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Standard Board

AS3956-WL_DK_ST

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1 General Description

This application note describes the AS3956 General Purpose Demo Kit and its usage. The purpose of the demonstrator is to show all the features and functionalities of the AS3956. The demonstration works in combination with a reader (AS3911 GP demonstrator) and/or NFC enabled smartphone. The main features of the demonstrator are:

- Demonstration of a Tag 4 Type (T4T) operation
- Demonstration of a Tag 2 Type (T2T) operation

The Evaluation Kit allows you to supply all components by the PC USB Port. No external supply or battery is needed. Except the USB cable (included), no wiring is needed. This allows a fast and convenient evaluation of the AS3956.

1.1 Kit Content

The AS3956 Demo Kit includes the following items:

- AS3956 tags (3 pcs.)
- Controller Board with USB interface
- USB Cable
- USB Data Stick



Figure 1: Demo kit content

1.2 Compatibility

This demo works with

• AS395x GP GUI version 1.0.11.0 or higher and FW 1.0.9 or higher

2 Hardware Description

The AS3956 demo kit is composed of 3 tags and a controller board. The tag consists of the AS3956, antenna and a connector. The tag (unpowered) works like a standard NFC-Forum T2T.

Connector provides all connections required for the microcontroller:

- VSS
- SPI/I2C
- /IRQ
- VPREG

2.1 Controller Board Description

The controller board mainly consists of the USB connector, PIC24FJ128GB202 microcontroller and an 8MHz crystal. The board is powered by USB or by RF field energy extracted by AS3956.

2.1.1 Controller Board Layout and Schematics





3D View

Top Layer

Bottom Layer











2.1.2 Bill of Materials

	Bill of N	Aaterials		am	
	Company: Application	ams AG			
	Engineer: Product	dstr			
	Number: ARS Project	AS3956			
	Name: Boardtype & Version:	AS3956 Demo Kit Controllerboard V1.0			
	Date: Revision:	28/8/2017 Rev 1.0.0			
#	Designator	Comment	Manufacturer	Manufacturer Part Number	Qua ntity
	C1, C2, C4	100n	MULTICOMP	MC0402X104K160CT	3
	C3. C5	10u	TDK	AC	2
	C6. C7	1u	KEMET	C0603C105K9RACTU	2
	D1, D2, D3,				
	D4, D9	LED_LUMEX	KINGBRIGHT	KPHHS-1005QBC-D-V	5
			ON SEMICONDUC		
	D5	Zener	TOR	MM3Z6V8T1G	1
	D6, D7, D8	9V	EPCOS	CDS3C09GTA.	3
	L1	Ferritbeat	MURATA	BLM18EG471SN1D	1
	Logo1				1
			TE		
	20	90212 Connector	CONNECTIVIY /	1724502 0	1
	P3	69212_Connector		1754592-0	1
	R1	10k		CRG0402 110K	1
	R10	866			1
	R11	62k		MCSR04X6202FTI	1
	R2 R3 R4	UZK			
	R5, R6	470	MULTICOMP	MCMR04X4700FTL	5
			YAGEO		
	R7, R8	27R	(PHYCOMP)	RC0402FR-0727RL	2
	R9	33k	MULTICOMP	MCMR04X3302FTL	1
E	S1	SW_DPST1_THMD	COMPONENTS	PCM12SMTR	1
	1.11	PIC24E.1128GB202	MICROCHIP	Г 1024ГЈ 1200В202- I/MM	1
	112	AS1360-33	ams	AS1360-33-T	1
	02	A01000-00	Hirose Electric	A01000-00-1	
	U3	USB_Micro_AB	Co Ltd	ZX62-AB-5PA(11)	1 34



2.2 Tag Description

Tag consists of AS3956 IC, Coil antenna and an FCC connector.

