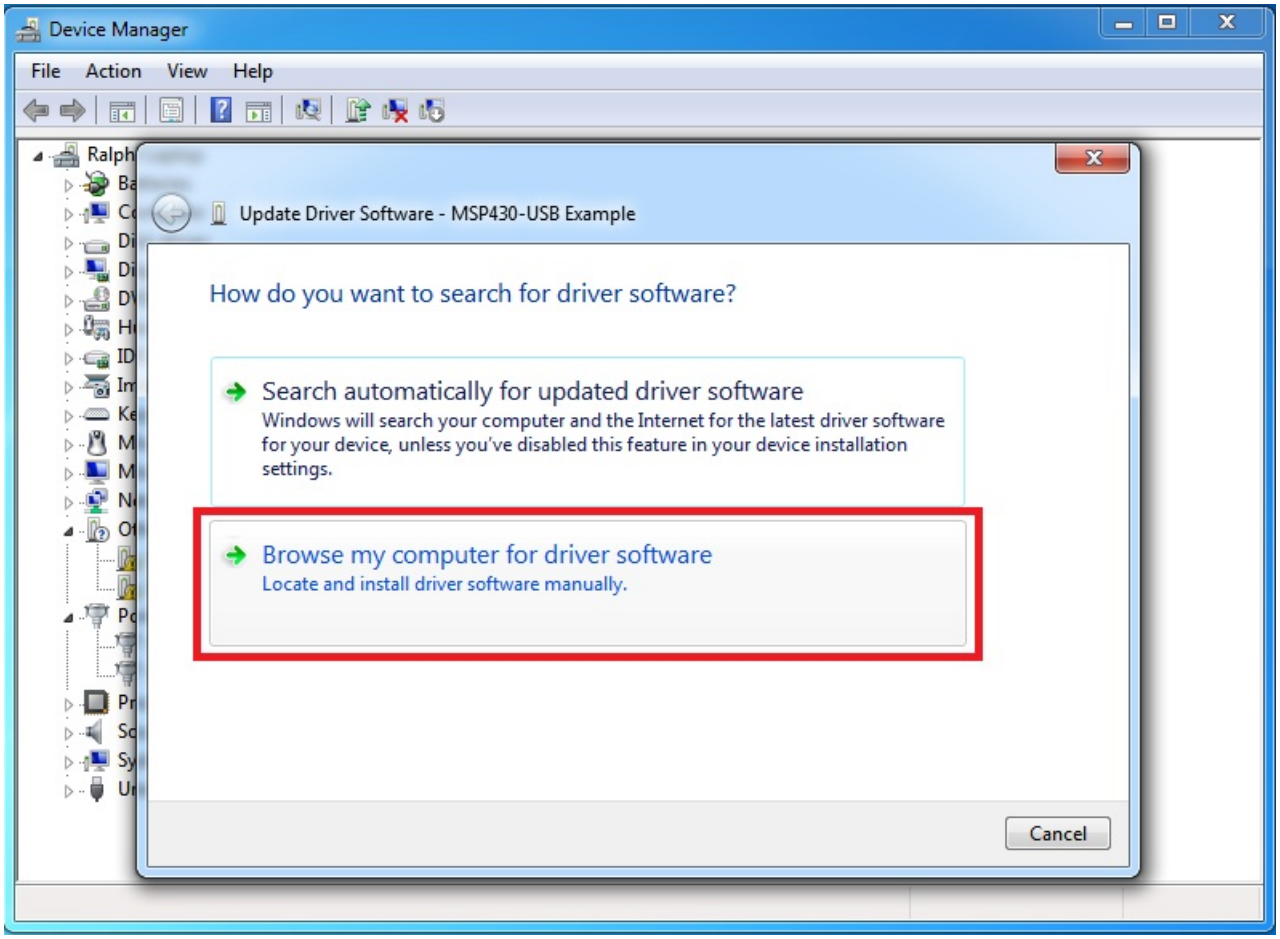


Figure 7. Browse Computer for Driver Software

Copyright © 2016, Texas Instruments Incorporated

Downloaded from www.Manualslib.com manuals search engine

3. Browse to the driver software, which is located at [Installed Path]\usblib\USB_config (see Figure 8).

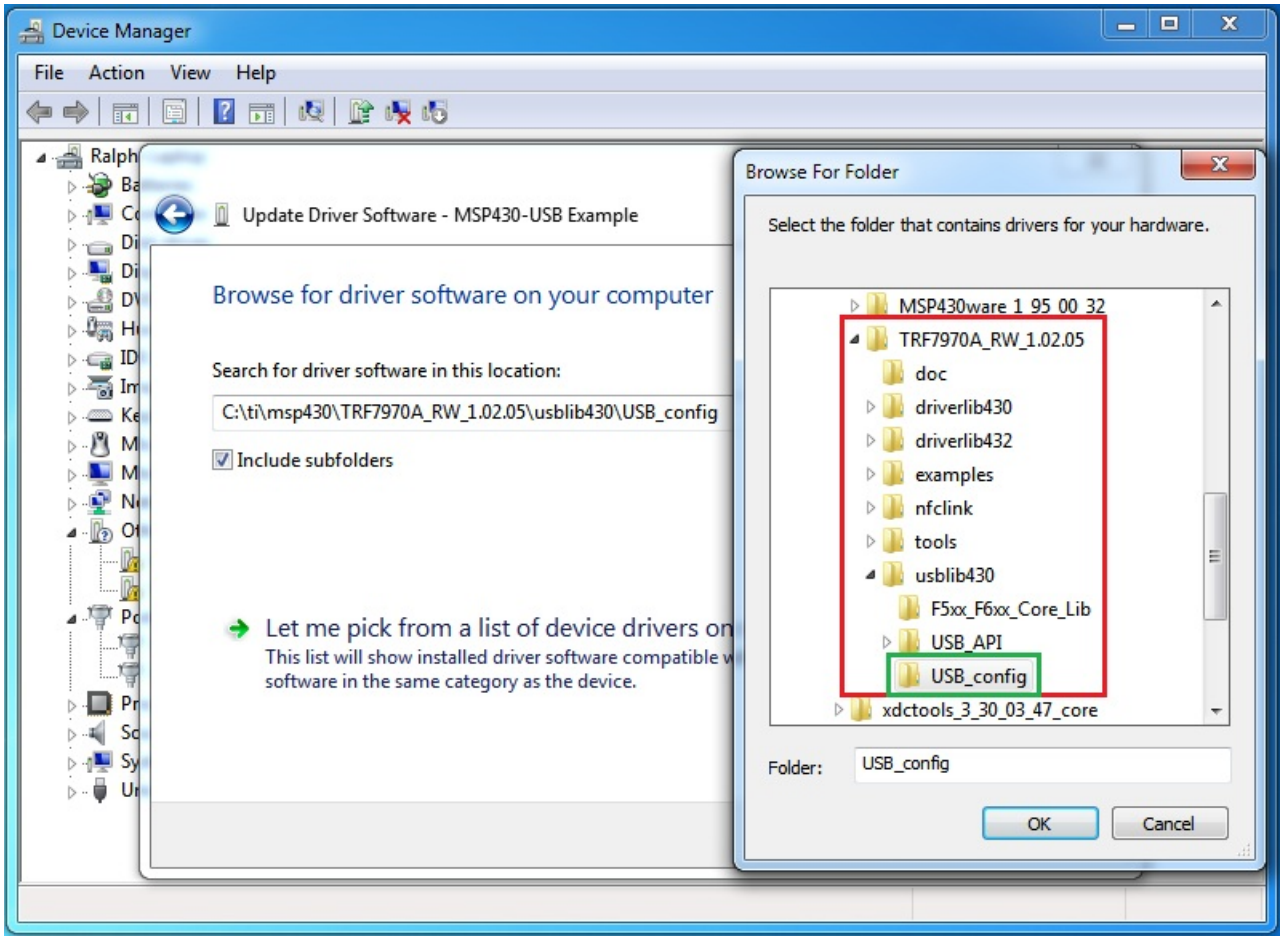


Figure 8. Location Of CDC Driver in Installed Firmware Package

4. After selecting the USB_config folder, click OK and then click Next.
5. There is a warning regarding the driver signature. Click continue to finishing installing the driver.
6. Now the CDC driver should be installed and the LaunchPad development kit can be connected to the TI NFC Tool GUI.

2.5 Change Jumper for Older DLP-7970ABP BoosterPack Plug-in Modules

If you are using a BoosterPack plug-in module version 4.4 or older, the IRQ jumper may need to be changed. See *DLP-7970ABP Hardware Update Overview* for more information.

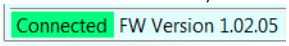
Copyright © 2016, Texas Instruments Incorporated
Downloaded from www.Manualslib.com manuals search engine

3 TI NFC Tool GUI

This section describes the TI NFC Tool GUI, which gives users the ability to configure the NFCLink Standalone firmware to communicate with NFC enabled devices using different modes and protocols. This guide describes use of version 1.8 of the TI NFC Tool. The TI NFC