TI Designs
Dynamic Field-Powered NFC Reference Design for Data Logging, Access Control, and Security Applications

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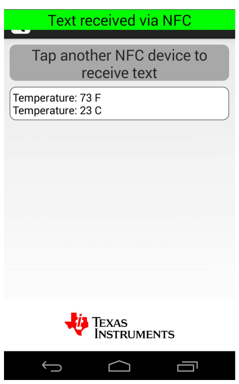
Design Resources

TIDA-00217	Tool Folder Containing Design Files
RF430CL330H	Product Folder
MSP430FR5969	Product Folder
TMP103	Product Folder
TPD1E10B06	Product Folder



Design Features

- RF430CL330H Dynamic NFC Transponder Enables Static Tag Emulation
- NFC Type 4B Compliant
- NFC/RFID Protocol Handled in ROM Code
- Passive or Active Operational Modes
- Wireless Sensor Interface
- Uses Either Field or Bus Power

Featured Applications

- Replacement Part Authentication
- Access Control and Accountability
- Personal Identification
- Battery-less Sensor Interface
- Security token Transfer
- BLE / Wifi Connection Handover
- Low Power Transfer of Local Data
  – Genuine Part Identification, Maintenance Data, Inspection Data

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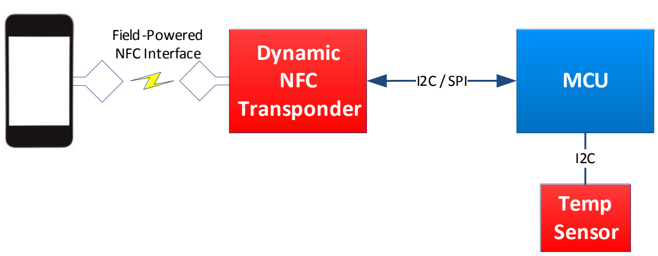
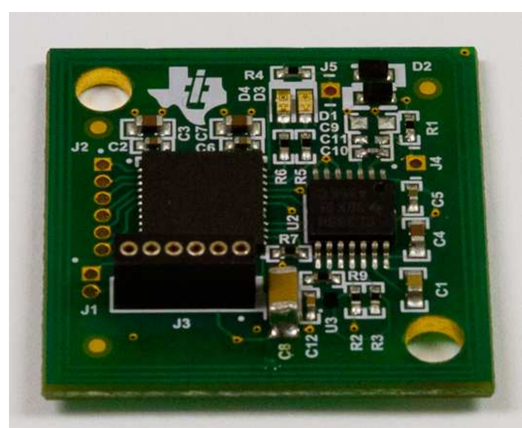




An IMPORTANT NOTICE at the end of this TI reference design addresses authorized use, intellectual property matters and other important disclaimers and information.

1 Key Specifications

PARAMETER	SPECIFICATIONS and FEATURES	DETAILS
Field Power Supply Range	2–2.9 V only available while RF field present	See Section 4.2
Bus Power Supply Range	2–3.6 Vdc, 3 V Nominal	
Typical Read/Write Distance	~ 1–5 cm	See Section 6
RF Protocol	ISO14443B	See Section 3.1.1
Data Rate	106-848kbps	See Section 3.1.1
Typical Data Throughput	Write: 2.0 – 4.8 kBps	See Section 6.1
	Read: 2.3 – 6.2 kBps	
NFC Operating Frequency	13.56 MHz	See Section 3.1.1
Memory	3 KB SRAM (RF430CL), 64 KB FRAM (MSP430FR)	See Section 3.1.1 and Section 3.1.2
Wired Interface from Transponder to Application Processor	SPI, I^2C	See Section 3.1.1
Form Factor	1 x 1 inch square PCB	See Section 10
Field Power Source	NFC Compliant Phone or Tablet	See Table 2
Temperature Sensor Type and Range	Ambient sensor from –10°C to +100°C	See Section 4.1.4

2 System Description

In many systems, it is imperative that only authentic, inspected, and properly maintained parts are utilized. It is also desirable to enable wireless, field-powered data transfer in order to prevent powering up systems that could have safety risks to human operators. Near Field Communication (NFC) represents an ideal solution for both these problems.

This reference design describes the implementation of a subsystem capable of storing such information and communicating this data to the outside world by way of NFC or I^2C/SPI/UART to a connected host controller. The proliferation of NFC enabled devices in the consumer and industrial markets makes NFC a commonly available communication interface which offers the benefits of low power, small form factor, and low cost. In addition to providing replacement part identification, a digital temperature sensor is available for localized sensor data. This reference design addresses component selection, antenna design, proper data encapsulation, and power management.

The system-level challenges for this design include proper antenna design, power management, and timing requirements to meet a large variety of NFC Reader/Writer devices ranging from NFC enabled phones or tablets to custom designed handheld units.

3 Block Diagram

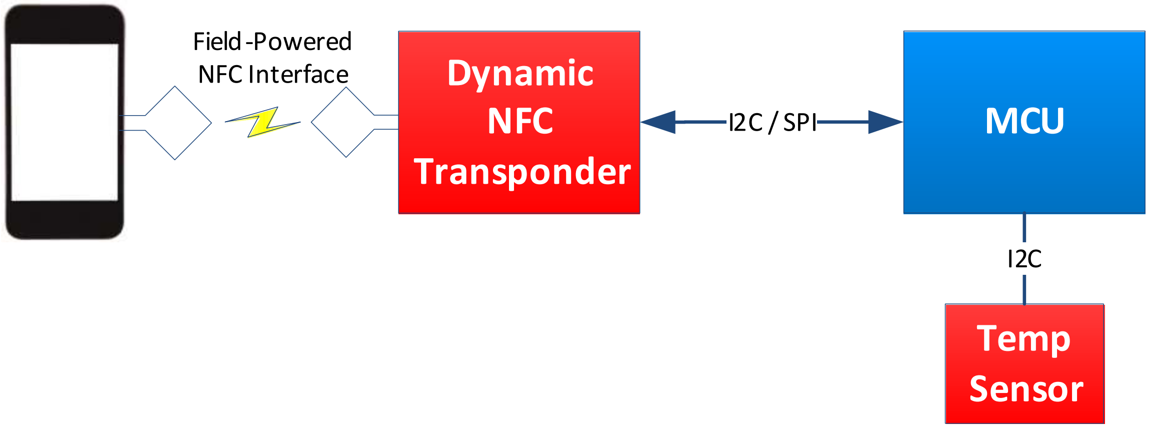


Figure 1. System Block Diagram

3.1 Highlighted Products

Dynamic Field-Powered NFC Reference Design for Data Logging, Access Control, and Security Applications features the following devices:

- **RF430CL330H**
  - Dynamic NFC Interface Transponder
- **MSP430FR5969**
  - FRAM Mixed Signal Microcontroller
- **TMP103**
  - Digital Temperature Sensor with I^2C/SMBUS Expanded Interface
- **TPD1E10B06**
  - Single Channel ESD in 0402 package with 10 pF Capacitance and 6 V Breakdown

For more information on each of these devices, see the respective product folders at www.ti.com.

