Application Note

UHF Desktop Reader / Module - AUxx series

Device command description & firmware update procedure

ARYGON TECHNOLOGIES

Dagobertstrasse 9
D - 55116 Mainz
Germany
Phone +49 (0) 61 31-30476-0
Fax +49 (0) 61 31-30 476-20
Email. info@arygon.com
http://www.arygon.com

Document: Application Note

Author: ARYGON Technologies AG

Version: 1.2

Document History

Revision	Date	Description
1.0	01.03.2011	Initial version
1.1	07.04.2011	Added Error code Information and state charts, command frame review with firmware
1.2	27.05.2011	Channel selection and switching (frequency hopping) description added

Table 1 - Dokument History

Contact Information

For additional information and sales office addresses visit:
http://www.arygon.com or **http://www.nfc-global.com**

FCC NOTICE

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communication. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off
and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- **Reorient or relocate the receiving antenna**
- **Increase the separation between the equipment and receiver**
- **Connect the equipment into an outlet on a circuit different from that to which the receiver is connected**
- **Consult the dealer or an experienced radio/TV technician for help**

THIS DEVICE COMPLIES WITH PART 15 OF FCC RULES. OPERATION IS SUBJECT TO THE FOLLOWING WO CONDITIONS:

1) THIS DEVICE MAY NOT CAUSE HARMFUL INTERFERENCE AND
2) THIS DEVICE MUST ACCEPT ANY INTERFERENCE RECEIVED, INCLUDING INTERFERENCE

THAT MAY CAUSE UNDESIRED OPERATION

WARNING: CHANGES OR MODIFICATIONS NOT EXPRESSLY APPROVED BY THE PARTY RESPONSIBLE FOR COMPLIANCE COULD VOID THE USER'S AUTHORITY TO OPERATE THE

1. Disclaimer

Products sold by ARYGON Technologies AG are covered by the ARYGONSs Term and Conditions of Sale. ARYGON Technologies AG makes no warranty, express, statutory, implied, or by description regarding the information set forth herein or regarding the freedom of the described devices from patent infringement. ARYGON Technologies AG reserves the right to change specifications and prices at any time and without notice. Therefore, please check with ARYGON Technologies AG for current information.
This product is intended for use in normal commercial applications. Applications requiring extended temperature range, unusual environmental requirements, or high reliability applications, such as for military, medical life-support or life-sustaining equipment are specifically not recommended without additional consultation of ARYGON Technologies AG.
The information provided in this document by ARYGON Technologies AG is believed to be correct and accurate. However, ARYGON Technologies AG shall not be liable to recipient or any third party for any damages, including but not limited to personal injury, property damage, loss of profits, loss of use, interruption of business or indirect, special, incidental or consequential damages, of any kind, in connection with or arising out of the furnishing, performance or use of the technical data herein. No obligation or liability to recipient or any third party shall arise or flow out of ARYGON Technologies AG rendering of technical or other services.

Table of Contents:

List of Tables:

List of Figures:

2. Introduction

This document describes the architecture important functions. For a complete reference of implemented functions please refer to the Doxygen documentation.

Application Layer

After connecting the reader to the computer the reader is automatically installed as a HID (Human Interface Device). The USB HID protocol defines different reports. Every report starts with its own report ID defining the length and if it is an incoming or an outgoing report.

USB Report-Frame

Each report frame starts with a Report ID byte. The second byte defines the length of the frame (the ID and the length bytes are included in the length).

Byte 1	Byte 2	Variable length
Report ID	Frame Length	Payload

Table 2 Report Frame

USB Reports

The following table gives an overview of the implemented USB reports. Each USB report causes the device to reply with a response frame (incoming report).