2.2.1 Tag Dimensions

2.2.1.1 20x25 mm tag



2.2.1.2 22x38 mm tag



2.2.1.3 32x45 mm tag



3 Software Description

The AS3956 IC natively behaves like a T2T with NDEF message. It can be used with a standard NFC enabled phone. The AS395x Evaluation Software package includes a general purpose AS395x Evaluation Software (Desktop GUI)

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3.1 AS395x Evaluation Software

With the AS395x Evaluation Software users can:

- Change the AS3956 configuration setup to operate as a T4T or T2T, enable energy harvesting, data protection, silent mode and other advanced features
- Manipulate the contents of the NDEF message, both for T2T and T4T
- Do data transfer between the Desktop GUI and the Android demo app. Currently data transfer is supported only in extended mode, tunneling mode will added in the future versions.

The AS395x Evaluation SW can be downloaded from the following destinations:

	Software	FTP site	User	Password
AS395x	General			
GUI	purpose	TBD	TBD	TBD

View Settings Help	• ×
ype 2 Tag Type 4 Tag File Transfer Memory Map Advanced Configure as Type 2 Tag def Message NDEF message records Image: Create / Edit Clear NDEF message bytes Image: Create / Edit Clear Read	am
ype 2 Tag Type 4 Tag File Transfer Memory Map Advanced Configure as Type 2 Tag def Message NDEF message records Image: Create / Edit Clear Read Write NDEF message bytes	
Configure as Type 2 Tag def Message NDEF message records	
def Message NDEF message records Teate / Edit Clear Read Write NDEF message bytes	
NDEF message records Image: http://www.ams.com Create / Edit Clear NDEF message bytes	
Inttp://www.ams.com Create / Edit Clear Read NDEF message bytes	
Create / Edit Clear Read Write NDEF message bytes	
Create / Edit Clear Read Write NDEF message bytes	
Create / Edit Clear Read Write NDEF message bytes	
Create / Edit Clear Read Write NDEF message bytes	
Create / Edit Clear Read Write NDEF message bytes	
Create / Edit Clear Read Write NDEF message bytes	
Create / Edit Clear Read Write NDEF message bytes	
Create / Edit Clear Read Write NDEF message bytes	
Create / Edit Clear Read Write NDEF message bytes	
NDEF message bytes	
EW/4 0.2	3956

Figure 2: AS395x GUI





Figure 3: AS395x GUI Version

4 AS395x Evaluation Software User Guide

4.1 Type 2 Tag tab

From this tab the AS3956 can be configured to operate as an NFC Forum Type 2 Tag. Here the NDEF message can also be read or written.

To setup the AS3956 as a T2T click on *Configure as Type 2 Tag* button.

le View	Settings He	lp			am
3					
Type 2 Tag	Type 4 Tag	File Transfer	Memory Map	Advanced	
	Configu	ire as Type 2 Tag			
Ndef Messa	ge				
NDEF mes	sage records				
8		I WARK			
• r	http://www.ams.c	om			
Create /	Edit Clear		Read Write		
Create /	Edit Clear		Read Write		
Create / NDEF mes	Edit Clear		Read Write		
Create / NDEF mes	Edit Clear		Read Write		
Create / NDEF mes	Edit Clear ssage bytes		Read Write		
Create / NDEF mes	Edit Clear ssage bytes		Read Write		
Create / NDEF mes	Edit Clear ssage bytes		Read Write		
Create / NDEF mes	Edit Clear ssage bytes		Read Write		
Create / NDEF mes	Edit Clear ssage bytes		Read Write		
Create / NDEF mes	Edit Clear ssage bytes		Read Write		
Create / NDEF mes	Edit Clear ssage bytes		Read Write		

Figure 6: AS395x GUI - Type 2 Tag tab

To clear the NDEF message, click on the *CLear* button, pressing the *Write* button after that is not necessary.

To change or create the NDEF message, click on *Create/Edit* button to bring the NDEF message dialog.