3.1.1 RF430CL330H Features

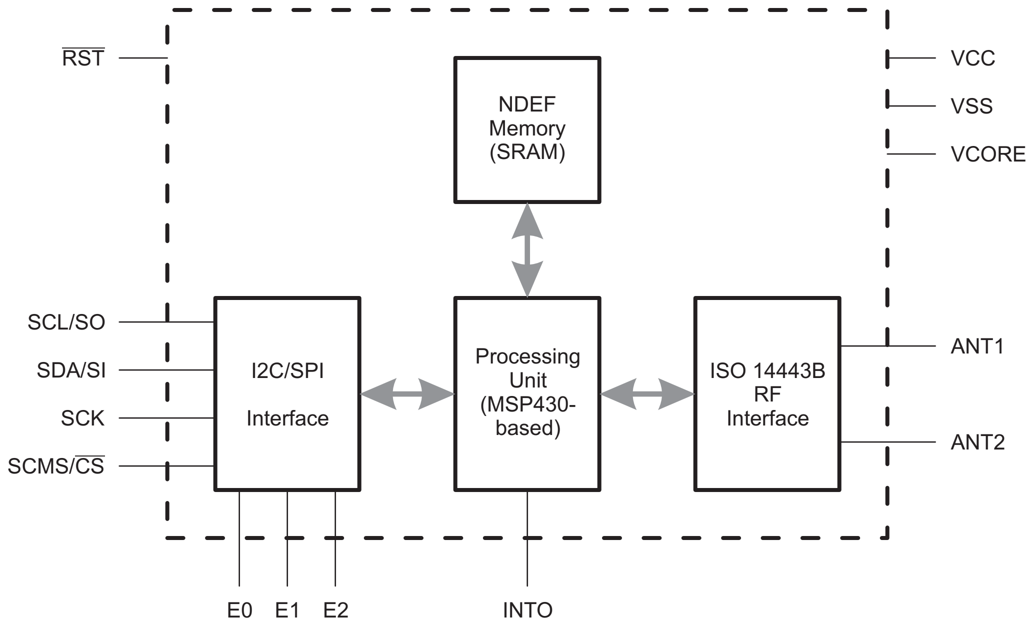


Figure 2. RF430CL330H Block Diagram

- NFC Tag Type 4B
- ISO14443B Compliant 13.56-MHz RF Interface Supporting up to 848 kbps
- SPI or I^{2}C Interface to Write and Read NDEF Messages to Internal SRAM
- 3KB SRAM for NDEF Messages
- Automatic Checking of NDEF Structure
- Interrupt Register and Output Pin to Indicate NDEF Read or Write Completion

3.1.2 MSP430FR5969 Features

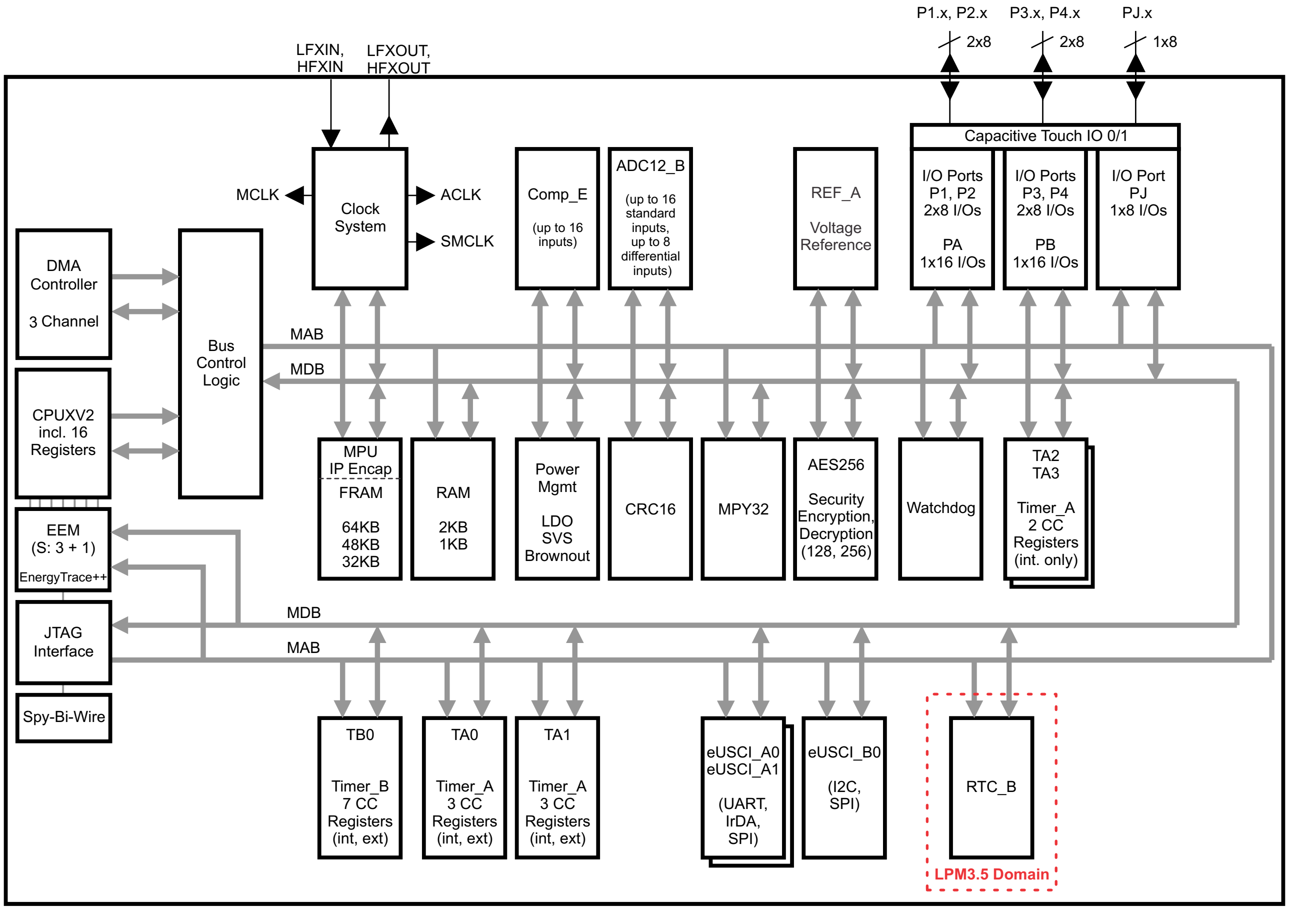


Figure 3. MSP430FR5969 Block Diagram

- Embedded Microcontroller
  - 16-Bit RISC Architecture up to 16-MHz Clock
  - Wide Supply Voltage Range (1.8 V to 3.6 V)
- Optimized Ultralow-Power Modes
- Ultralow-Power Ferroelectric RAM (FRAM)
  - Up to 64KB Nonvolatile Memory
  - Ultralow-Power Writes
  - Fast Write at 125 ns Per Word (64KB in 4 ms)
  - Unified Memory = Program + Data + Storage in One Single Space
  - 10^{15} Write Cycle Endurance
  - Radiation Resistant and Nonmagnetic
- Intelligent Digital Peripherals
  - 32-Bit Hardware Multiplier (MPY)
  - Three-Channel Internal DMA
  - Real-Time Clock (RTC) With Calendar and Alarm Functions
  - Five 16-Bit Timers With up to Seven Capture/Compare Registers Each
  - 16-Bit Cyclic Redundancy Checker (CRC)