Tool GUI can be opened from the Start Menu under *Programs → Texas Instruments → NFC Reader-Writer Application*. Alternatively, it can be found in the file system at *[Install Path]\tools\TI NFC Tool\TI NFC Tool\bin\Debug*.

3.1 How to Connect

3.1.1 Auto Connect

The Auto Connect section is located at the top left of the GUI (see Figure 9). Use the Hardware Selection drop-down menu to select the appropriate hardware platform and click the Auto Connect button. If the selected hardware platform is connected and has the correct firmware loaded, then the connection is successful and the status bar at the bottom left turns green: 

. Otherwise, an error message is displayed. If this occurs, attempt to use Manual Connect instead.

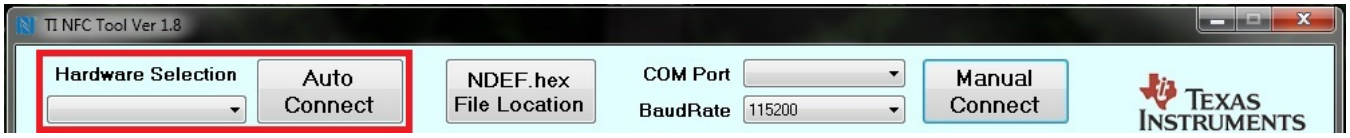


Figure 9. TI NFC Tool Auto Connect

3.1.2 Manual Connect

If an error message appears using Auto Connect, manually select the COM port. To manually connect the LaunchPad development kit to the GUI, use the COM Port drop-down menu located at the top right (see Figure 10). It displays the COM ports available for connection. If there are multiple USB devices connected to the PC, the Advanced COM tab can be used to determine the correct COM port for the LaunchPad development kit. Select the desired COM port and click Manual Connect. If an incorrect COM port is selected, an error message is displayed.