USB Report Name	Report ID outgoing	Report ID incoming
callSendFirmwareHardwareID	0x10	0x11
callAntennaPower	0x18	0x19
writeRegister	0x1A	0x1B
callReadRegister	0x1C	0x1D
callReadRegisters	0x57	0x58
callChangeFreq	0x41	0x42
configGen2	0x59	0x5A
callEnableBootloader	0x55	0x56
callStartStop	0x5D	0x5E
callInventory	0x31	0x32
callInventoryRSSIInternal	0x43	0x44
callInventory6B	0x3F	0x40
callSelectTag	0x33	0x34
callWriteToTag	0x35	0x36
writeToTag6B	0x47	0x48
callReadFromTag	0x37	0x38
readFromTag6B	0x49	0x50
callLockUnlock	0x3B	0x3c
callKillTag	0x3D	0x3E
callNXPCommands	0x45	0x46

Table 3 USB Reports Overview

It is recommended to send the reports always with the maximal report length of 64 bytes. Most reports are already defined in the descriptor with the maximal length. The others may change in future. Windows truncates longer reports and discards shorter reports!

Reader Related USB Reports

These commands are intended to configure the AUDR UHF reader and for obtaining information about the firmware.

callSendFirmwareHardwareID

This report sends the firmware or the hardware ID to the host computer.

Byte	0	1	2
Content	0x10(ID)	3(length)	Payload

Table 4- callSendFirmwareHardwareID - outgoing

Payload:
0x00…Firmware
0x01…Hardware

Byte	0	1	2 .. 47
Content	0x11(ID)	length	Zero terminated string

Table 5- callSendFirmwareHardwareID - incoming

callAntennaPower

This report enables or disables the RF power on the RF-output ports.

Byte	0	1	2
Content	0x18(ID)	3(length)	Payload

Table 6 –callAntennaPower - outgoing

Payload:
0x00…RF-Power OFF
0x01…RF-Power ON

Byte	0	1	2
Content	0x19(ID)	3(length)	0 on success

Table 7 - callAntennaPower - incoming

writeRegister

This function writes one register of the AUDR UHF reader.

Byte	0	1	2	3	4	5
Content	0x1A(ID)	5(length)	reg_number	val_0	val_1	val_2

Table 8 - writeRegister – outgoing

val_1 and **val_2** are used only if reg_number is a deep register (e.g.: Modulator Control Register).
If reg_number ≥ 0x80 a direct command is executed.

Byte	0	1	2
Content	0x1B(ID)	3(length)	0 on success

Table 9 - writeRegister – incoming

callReadRegister

This function reads one register from the AUDR UHF reader

Byte	0	1	2
Content	0x1C(ID)	2(length)	reg_number

Table 10 - callReadRegister - outgoing

If a 3-bytes deep register is selected the controller sends back 3 data bytes.

Byte	0	1	2	3	4	5
Content	0x1D(ID)	6(length)	0x00 on success	val0	val1	val2

Table 11 - callReadRegister - incoming

callReadRegisters

This function reads all register in one bulk from AUDR UHF reader.

Byte	0	1
Content	0x57(ID)	1(length)

Table 12 - callReadRegisters - outgoing

Byte	0	1	2	…	44
Content	0x58(ID)	45(length)	reg 0x00	…	reg 0x1F

Table 13 - callReadRegisters - incoming

callChangeFreq

This report sets, modifies or measures frequency related properties. freq comprises 3 bytes and is transmitted in kHz. E.g.: 868000 means 868 MHz.

Get RSSI Level

Byte	0	1	2	3 .. 5
Content	0x41(ID)	length	0x01	freq

Table 14 - callChangeFreq - Get RSSI Level - outgoing

Byte	0	1	2	3
Content	0x42(ID)	64(length)	I-channel	Q-channel

Table 15 - callChangeFreq - Get RSSI Level - incoming

Get Reflected Power Level

Byte	0	1	2	3 .. 5
Content	0x41(ID)	length	0x02	freq

Table 16 - callChangeFreq - Get Reflected Power Level - outgoing

Byte	0	1	2	3
Content	0x42(ID)	64(length)	I-channel	Q-channel

Table 17 - callChangeFreq - Get Reflected Power Level - incoming

Add frequency to frequency list used for hopping

Byte	0	1	2	3 .. 5	6	7
Content	0x41(ID)	length	0x04	freq	rssi_threshhold(dBm)	profile_id