- High-Performance Analog
  - 16-Channel Analog Comparator
  - 14-Channel 12-Bit Analog-to-Digital Converter (ADC) With Internal Reference and Sample-and-Hold
    - 200 ksps at 75-µA Consumption
- Multifunction Input/Output Ports
  - All Pins Support Capacitive Touch Capability With No Need for External Components
  - Accessible Bit-, Byte-, and Word-Wise (in Pairs)
  - Edge-Selectable Wake From LPM on All Ports
  - Programmable Pullup and Pulldown on All Ports
- Code Security and Encryption
  - 128-Bit or 256-Bit AES Security Encryption and Decryption Coprocessor (MSP430FR59xx Only)
  - Random Number Seed for Random Number Generation Algorithms
- Enhanced Serial Communication
  - eUSCI_A0 and eUSCI_A1 Support
    - UART With Automatic Baud-Rate Detection
    - IrDA Encode and Decode
    - SPI at Rates up to 10 Mbps
  - eUSCI_B0 Supports
    - I^2C With Multiple Slave Addressing
    - SPI at Rates up to 8 Mbps
  - Hardware UART and I^2C Bootstrap Loader (BSL)
- Flexible Clock System
  - Fixed-Frequency DCO With 10 Selectable Factory-Trimmed Frequencies
  - Low-Power Low-Frequency Internal Clock Source (VLO)
  - 32-kHz Crystals (LFXT)
  - High-Frequency Crystals (HFXT)
- Development Tools and Software
  - Professional Development Environments
  - Development Kit (MSP TS430RGZ48C)
- For Complete Module Descriptions, see the SP430FR58xx, MSP430FR59xx, MSP430FR68xx, and MSP430FR69xx Family User's Guide (SLAU367)

3.1.3 TMP103 Features

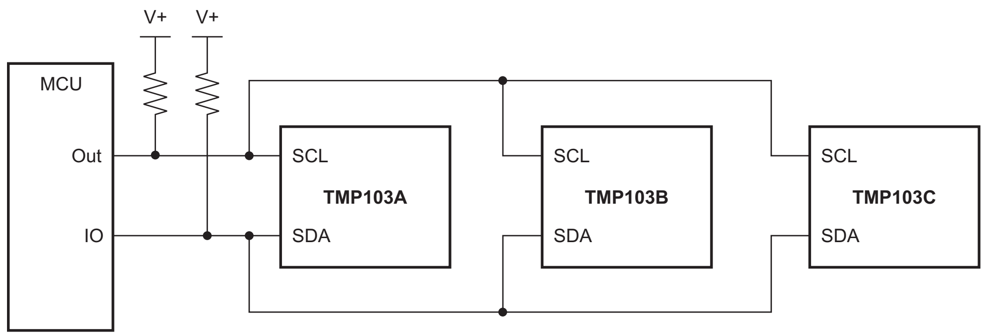


Figure 4. TMP103 Block Diagram

- Multiple Device Access (MDA):
  - Global Read/Write Operations
- I²C™-/SMBus™-Compatible Interface
- Resolution: 8 Bits
- Accuracy: ±1°C Typ (–10°C to +100°C)
- Low Quiescent Current:
  - 3 µA Active IQ at 0.25 Hz
  - 1 µA Shutdown
- Supply Range: 1.4 V to 3.6 V
- Digital Output
- Package: 4-Ball WCSP (DSBGA)

3.1.4 TPD1E10B06 Features

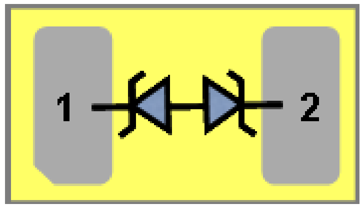


Figure 5. TPD1E10B06 Block Diagram

- Provides System Level ESD Protection for Low-voltage IO Interface
- IEC 61000-4-2 Level 4
  - ±30kV (Air-Gap Discharge)
  - ±30kV (Contact Discharge)
- IEC 61000-4-5 (Surge): 6A (8/20µs)
- IO Capacitance 12 pF (Typ)
- R_{DYN} 0.4 Ω (Typ)
- DC Breakdown Voltage ±6 V (Min)
- Ultra Low Leakage Current 100 nA (Max)
- 10 V Clamping Voltage (Max at I_{PP} = 1A)
- Industrial Temperature Range: –40°C to 125°C
- Space Saving 0402 Footprint (1.0 mm × 0.6 mm × 0.5 mm)

4 System Design Theory

4.1 Component Selection

4.1.1 Dynamic Interface Transponder

The RF430CL330H Dynamic NFC Interface Transponder is an NFC Tag Type 4B device that combines a wireless NFC interface and a wired SPI or I^2C interface to connect the device to a host. The NDEF message in the SRAM can be written and read from the integrated SPI or I^2C serial communication interface and can also be accessed and updated wirelessly via the integrated ISO14443B-compliant RF interface that supports up to 848 kbps. The RF430CL330H was chosen to allow for a low cost, dual interface (wired and wireless) transponder which allows for communication to/from a host controller. This functionality is not possible with a standard passive NFC transponder (wireless only).

4.1.2 Rectification Diodes

To power the microcontroller and temperature sensor by way of the NFC field, the AC voltage on the antenna must be converted to DC using a bridge rectifier. To keep the voltage drop as low as possible, general purpose schottky diodes are used with a typical drop of 0.4 V.

4.1.3 Microcontroller Selection

The MSP430 ultra-low-power (ULP) FRAM platform combines uniquely embedded FRAM and a holistic ultra-low-power system architecture, allowing innovators to increase performance at lowered energy budgets. FRAM technology combines the speed, flexibility, and endurance of SRAM with the stability and reliability of flash at much lower power. The MSP430FR5969 was chosen for the large (64kB) amount of non-volatile memory along with ultra-low power operation, which is important when powering the device from the NFC field.

4.1.4 Digital Temperature Sensor

The TMP103 digital temperature sensor device was chosen to enable temperature measurements in theDynamic Field-Powered NFC Reference Design for Data Logging, Access Control, and Security Applications. The TMP103 device is a digital output temperature sensor in a four-ball wafer chip-scale package (WCSP). The TMP103 device is capable of reading temperatures to a resolution of 1°C, with only 3 uA active quiescent current at 0.25 Hz. For minimal cost, board space, and current consumption, the addition of the TMP103 device to the subsystem allows for accurate measurements whether powered from the NFC field or wall/battery.

4.1.5 ESD Protection

The TPD1E10B06 Single Channel ESD protection device was chosen to protect the Spy Bi-Wire (2-wire JTAG) programming interface. The device offers over ±30KV IEC air-gap, over ±30KV contact ESD protection, and has an ESD clamp circuit with a back-to-back diode for bipolar or bidirectional signal support. The 10 pF line capacitance is suitable for a wide range of applications supporting data rates up to 400 Mbps. The 0402 package is industry standard and convenient for component placement in space saving applications. The TPD1E10B06 is characterized for operation over ambient air temperature of –40°C to 125°C.

4.2 Field Power

In order to operate from field power, AC voltage on the antenna is rectified to DC using a half bridge rectifier. The schematic snippet below shows the external rectifier diodes and storage capacitor as used in this reference design. It is important to use Schottky diodes for minimal voltage loss. The RF430CL330H internally limits the voltage to 3 V, which provides ~2.6 V to the connected microcontroller after the ~0.4 V drop from the schottky diodes.