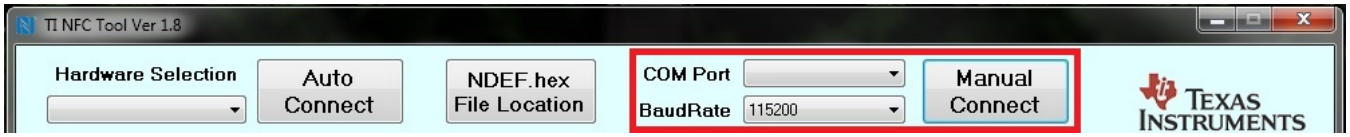


Figure 10. TI NFC Tool Manual Connect

Copyright © 2016, Texas Instruments Incorporated

Downloaded from www.Manualslib.com manuals search engine

3.2 Proper Interaction of NFC Devices With the DLP-7970ABP BoosterPack Plug-in Module

Due to the short range of NFC technology, correct presentation of the BoosterPack plug-in module and any NFC enabled device is required for proper NFC operation to occur. This is done by aligning the NFC antennas of each device so they are coupled correctly. This section contains figures that show correct and incorrect presentations to an NFC BoosterPack plug-in module using an NFC-enabled smartphone, an NFC/RFID tag, and another NFC BoosterPack plug-in module. Throughout this document, any comments referring to *present* or *presenting* an NFC device or tag to the BoosterPack plug-in module refers to the following information.

The antenna of the BoosterPack plug-in module is located above the IC circuitry and is indicated by the traces etched into the PCB, which is the antenna coil (see Figure 11). The IC package that is labeled *DLP Design* is not an antenna and cannot be used for NFC communication.



Figure 11. Antenna Location on DLP-7970ABP

Copyright © 2016, Texas Instruments Incorporated
Downloaded from www.Manualslib.com manuals search engine

Figure 12 shows correct and incorrect presentation of a NFC enabled phone to the BoosterPack plug-in module. The antennas on NFC enabled phones vary based on phone model. Typically, a good point of reference is near the phone battery for most models. Most Android phones need to be unlocked for NFC communication to occur. By default, NFC-enabled phones do not enable NDEF card emulation.

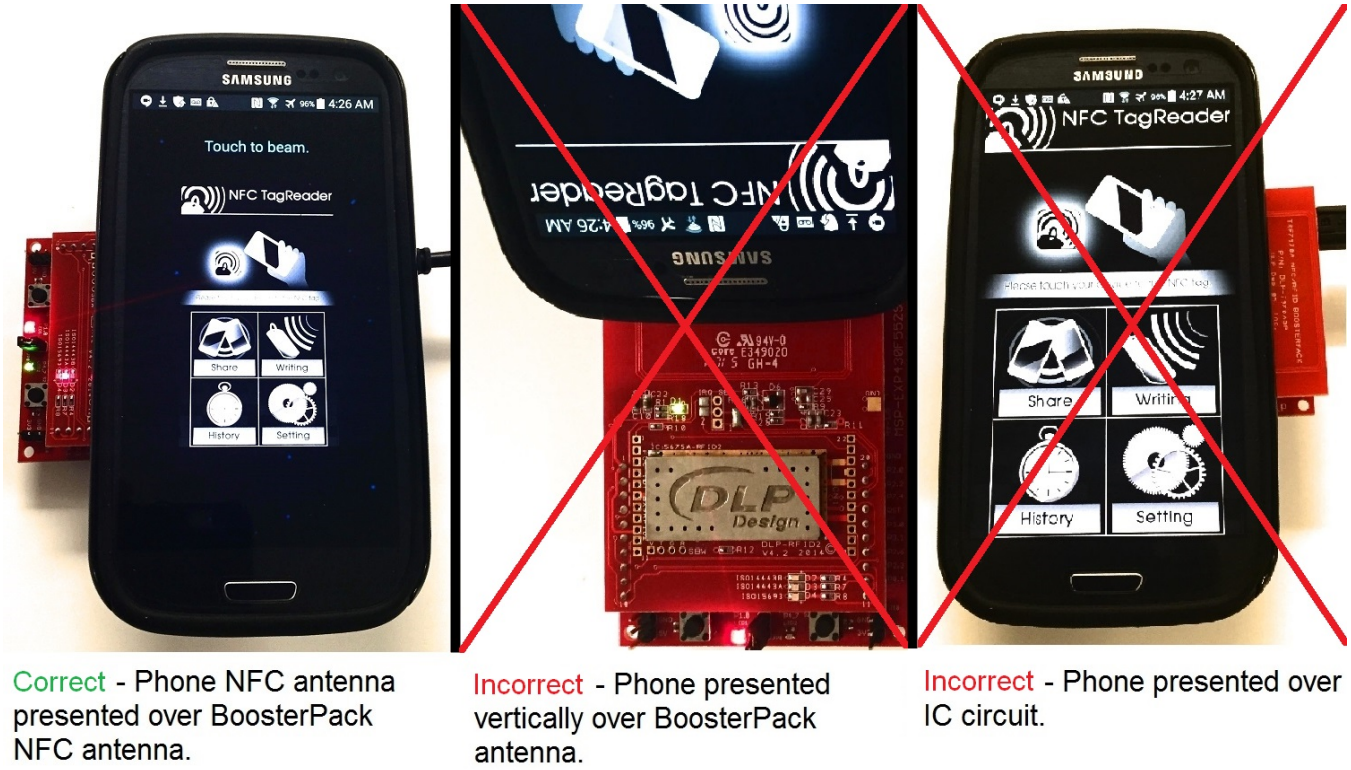


Figure 12. Phone Correct and Incorrect Presentation to BoosterPack™ Plug-in Module

Copyright © 2016, Texas Instruments Incorporated
Downloaded from www.Manualslib.com manuals search engine

Figure 13 shows the proper presentation of a tag to the BoosterPack plug-in module. Similar to the NFC enabled phone, robust communication does not occur when the tag is presented to the IC circuit. Also, if the tag is presented beneath the LaunchPad development kit, it is on the edge of the NFC communication range of the BoosterPack plug-in module, and the LaunchPad development kit ground plane shields the NFC communication.