Record types	Message records	
Text	Add	
	Delete	
🙈 Image	Up	
Bluetooth	Down	
🛜 WiFi		
Contact		
😝 App launcher		
Propriatery		
		Ok Cancel

Figure 7: AS395x GUI – NDEF Message Dialog

Select the desired record type from the *Record types* list on left handside of the screen and then click *Add*. A record with the selected record type will be added to the *Message records* list. Now enter the URL text in the text box.

lecord types		Message records		
Text	Add	enter URL		
URL	Delete			
🛐 Image	Up			
Bluetooth	Down			
🛜 WiFi				
Contact				
😝 App launcher				
Propriatery				
The URI Record is used to s URI from one NFC device to	tore a URI (e another,	ther a URN or URL) in a <mark>NFC Foru</mark>	<u>m</u> compliant tag or to transp	porta

Figure 8: AS395x GUI - Create NDEF Message

When ready, press *Ok* to close the NDEF message dialog and go back to the *Type 2 Tag* tab and there press *Write*. A message box will pop up to inform if writing the NDEF message was successful.





The message is written into the AS3956 EEPROM and the board can be disconnected from USB. Any reader/NFC enabled phone will be able to read out the NDEF message.

x



4.2 Type 4 Tag tab

From this tab the AS3956 can be configured to operate as an NFC Forum Type 4 Tag and as in T2T, the NDEF message can also be read or written.

To setup the AS3956 as a T4T click on *Configure as Type 4 Tag* button.

	Settings He	þ				un
Type 2 Tag	Type 4 Tag	File Transfer	Memory Ma	p Advanced		
	Configu	re as Type <mark>4</mark> Tag				
Ndef Messag	je					
NDEF mes	sage records					
NDEF mes	sage records	nm				
NDEF mes	sage records ttp://www.ams.c	om				
NDEF mes	sage records ttp://www.ams.c	om				
NDEF mes	sage records ttp://www.ams.c	om				
NDEF mes	sage records ttp://www.ams.c	om				
NDEF mes	sage records ttp://www.ams.c	om				
NDEF mes	sage records ttp://www.ams.c	om				
NDEF mes	sage records ttp://www.ams.c	om				
NDEF mes	sage records ttp://www.ams.c	om				
NDEF mes	sage records ttp://www.ams.c Edit Clear	om	Read Writ			
NDEF mes	sage records ttp://www.ams.c Edit Clear sage bytes	om	Read Writ	e		
NDEF mes	sage records ttp://www.ams.c Edit Clear sage bytes	om	Read Writ	8		
NDEF mes	sage records ttp://www.ams.c Edit Clear sage bytes	om	Read Writ			
NDEF mes	sage records ttp://www.ams.c Edit Clear sage bytes	om	Read Writ			
NDEF mes	sage records ttp://www.ams.c Edit Clear sage bytes	om	Read Writ	e		

Figure 10: AS395x GUI - Type 4 Tag tab

Changing/creating the NDEF message follows the same procedure as in T2T NDEF message configuration. The difference is that in this case the NDEF message will go to the MCU's flash memory, not to the AS3956 EEPROM. MCU must be on for readers/NFC phones to read out the message, so either energy harvesting must be enabled or the MCU should be externally supplied (USB cable ex.). The GUI can be closed.

4.3 File Transfer tab

This tab is for demonstrating the data transfer application. There are several options for data transfer.

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• Files can be received or sent from/to an NFC phone. Smartphone App is currently not available for AS3956. This feature will be added in the future.



4.4 Memory Map tab

In this tab the complete EEPROM memory can read or written.

3							
Туре 2 Тад Туре 4 Тад	File Transfer	Memory Map	Advanced				
Description	Byte 0	Byte 1	Byte 2	Byte 3	Block	Access	
UID / Internal	73	378	73	5 13	00h	RO	
Fabrication data	<u> </u>	<u>2</u> 3	<u>4</u> 3	<u>2</u> 3	01h	RO	
Internal / Lock				20	02h	OTP	
сс	-	÷	 .)	÷	03h	OTP	
Data	7 0		7 5	7 3	04h	RW	
Data	<u></u>	<u>1</u> 20	<u>a</u> n	<u>2</u> 1	05h	RW	
Data			14 3	2 0	06h	RW	
Data	++-))		07h	RW	
Data	3 3		333	3 3	08h	RW	
Data	<u></u>	<u>1</u> 2%	<u>2</u> %	<u>a</u> n	09h	RW	
Data			2 81		0ah	RW	
Data					0bh	RW	
Data	3 3	33	33 4	3 3	0ch	RW	
Data fields format:) he	x 🔵 ascii					Read	Write

Figure 13: AS3956x GUI - Memory Map tab

To read the tag memory, press on *Read*. To change contents of the memory, change the bytes of the block you want to write and then click on *Write*. If the data fields are displayed in hex, enter the new data in hex. If data fields are displayed in ASCII, then data should be entered as text. The cells to be changed will be marked in red.