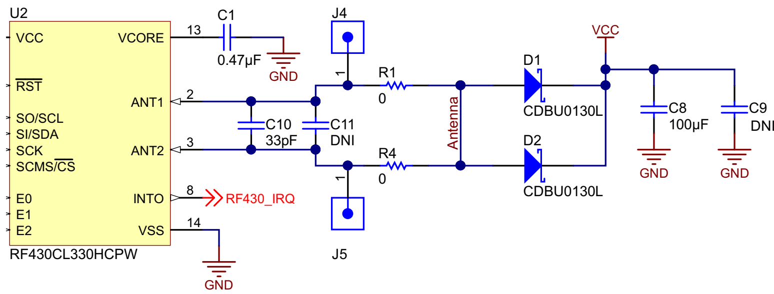


Figure 6. Half Bridge Rectifier

4.3 Antenna Design

In order to keep a small form factor, this reference design utilizes an antenna coil wrapped around the outside edge of the PCB instead of a separated antenna coil. This design allows for the largest antenna size and maximizes usage of available PCB area. When designing such an antenna, it is important to keep spacing of at least 3mm from large ground plane areas for optimum range performance. The measured antenna coil inductance and resulting tuning capacitor are shown below. For more information regarding antenna design, see Application Report, *RF430CL330H Practical Antenna Design Guide* (SLOA197).

Lant = 1.97 µH

Ctune = 33 pF

4.4 NDEF Data Encapsulation

The NFC Forum defines a data format for NFC messages called NDEF (NFC Data Exchange Format). Utilization of a common data format allows for all NFC compliant devices to exchange data in a "well known" format. NDEF allows for many different record types ranging from simple text records, URL, Vcard, and Bluetooth Connection Handover just to name a few. In this document, we will utilize the short text record type. This format is shown in Figure 7.

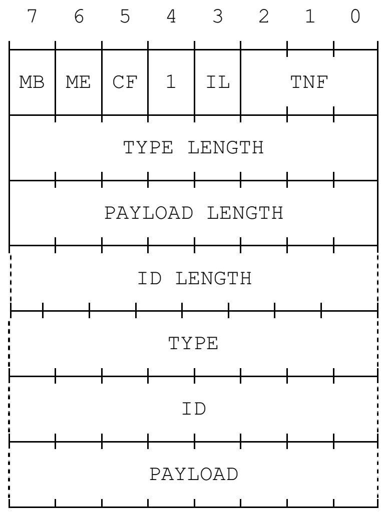


Figure 7. NDEF Record Format

NDEF messages are written in the RF430CL330H SRAM by way of the I^2C interface and then read out by way of the NFC wireless interface or vice versa. A simple "Hello, World!" text record example is shown in Figure 8. When changing the NDEF message, it is important to properly update the appropriate fields, especially length fields. If these fields are not properly formatted, the NDEF parser in the NFC reader device will not parse the data correctly. For additional details of NDEF, please refer to the NDEF specification available from the NFC Forum.

```
/* NDEF File for Hello, World! */
0x00, 0x14, /* NLEN; NDEF length (20 byte long message) */
0xD1, /* Record Header */
0x01, /* Type Length (1 byte) */
0x10, /* Payload Length (16 bytes) */
0x54, /* Type T = text */
0x02, /* Start of Payload, Status Byte (UTF-8, 2 byte language code)*/
0x65, 0x6E, /* 'e', 'n', */

/* 'Hello, world!' NDEF data; Empty NDEF message, length should match NLEN*/
0x48, 0x65, 0x6C, 0x6C, 0x6f, 0x2c, 0x20, 0x77, 0x6f, 0x72, 0x6c, 0x64, 0x21
```

Figure 8. NDEF Message Example

4.5 Software Control

The Dynamic Field-Powered NFC Reference Design for Data Logging, Access Control, and Security Applications includes an example firmware project which provides communication from the MSP430FR5969 to the RF430CL330H and TMP103. This includes writing an example NDEF message and also formatting measured temperature data as NDEF. The MSP430 uses eUSCI_B0 (enhanced Universal Serial Communication Interface) to control both devices located on the same I^2C bus. Each device is selected as required using the unique I^2C address. The RF430CL330H is first initialized with the following steps. The associated C code can be seen in Figure 9.

1. Write NDEF message into SRAM starting at address 0x0000
2. Write Interrupt Enable register (enable end of write and end of read interrupts)
3. Write Interrupt Enable register (enable end of write and end of read interrupts)

```
/****************************************************************************/
/* Configure RF430CL330H for Typical Usage Scenario                         */
/****************************************************************************/

//write NDEF memory with Capability Container + NDEF message
Write_Continuous(0, FRAM_Message, 48);

//Enable interrupts for End of Read and End of Write//
Write_Register(INT_ENABLE_REG, EOW_INT_ENABLE + EOR_INT_ENABLE);

//Configure INTO pin for active low and enable RF
Write_Register(CONTROL_REG, INT_ENABLE + INTO_DRIVE + RF_ENABLE);
```