Figure 13. Tag Correct and Incorrect Presentation to BoosterPack™ Plug-in Module

Figure 14 shows the correct and incorrect presentation of two BoosterPack plug-in modules. When two BoosterPack plug-in modules are used, the antennas on the BoosterPack plug-in modules should be aligned on top of each other. The antennas have weaker coupling when placed side-by-side horizontally or vertically.

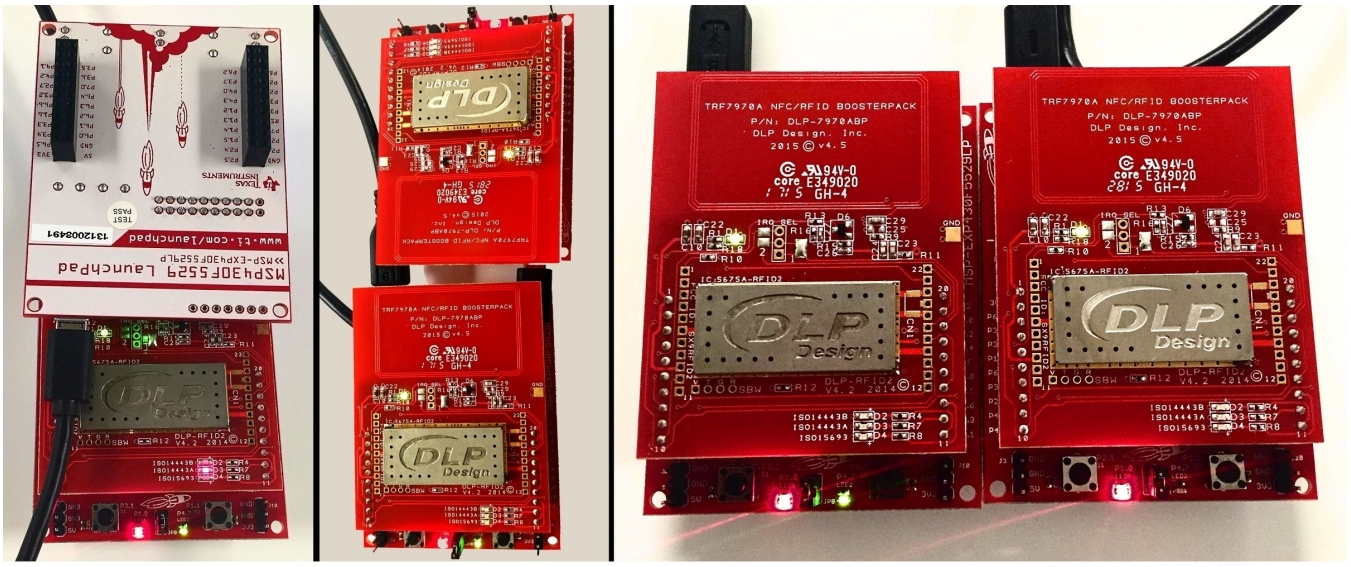


Figure 14. BoosterPack™ Plug-in Module Correct and Incorrect Presentation to BoosterPack™ Plug-in Module

Copyright © 2016, Texas Instruments Incorporated
Downloaded from www.Manualslib.com manuals search engine

3.3 NFC Operation Modes

Near Field Communication (NFC) offers three different modes of operation: Peer-to-Peer (P2P), Reader/Writer (RW), and Card Emulation (CE). This section discusses operation of each mode with the NFCLink Standalone GUI. For more information on NFC, visit www.ti.com/NFC.

3.3.1 Peer-to-Peer Mode

Peer-to-Peer (P2P) mode allows two NFC-enabled devices to communicate bidirectionally where both devices are able to initiate communication as needed.

Common use cases for P2P include sharing content from device to device, firmware updates, and pairing applications.

For detailed information about how Peer-to-Peer communication operates with the TRF7970A, see *NFC Active and Passive Peer-to-Peer Communication Using the TRF7970A*.

3.3.1.1 NFC Configuration Tab

The *Target Mode(s)* and *Initiator Mode(s)* allow the user to select multiple modes that determine if the TRF7970A acts as a target or an initiator and if passive or active communication is used (see Figure 15). After selecting which modes to enable, click *Start P2P*. The NFC enabled devices poll or listen based on the selected P2P modes.