	Þ						u
Туре 2 Тад Туре 4 Тад	File Transfer	Memory Map	Advanced				
Description	Byte 0	Byte 1	Byte 2	Byte 3	Block	Access	
Data	00	00	00	00	0bh	RW	
Data	00	00	00	00	0ch	RW	
Data	00	00	00	00	0dh	RW	
Data	AA	00	00	00	0eh	RW	
Data	00	BB	00	00	Ofh	RW	
Data	00	00	cc	00	10h	RW	
Data	00	00	00	DD	11h	RW	
Data	00	00	00	00	12h	RW	
Data	00	00	00	00	13h	RW	
Data	00	00	00	00	14h	RW	
Data	00	00	00	00	15h	RW	
Data	00	00	00	00	16h	RW	
Data	00	00	00	00	17h	RW	
Data fields format: () hex	ascii					Read	Write

Figure 13: AS395x GUI – Memory Map tab, data enter

When the content of the tag memory was changed from the RF interface, reading again with the GUI will show the text in the cells in blue, indicating that the content in these cells changed since the last read.

4.5 Advanced tab

The Advanced tab has four sections:

• IC Configuration

Part of the settings saved in the AS3956 EEPROM configuration words can be changed here. Refer to the datasheet for information on what each options means.

e View Settings H	elp	C	m
Type 2 Tag Type 4 Tag	File Transfer Memory Map Advanced		
Silent mode Enabled Voltage level: 1.42 Energy harvesting Voltage level: 1.80 Output resistane: 0	 Enable tunneling mode Enable extended mode Enable authentication settings over RF Forward CRC to buffer Send NAK on CRC and parity error Invert ISO14443-4 compliance bit on CL2 Enable configuration over RF RF has priority during EEPROM arbitration 	I2C slave address Power mode: 0 SENS response: 0044 SELECT response: 00	
Authentication settings			
Fabrication data			
		Read Write	

Figure 14: AS395x GUI – Advanced tab

- Authentication settings for details on each option, refer to the datasheet. To enable password authentication:
 - \circ Click on the Authentication settings section in the Advanced tab.
 - Enter the block number where protection should start in the *Start address* text box.
 Protected blocks will be all the blocks from the start address to the end of the memory address space. If the start address is beyond the valid addresses, data protection will be disabled.
 - Select which EEPROM operations (read and/or write) require authentication. If nothing is selected, data protection will be disabled.
 - Optionally change the authentication counter to a valid value (1-7).
 - Click *Write* to write the settings to the EEPROM.

To disable password authentication:

• Click on the *Authentication settings* section in the *Advanced* tab.



- In the *Start address* text box enter a value that is beyond the valid addresses, ex. FFh and/or uncheck the *EEPROM Read* and *EEPROM Write* check boxes.
- Click *Write* to write the new settings to the EEPROM.

S395f _X Evaluation SW View Settings He))	ar
2		
Type 2 Tag Type 4 Tag	File Transfer Memory Map Advanced	
IC Configuration		
Authentication settings		
Authenticated operation	Counter	
 EEPROM Read 	7	
 EEPROM Write 	Start address	
Interface	64	
MCU dislabed	Password	
RF disabled	61736466	
Interrupt masks		
Fabrication data		
	1	
	Read	Write

Figure 15: AS395x GUI – Advanced tab, Authentication Settings

 Interrupt masks – define which interrupt sources will trigger an IRQ. Checking a source will disable it. This part and the IC Configuration comprise the contents of the AS3956 configuration words.