Figure 9. RF430CL330H Initialization Procedure

4.6 Temperature Management Implementation

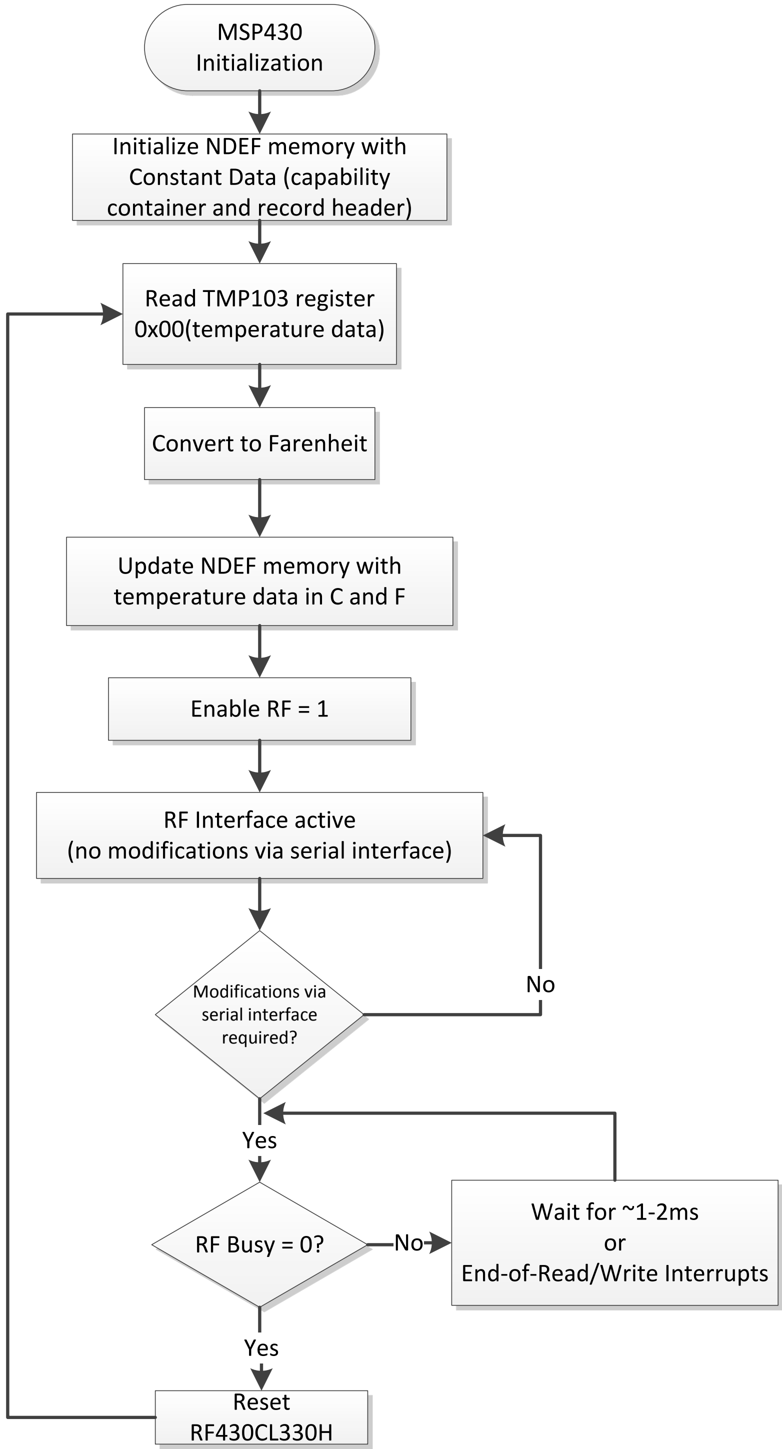


Figure 10. Temperature Measurement Firmware Flow

5 Getting Started

An MSP-FET must be used to program the Reference Design board.

The appropriate connections between the Reference Design hardware and the MSP-FET programming tool are shown in Table 1. For convenience, the pinout diagram of the MSP-FET debugger is shown in Figure 11. Once the electrical connections between the Reference Design board and the MSP-FET are complete, then Code Composer Studio can be used to program the board.

NOTE: Since the Reference Design uses the MSP430FR5969 microcontroller, the minimum-required version of Code Composer Studio is v6.0.

Table 1. TIDA-00217 and MSP-FET JTAG Connector Pin Numbers and Names

TIDA-00217 J3 PIN NUMBER	TIDA-00217 J3 PIN NAME	MSP-FET JTAG CONNECTOR PIN NUMBER	MSP-FET JTAG CONNECTOR PIN NAME
1	NC	-	-
2	VCC	2	VCC_TOOL
3	SBWTCK	7	TCK
4	SBWTDIO	1	TDO/TDI
5	GND	9	GND
6	NC	-	-

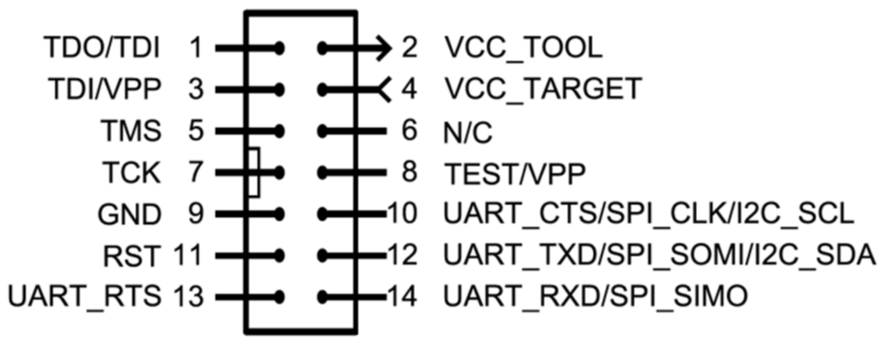


Figure 11. MSP-FET JTAG Connector Pinout

After programming the Reference Design board, all that is necessary is to place the board near an NFC-compliant device's NFC antenna. The message that is programmed into the reference design board will then automatically appear on the phone or tablet's screen.

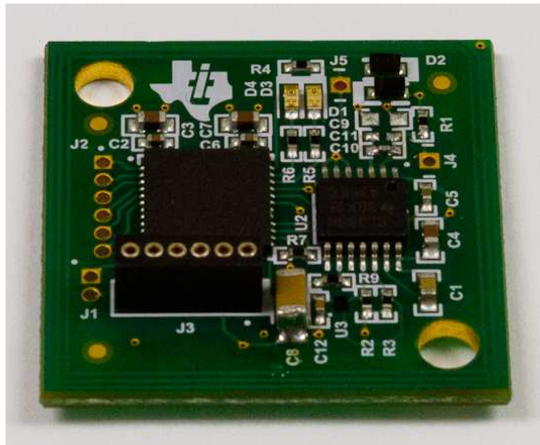


Figure 12. Dynamic Field-Powered NFC Reference Design for Data Logging, Access Control, and Security Applications Board

6 Test Results

The Reference Design was tested with several different NFC compliant devices, in order to determine the actual range of operation and data read/write throughput. Results for both field-powered and battery/line powered conditions are shown in this section for range of operation. The communication range of the reference design varies based on the NFC reader/writer implementation of each tested device.

Table 2. Communication Range

Phone/Tablet/Reader	Field Powered	Battery/Line Powered
Nexus 4	1.4 cm	2.1 cm
Nexus 5	1.4 cm	2.1 cm
Nexus 7	1.4 cm	1.9 cm
Samsung S4	1.3 cm	2.0 cm
TRF7970AEVM	3.0 cm	4.5 cm

6.1 Throughput Results

Data throughput varies based on the NFC reader/writer implementation of each tested device. The conditions for the data throughput testing are listed in Table 3, along with the test results for several NFC compliant devices.

- Data Rate: 106 kbps
- Payload size: 2,306 Bytes
- Start/End Time marks: ReqB command / Deselect response

Table 3. Data Throughput Rates

Phone/Tablet/Reader	Write Throughput	Read Throughput
Nexus 4	4.8 kBps	6.2 kBps
Nexus 5	3.1 kBps	4.1 kBps
Nexus 7	4.3 kBps	5.9 kBps
Samsung S4	2.0 kBps	2.3 kBps
TRF7970A (NFC Link)	2.3 kBps	4.5 kBps

6.2 Antenna Measurements

Figure 13 and Figure 14 show measurement results from the antenna tuning procedure. Antenna tuning is necessary in order to keep the antenna resonant at the NFC operating frequency of 13.82 MHz to maximize data and power transfer.