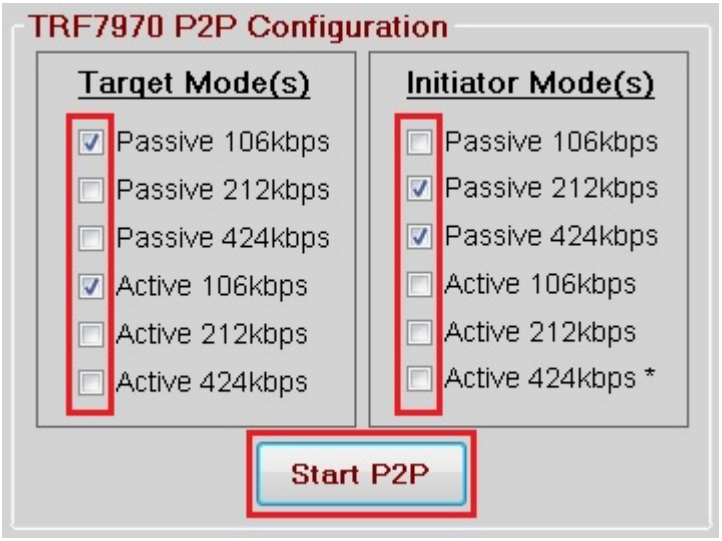


Figure 15. NFC Configuration Tab – P2P Configuration

3.3.1.2 Peer-to-Peer-Tab

When Peer-to-Peer mode is enabled and a connection is established between the TRF7970A and an NFC device that is presented, the Peer-to-Peer tab automatically opens (see Figure 16). The *P2P Status* pane includes information about the current mode, bitrate, technology, bytes received since the P2P communication started, and the RSSI value. The Receive pane displays P2P messages received by the TRF7970A.

When NFC Data Exchange Format (NDEF) messages are received, the GUI attempts to parse the data and display it in ASCII. Text and URI Record Type Definitions (RTDs) are automatically parsed. Other NDEF messages are displayed as an unknown RTD. Any non-NDEF formatted messages is shown in the pane as raw data. Any NDEF messages received can also be found inside the NDEF.hex file located at [*Install Path*] *\tools\TI NFC Tool\TI NFC Tool\bin\Debug*.

Most NFC enabled smartphone apps use the NDEF message format to exchange information over P2P communication such as text messages and URLs.

Copyright © 2016, Texas Instruments Incorporated

Downloaded from www.Manualslib.com manuals search engine

The *Transmit* pane supports sending out Text RTDs or URI RTDs from the TRF7970A to the connected NFC device. The GUI limits the message length to 246 bytes.

When the NFC device is removed, then the Peer-to-Peer tab automatically switches back to the NFC Configuration tab.

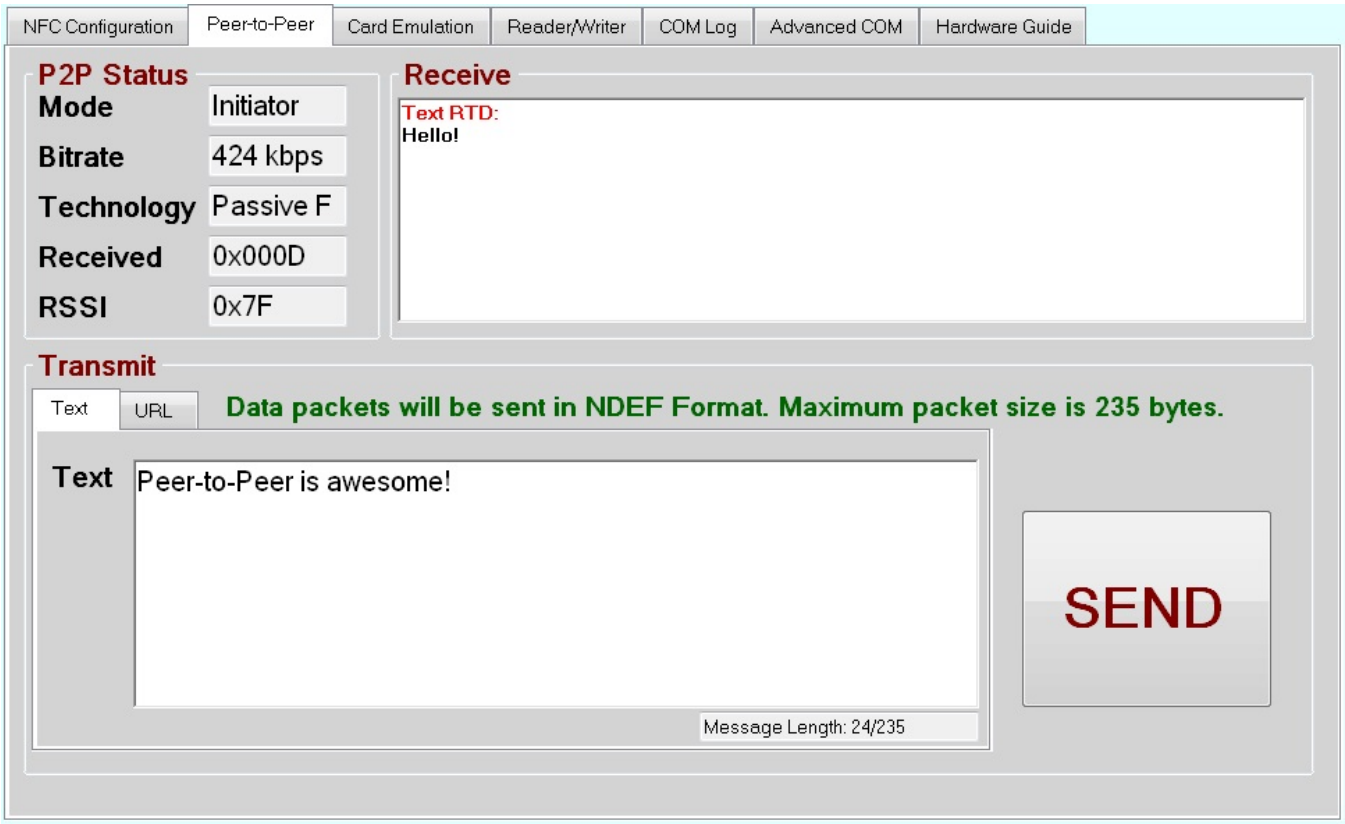


Figure 16. Peer-to-Peer Tab

3.3.2 Reader/Writer Mode

Reader/Writer mode allows an NFC enabled device to read data from and write data to various NFC and RFID tags, transponders, and contactless smartcards. Supported standard tag types are:

- NFC Forum Type 2 Tags (T2T)/ISO14443A
- NFC Forum Type 3 Tags (T3T)/FeliCa
- NFC Forum Type 4A Tags (T4TA)/ISO14443A
- NFC Forum Type 4B Tags (T4TB)/ISO14443B
- NFC Forum Type V Tags (T5T)/ISO15693

Common use cases for Reader/Writer mode include access control, product authentication, and pairing applications.

For detailed information about how Reader/Writer mode operates with the TRF7970A, see *NFC/HF RFID Reader/Writer Using the TRF7970A*.

Copyright © 2016, Texas Instruments Incorporated
Downloaded from www.Manualslib.com manuals search engine

3.3.2.1 NFC Configuration Tab

Use the check boxes in the Reader/Writer section to choose which technologies to enable for the TRF7970A and then click the Start RW button (see Figure 17). Only one NFC/RFID tag should be presented to the RF field at a time when using Reader/Writer mode.

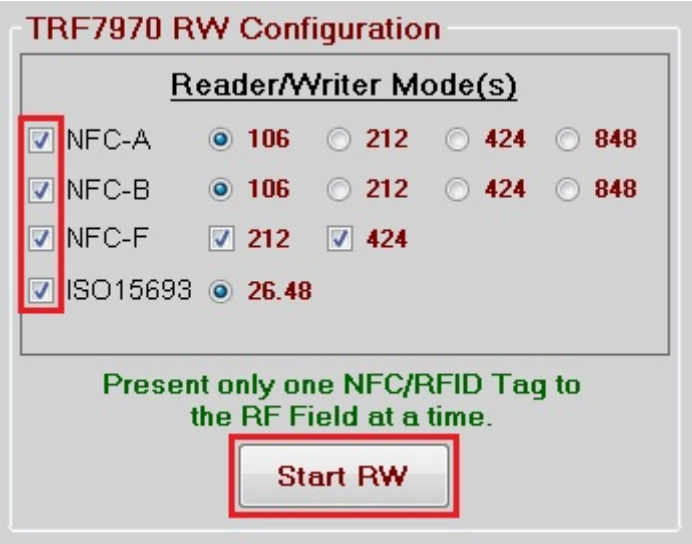


Figure 17. NFC Configuration Tab – RW Configuration

3.3.2.2 Reader/Writer Mode Tab

When Reader/Writer mode is enabled and a supported NFC tag is presented, the Reader/Writer tab automatically opens (see Figure 18). The *RW Status* pane includes information about the tag type being read, bitrate of the communication, NFC technology, RSSI value, and Unique Identifier (UID) of the tag.

The *Tag Content* pane displays the contents of a tag that has been read when applicable. If an NDEF message is stored inside the tag, the GUI attempts to parse the message and display it in ASCII. Text and URI RTDs are automatically parsed. Other NDEF messages are displayed as an unknown RTD. If the tag is not NDEF formatted, then the pane displays all raw data read from the tag. Any NDEF messages received can also be found inside the NDEF.hex file located at: *[Install Path]\tools\TI NFC Tool\TI NFC Tool\bin\Debug*

The *Tag Write* pane can be used to write a custom Text RTD or URI RTD to a presented tag by pressing the WRITE button. The Tag Content screen displays a message to indicate whether or not the write was successful. The GUI limits the message length to 246 bytes. It also can be used to format T5T tags for NDEF messages with the FORMAT button.

When the tag is removed, then the Reader/Writer tab automatically switches back to the NFC Configuration tab.