AS395(xEvaluation SW			
ile View Settings Help			am
3			
Type 2 Tag Type 4 Tag File	ransfer Memory Map Advanced	3	
IC Configuration			
Authentication settings			
Interrupt masks			
Interrupt Mask 0	Interrupt Mask 1		
✓ Power up	Exercise error		
Sleep request	Parity error		
BE EERPOM write	CPC error		
RE FEPROM read	Buffer error		
Receive end	Write EEPROM success		
Transmit end	Write EERPOM error		
Exit RF / Field off	Access error		
Fabrication data		9	
		10	
		Read Write	
		FW 4.0.8	AS3956

Figure 16: AS395x GUI – Advanced tab, Interrupt masks

• Fabrication data – the read only configuration data of the AS3956 are written at production time

3			
Type 2 Tag Type 4 Tag File Transfe	r Memory Map Adv	vanced	
IC Configuration			
Authentication settings			
Interrupt masks			
Fabrication data			
	Trimming bits	EEPROM Size:	
Test mode enabled	Silent mode voltage:	4 Kbit	
Decreased modulator resistence	5	Interface:	
MISO pull down ISS low enabled	Regulator voltage:	SPI 🔛	
MISO pull down ISS high enabled	4	Frame delay time:	
Decoder compensation register:	Oscillator:		
0	2	313230	
		Read Write	

Figure 17: AS395x GUI – Advanced tab, Fabrication data



5 Data protection

Data protection can be enabled from the GUI when authentication settings over RF is set to be allowed in the AS3956 IC's configuration settings.

le View Settings H	elp	ar
Type 2 Tag Type 4 Tag IC Configuration Silent mode Enabled Voltage level: 1.42 Energy harvesting Voltage level: 1.80 Output resistane: 0	File Transfer Memory Map Advanced Enable tunneling mode Enable extended mode Enable authentication settings over RF Forward CRC to buffer Send NAK on CRC and parity error Invert ISO14443-4 compliance bit on CL2 Enable configuration over RF	I2C slave address Power mode: 0 SENS response: 0044 SELECT response: 00
Authentication settings Interrupt masks Fabrication data		Read Write

Figure 35: AS395x GUI - Enable auth settings from RF

How to enable/disable from the GUI refer to the AS395x Evaluation Software User Guide section of this document.

6 Configure and Use Example

6.1 AS3956 with NFC Enabled Android Smartphone¹

6.1.1 NFC T2T

• Connect the Controller board to the computer with USB cable and start the *AS395x Evaluation Software*.

- Click on the *Type 2 Tag* tab.
- Click on *Configure as Type 2 Tag*. The AS3956 is now configured as T2T.
- Disconnect the USB cable.

• Place the tag on the back of the smartphone. Smartphone will detect the tag and take appropriate action.²

6.1.2 NFC T4T

6.1.2.1 Powered from USB port

• Connect the AS3956 Controller board to the computer with USB cable and start the AS3956 *Evaluation Software*.

- Click on the *Type 4 Tag* tab.
- Click on *Configure as Type 4 Tag*. The AS3956 is now configured as T4T.

• Place the tag on the back of the smartphone. Smartphone will detect the tag and take appropriate action.³

6.1.2.2 Powered from AS3956 (energy harvesting)

Connect the Controller board to the computer with USB cable and start the *AS395x Evaluation Software*.

- Click on the *Type 4 Tag* tab.
- Click on *Configure as Type 4 Tag*. The AS3956 is now configured as T4T.
- Click on the Advanced tab.
- Click on the *IC Configuration*.
- Click the *Read* button. To read the current settings of AS3956.
- In the *Energy harvesting* box click up arrow until the *Voltage level>* is set to *3,30*. To set the regulated output voltage value.
- With the drop-down menu set the *Output resistance:* to 25. To set the output resistance of voltage regulator.
- Click *Write*. To write the settings to AS3956.
- Disconnect the USB cable from the controller board and move the switch on controller board to position *VP_REG*.

¹ For this application note Samsung Galaxy S4 was used. Android version 5.0.2

² NFC must be enabled

³ NFC must be enabled