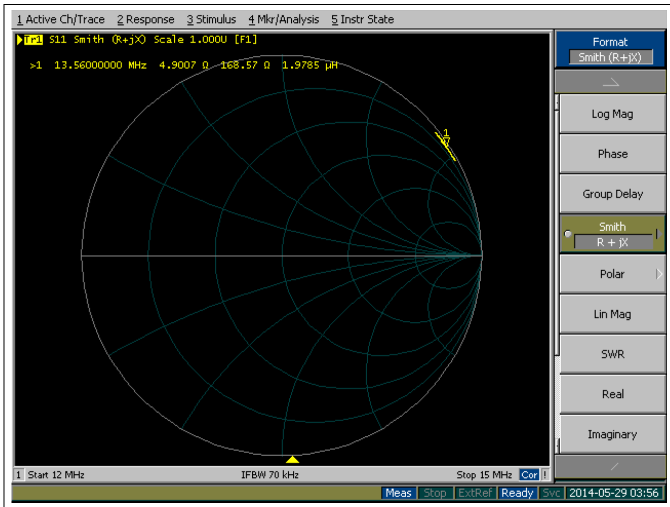


Figure 13. Coil Inductance (1.9785 µH)

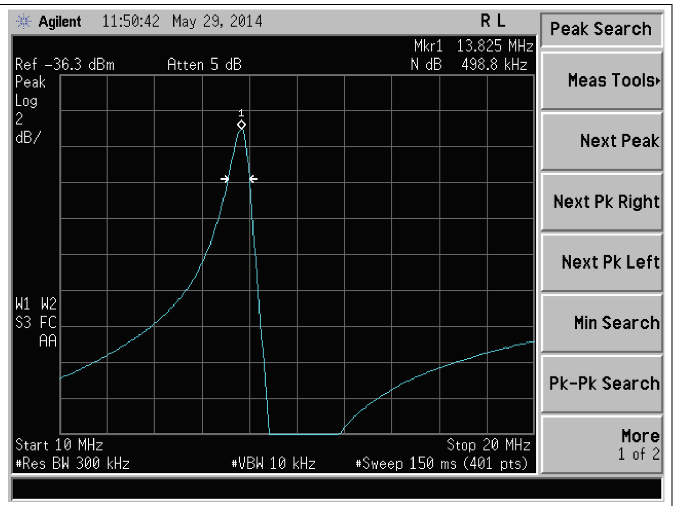


Figure 14. Resonant Frequency and Bandwidth

$$BW = f2 - f1$$

$$Q = \frac{fres}{BW}$$

$$Q = \frac{13.82\ MHz}{498.8\ kHz}$$

$$Q = 27.7 \tag{1}$$

6.3 Application Specific Results

As seen in Figure 15, the reference design transmits the local temperature data to the NFC-compliant device in both Celsius and Fahrenheit format. The firmware is written to re-transmit this data every four seconds while the Reference Design remains in the NFC RF field.

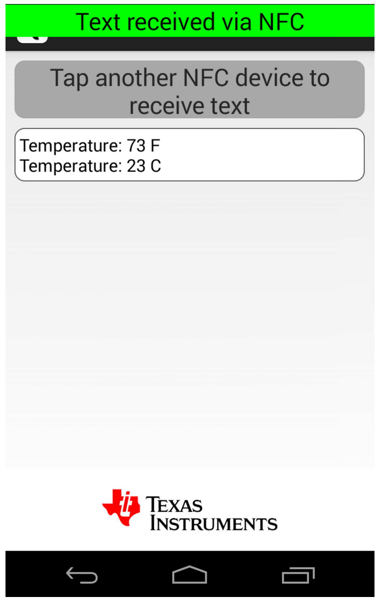


Figure 15. Temperature Application

In Figure 16, the Reference Design firmware is programmed to transmit a part authentication ID number. This demonstrates a supply chain part authentication application. Encryption of the data transmission is not implemented in this firmware, but is an easy addition with the MSP430FR5969 device's built-in AES module.

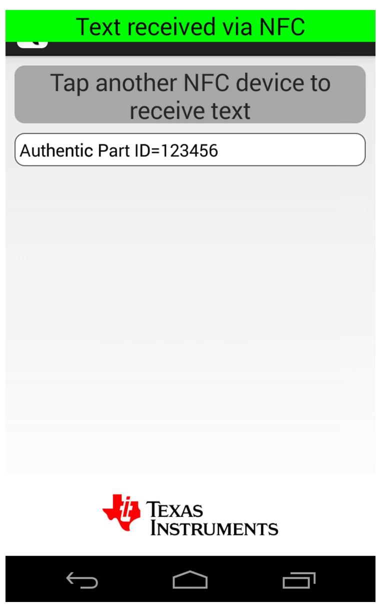


Figure 16. Part ID Authentication Application

7 Schematics

To download the schematics for the Dynamic Field-Powered NFC Reference Design for Data Logging, Access Control, and Security Applications, see the design files at TIDA-00217.

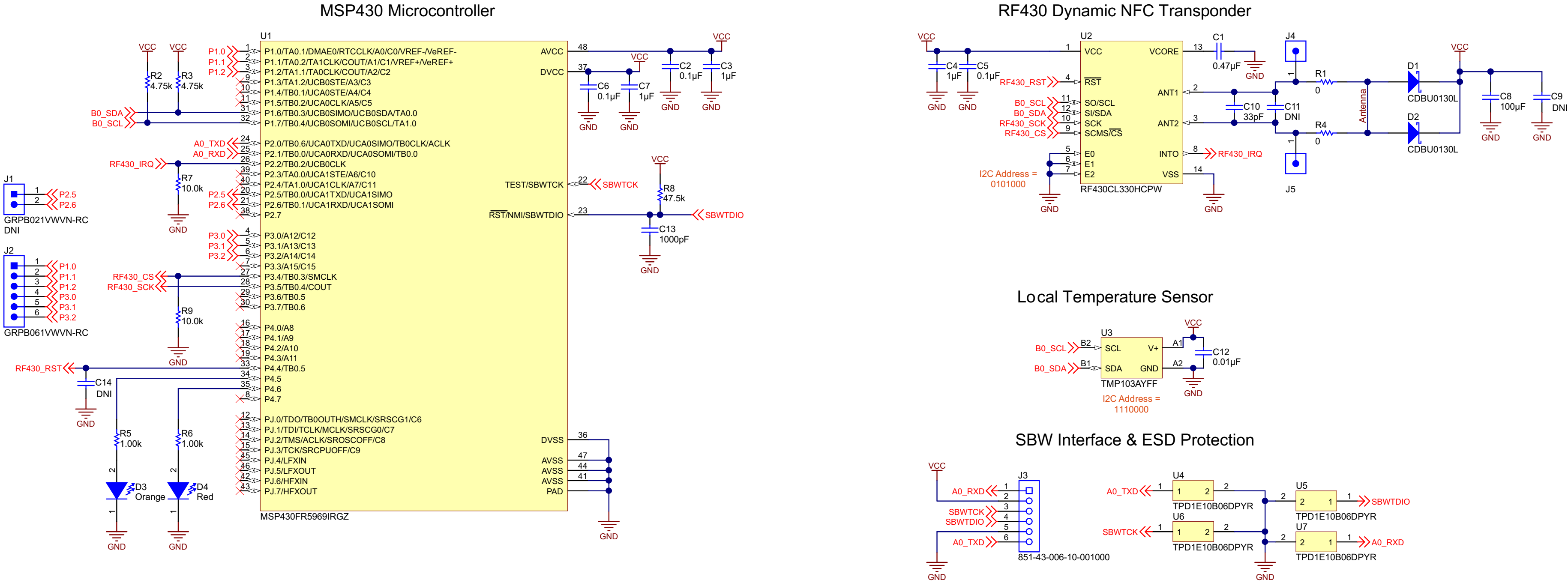


Figure 17. Dynamic Field-Powered NFC Reference Design for Data Logging, Access Control, and Security Applications Schematic

8 Bill of Materials

To download the bill of materials (BOM) for the Dynamic Field-Powered NFC Reference Design for Data Logging, Access Control, and Security Applications, see the design files at TIDA-00217. Table 4 shows the BOM for the reference design.