Copyright © 2016, Texas Instruments Incorporated

Downloaded from www.Manualslib.com manuals search engine

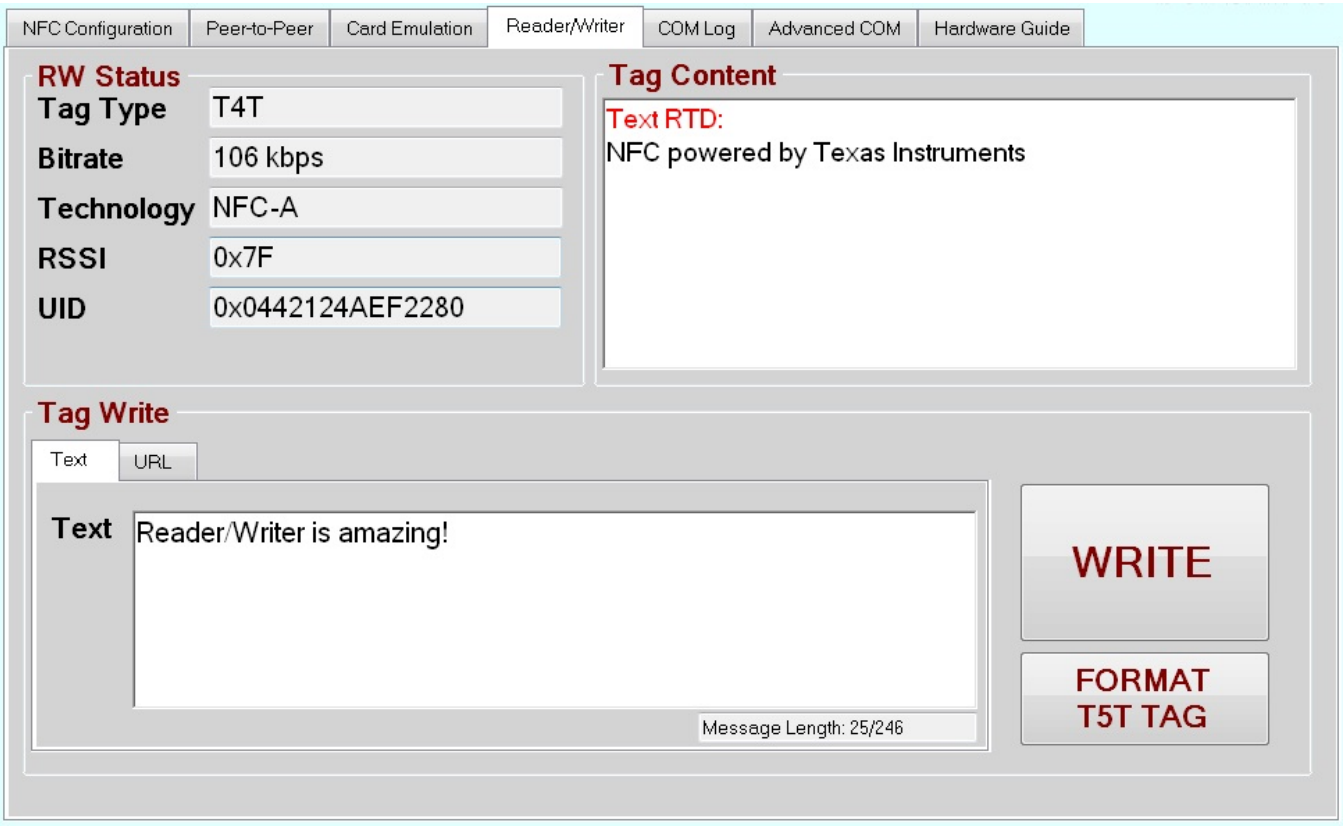


Figure 18. Reader/Writer Mode Tab

3.3.3 Card Emulation Mode

Card Emulation mode allows NFC transceivers to emulate and behave as an NFC transponder/tag, which can be read by other NFC enabled Reader/Writer devices.

Common use cases for Card Emulation mode include access control, pairing applications, and authentication applications.

For detailed information about how Card Emulation mode operates with the TRF7970A, see *NFC Card Emulation Using the TRF7970A*.

Copyright © 2016, Texas Instruments Incorporated
Downloaded from www.Manualslib.com manuals search engine

3.3.3.1 NFC Configuration Tab

To change between the different CE modes, use the checkboxes to select the desired modes and then click on Start CE (see Figure 19). *Card Emulation A* emulates a Type 4A Tag (ISO/IEC 14443A tag) and *Card Emulation B* emulates a Type 4B Tag (ISO/IEC 14443B tag).

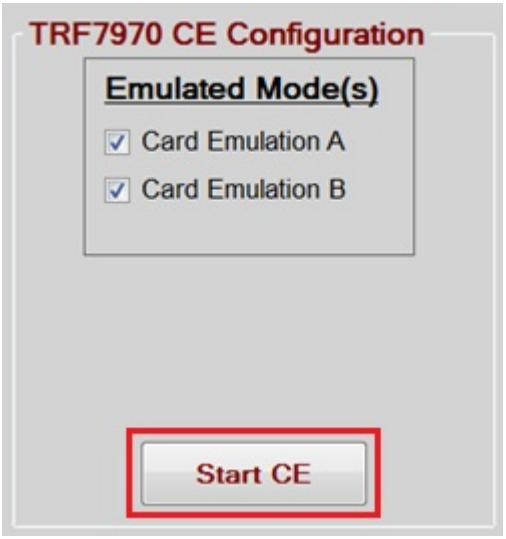


Figure 19. NFC Configuration Tab – CE Configuration

3.3.3.2 Card Emulation Tab

When Card Emulation mode is enabled and an NFC device capable of reading the emulated tag is presented, the Card Emulation tab automatically opens (see Figure 20). The *CE Status* pane includes information about the tag type being emulated, the bitrate of the communication, which NFC technology is being used, the RSSI value, and the emulated Unique Identifier (UID).

The *Received Read/Write Cmds* pane displays each command being sent to the TRF7970A by the NFC device. Read and Write commands are both displayed along with details about which files are being read and how many bytes are read from them.

The *Emulated Content* pane can be used to emulate a custom message that can be either a Text RTD or URI RTD. The message length is limited to 248 bytes in the GUI.

When the NFC device is removed, then the Card Emulation tab automatically switches back to the NFC Configuration tab.