Table 4. BOM

Designator	Quantity	Value	Description	Package Reference	PartNumber	Manufacturer
!PCB	1		Printed Circuit Board		ISE4003	Any
C1	1	0.47uF	CAP, CERM, 0.47uF, 25V, +/-10%, X7R, 0603	0603	GRM188R71E474KA12D	MuRata
C2, C5, C6	3	0.1uF	CAP, CERM, 0.1uF, 16V, +/-10%, X7R, 0402	0402	GRM155R71C104KA88D	MuRata
C3, C4, C7	3	1uF	CAP, CERM, 1uF, 16V, +/-10%, X7R, 0603	0603	GRM188R71C105KA12D	MuRata
C8	1	100uF	CAP, CERM, 100uF, 10V, +/-20%, X5R, 1206_190	1206_190	C3216X5R1A107M160AC	TDK
C10	1	33pF	CAP, CERM, 33pF, 50V, +/-5%, C0G/NP0, 0402	0402	GRM1555C1H330JA01D	MuRata
C12	1	0.01uF	CAP, CERM, 0.01uF, 16V, +/-10%, X7R, 0402	0402	GRM155R71C103KA01D	MuRata
C13	1	1000pF	CAP, CERM, 1000pF, 16V, +/-10%, X7R, 0402	0402	GRM155R71C102KA01D	MuRata
D1, D2	2	35V	Diode, Schottky, 35V, 0.1A, SOD-523F	SOD-523F	CDBU0130L	Comchip Technology
D3	1	Orange	LED, Orange, SMD	1.6x0.8x0.8mm	SML-311DTT86	Rohm
D4	1	Red	LED, Red, SMD	LED,1.6x.8x.8mm	SML-311UTT86	Rohm
J3	1		Receptacle, 6x1, 50mil, TH	Receptacle, 6x1, 50mil, TH	851-43-006-10-001000	Mill-Max
R1, R4	2	0	RES, 0 ohm, 5%, 0.063W, 0402	0402	CRCW04020000Z0ED	Vishay-Dale
R2, R3	2	4.75k	RES, 4.75k ohm, 1%, 0.063W, 0402	0402	CRCW04024K75FKED	Vishay-Dale
R5, R6	2	1.00k	RES, 1.00k ohm, 1%, 0.063W, 0402	0402	CRCW04021K00FKED	Vishay-Dale
R7, R9	2	10.0k	RES, 10.0k ohm, 1%, 0.063W, 0402	0402	CRCW040210K0FKED	Vishay-Dale
R8	1	47.5k	RES, 47.5k ohm, 1%, 0.063W, 0402	0402	CRCW040247K5FKED	Vishay-Dale
U1	1		Mixed Signal Microcontroller, RGZ0048B	RGZ0048B	MSP430FR5969IRGZ	Texas Instruments
U2	1		DYNAMIC NFC INTERFACE TRANSPONDER, PW0014A	PW0014A	RF430CL330HCPW	Texas Instruments
U3	1		Low-Power, Digital Temperature Sensor with Two-Wire Interface in WCSP, YFF0004AAAA	YFF0004AAAA	TMP103AYFF	Texas Instruments
U4, U5, U6, U7	4		ESD in 0402 Package with 10 pF Capacitance and 6 V Breakdown, 1 Channel, -40 to +125 degC, 2-pin X2SON (DPY), Green (RoHS & no Sb/Br)	DPY0002A	TPD1E10B06DPYR	Texas Instruments
C9, C14	0		CAP, CERM, xxxF, xxV, [TempCo], xx%, [PackageReference]	Used in PnP output	Used in BOM report	Used in BOM report
C11	0	39pF	CAP, CERM, 39pF, 50V, +/-5%, C0G/NP0, 0402	0402	GRM1555C1H390JA01D	MuRata
FID1, FID2, FID3, FID4, FID5, FID6	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A
J1	0		Header male, 2x1, 50mil, TH	2x1 Header	GRPB021VWVN-RC	Sullins Connector Solutions
J2	0		Header, 6x1, 50mil, TH	Header, 6x1. TH	GRPB061VWVN-RC	Sullins Connector Solutions
J4, J5 0	0		Header, 1x1, Tin, TH	Header,1x1, 50mil, TH	TMS-101-02-T-S	Samtec

9 Layer Plots

To download the layer plots for the Dynamic Field-Powered NFC Reference Design for Data Logging, Access Control, and Security Applications, see the design files at TIDA-00217. Figure 18 through Figure 25 show the layer plots for the Reference Design board.

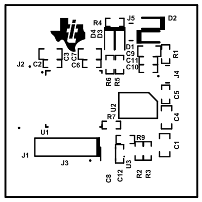


Figure 18. Top Overlay

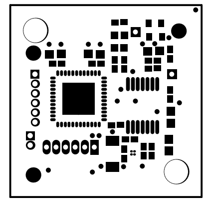


Figure 19. Top Solder Mask

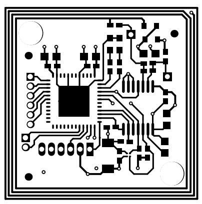


Figure 20. Top Layer

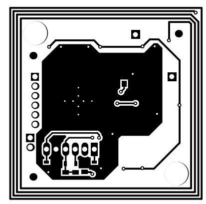


Figure 21. Bottom Layer

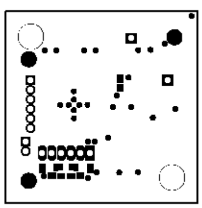


Figure 22. Bottom Solder Mask

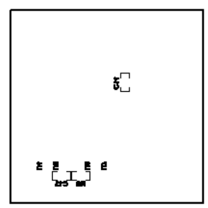


Figure 23. Bottom Overlay

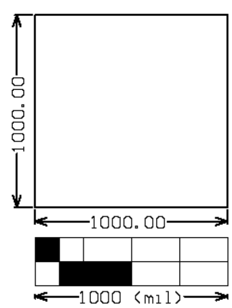
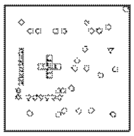


Figure 24. Board Dimensions



Symbol	Hit Count	Tool Size	Plated	Hole Type
	8	7.874mil (0.2mm)	PTH	Round
	22	10mil (0.254mm)	PTH	Round
	8	26mil (0.66mm)	PTH	Round
	6	27.559mil (0.7mm)	PTH	Round
	2	28mil (0.711mm)	PTH	Round
	2	125mil (3.175mm)	PTH	Round
	48 Total			

Drill Table

Figure 25. Drill Drawing

10 Altium Project

To download the Altium project files for the Dynamic Field-Powered NFC Reference Design for Data Logging, Access Control, and Security Applications, see the design files at TIDA-00217. Figure 26, Figure 27, and Figure 28 show the layout for the Reference Design board.