Copyright © 2016, Texas Instruments Incorporated

Downloaded from www.Manualslib.com manuals search engine

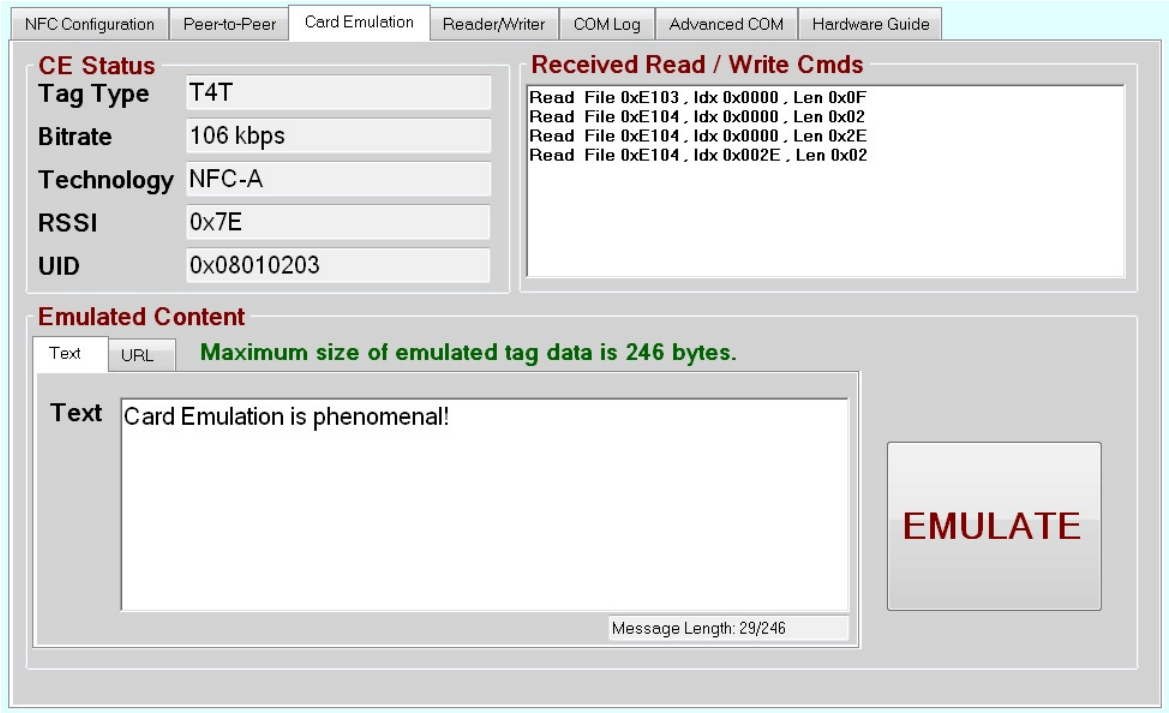


Figure 20. Card Emulation Tab

3.3.4 Advanced COM

The Advance COM Tab can be used to display a list of all COM port names and the COM port numbers for connected devices (see Figure 21). Click Refresh Available COM after opening the tab to see the latest list of devices. This list is similar to what is seen inside of Device Manager under Ports (COM & LPT), but displays only COM ports.

If the example firmware has been loaded and the CDC driver has been installed, then this tab can be used to manually connect to the MSP-EXP430F5529LP if the Auto Connect feature does not work.

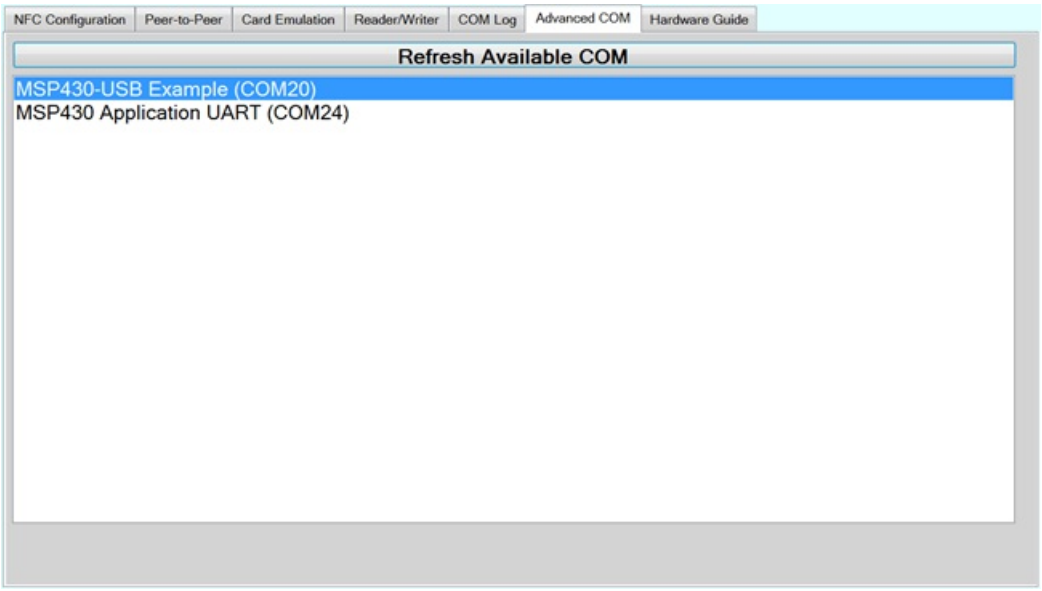


Figure 21. Advanced COM Tab

Copyright © 2016, Texas Instruments Incorporated
Downloaded from www.Manualslib.com manuals search engine

4 Summary

After the NFCLink Standalone GUI has been set up, refer to the following resources for further assistance in development:

1. NFC Active and Passive Peer-to-Peer Communication Using the TRF7970A
2. NFC/HF RFID Reader/Writer Using the TRF7970A
3. NFC Card Emulation Using the TRF7970A

Copyright © 2016, Texas Instruments Incorporated

Downloaded from www.Manualslib.com manuals search engine

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2016, Texas Instruments Incorporated

Downloaded from www.Manualslib.com manuals search engine