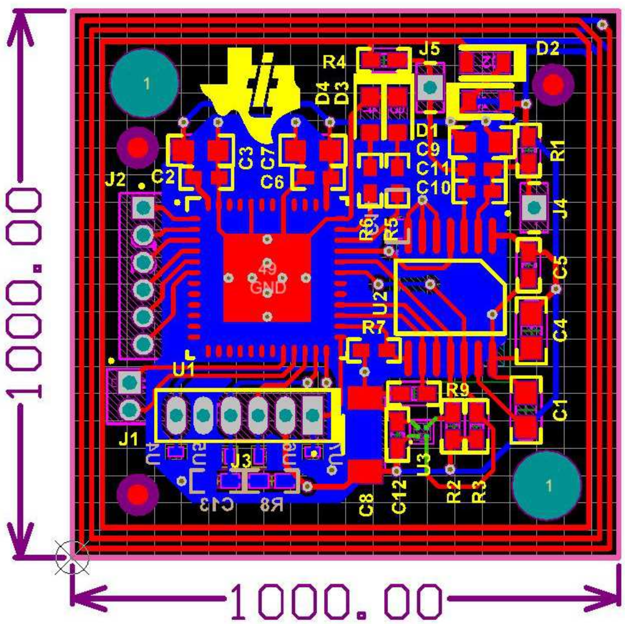


Figure 26. All Layers

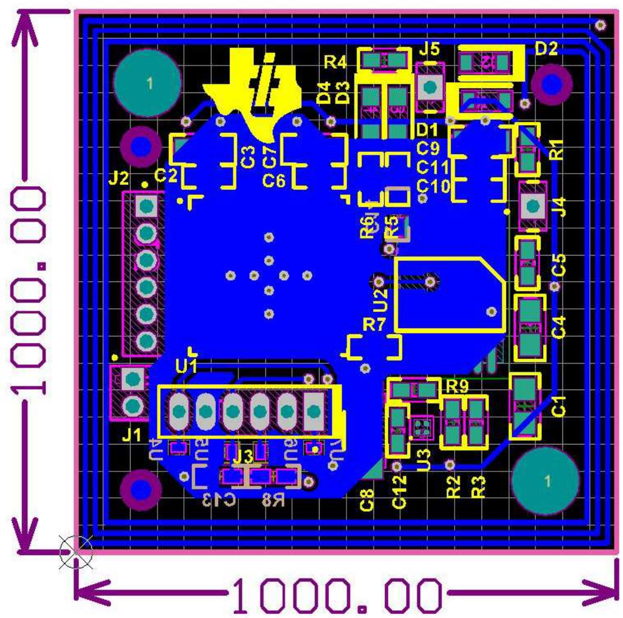


Figure 27. Bottom Layer

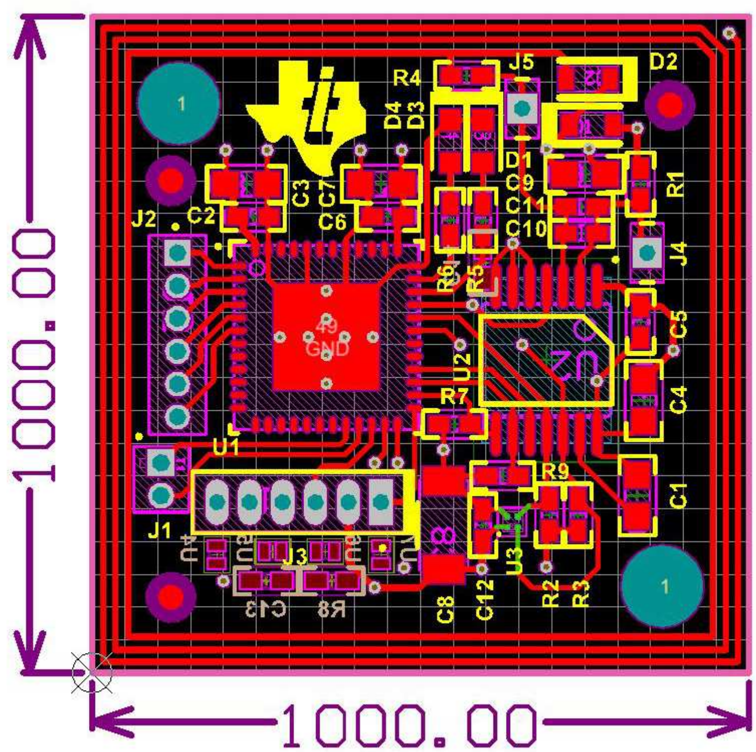


Figure 28. Top Layer

11 Layout Guidelines

12 Gerber Files

To download the Gerber files for the Dynamic Field-Powered NFC Reference Design for Data Logging, Access Control, and Security Applications, see the design files at TIDA-00217.

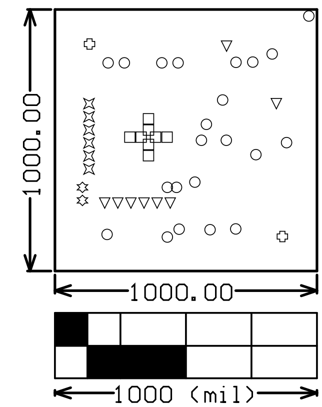


Figure 29. Fabrication Drawing

13 Assembly Drawings

To download the assembly drawings for the Dynamic Field-Powered NFC Reference Design for Data Logging, Access Control, and Security Applications, see the design files at TIDA-00217.

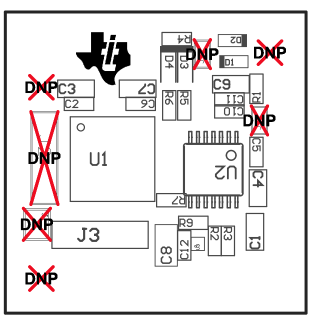


Figure 30. Top Overlay

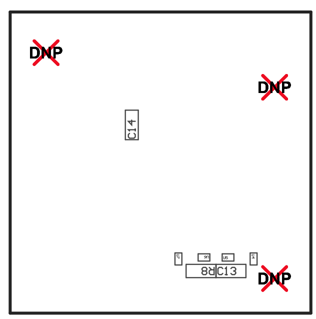


Figure 31. Bottom Overlay

14 Software Files

To download the software files for the Dynamic Field-Powered NFC Reference Design for Data Logging, Access Control, and Security Applications, see the design files at TIDA-00217

15 References

For additional references, see the following:

1. RF430CL330H Data Sheet, *Dynamic NFC Interface Transponder* (SLAS916)
2. MSP430FR5969 Data Sheet, *MSP430FR59xx Mixed-Signal Microcontrollers* (SLAS704)
3. TMP103 Data Sheet, *Low-Power, Digital Temperature Sensor with Two-Wire Interface in WCSP* (SBOS545)
4. TPD1E10B06 Data Sheet, *Single Channel ESD Protection Device in 0402 Package* (SLLSEB1)
5. NFC Forum Specifications: http://nfc-forum.org/our-work/specifications-and-application-documents/
6. Application Report, *RF430CL330H Practical Antenna Design Guide* (SLOA197)

16 About the Authors

EVAN D. CORNELL is a Systems Architect at Texas Instruments where he is responsible for developing reference design solutions for the industrial segment. Evan brings to this role experience in system-level analog, mixed-signal, and power management design. Evan earned his Master of Electrical and Computer Engineering (M.Eng.) and Bachelor of Science (BS) in Electrical Engineering from the Rose-Hulman Institute of Technology in Terre Haute, IN. Evan is a member of the Institute of Electrical and Electronics Engineers (IEEE).

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Revision History

Changes from Original (June 2014) to A Revision **Page**

- Added a paragraph, a table, and an illustration concerning MSP-FET at the beginning of Section 5 Getting Started..... 15

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

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