Table 18 - callChangeFreq – Add frequency to hopping list - outgoing

Byte	0	1	2	3
Content	0x42(ID)	64(length)	0xFC on success	0xFF on success

Table 19 - callChangeFreq – Add frequency to hopping list - incoming

Clear frequency list used for hopping

Byte	0	1	2
Content	0x41(ID)	length	0x08

Table 20 –Clear frequency hopping list - outgoing

Byte	0	1	2	3
Content	0x42(ID)	64(length)	0xFC on success	0xFF on success

Table 21 - Clear frequency hopping list – incoming

Set frequency hopping related parameters

Byte	0	1	2	3 .. 4	5 .. 6	7 .. 8
Content	0x41(ID)	length	0x10	listeningTime	maxSendingTime	idleTime

Table 22 – Set frequency hopping parameters - outgoing

Byte	0	1	2	3
Content	0x42(ID)	64(length)	0xFC on success	0xFF on success

Table 23 - Set frequency hopping parameters - incoming

Get frequency hopping related parameters

Byte	0	1	2
Content	0x41(ID)	length	0x11

Table 24 - Get frequency hopping parameters – outgoing

Byte	0	1	2	3	4	5 .. 6	7 .. 8
Content	0x42(ID)	64(length)	0xfe	0xff	profile_id	listening_time	max_sending_time

9 .. 10	11 .. 13	14 .. 16	17	18	19
idle_time	gui_min_freq	gui_max_freq	gui_num_freqs	rssi_threshold	act_num_freqs

Table 25 - Get frequency hopping parameters – incoming

Continuous modulation test

Starts continuous modulation of the RF field for given duration. If duration is set to 0 continuous modulation is active until the next report is received from GUI.

Byte	0	1	2	3 .. 5	6 .. 7
Content	0x41(ID)	length	32	don't care	duration in ms

Table 26 - Continuous modulation test – outgoing

Byte	0	1	2	3
Content	0x42(ID)	64(length)	0xfe	0xff

Table 27 - Continuous modulation test – incoming

configGen2

This function sets and reads various gen2 related settings. The values are only being set if the proper set_ value is set to 1.

Byte	0	1	2	3	4	5	6	7
Content	0x59(ID)	length	set_lf	lf	set_coding	coding	set_session	session

8	9	10	11	12	13
set_trext	trext	set_qbegin	qbegin	set_sensitivity	sensitivity

Table 28 – configGen2 - outgoing

Byte	0	1	2	3	4	5	6	7
Content	0x5A(ID)	0x40(length)	reserved(0)	lf	reserved(0)	coding	reserved(0)	session

8	9	10	11	12	13
reserved(0)	trext	reserved(0)	qbegin	reserved(0)	sensitivity

Table 29 – configGen2 - incoming

Values for the different parameters are:

Name	values
lf	0 = 40 kHz, 3 = 80 kHz (not available for AS3992), 6 = 160 kHz, 8 = 213 kHz, 9 = 256 kHz, 12 = 320 kHz, 15 = 640 kHz
coding	0 = FM0, 1 = Miller2, 2 = Miller4, 3 = Miller8
session	0 = S0, 1 = S1, 2 = S2, 3 = SL
trext	0 = short preamble, pilot tone, 1 = long preamble, pilot tone
qbegin	0 .. 15. Initial gen2 round is 2^qbegin long
sensitivity	-128 .. 127 (dBm)

Table 30 - configGen2 - parameter settings

callEnableBootloader

This function erases the programmed firmware but does not affect the bootloader. The firmware of the device needs to be reprogrammed afterwards.

Byte	0	1	2	3
Content	0x55(ID)	4(length)	dont_care	dont_care

Table 31 - callEnableBootloader – outgoing

Byte	0	1	2
Content	0x56(ID)	3(length)	1 on success

Table 32 - callEnableBootloader – incoming

callStartStop

This function starts/stops the automatic scanning procedure.

Byte	0	1	2	3
Content	0x5D(ID)	6(length)	update	start

Table 33 - callStartStop - outgoing

Byte	0	1	2
Content	0x5E(ID)	3(length)	current start value Subsequently callInventoryRSSIInternal() result packages are returned in a dense continuous loop. See there for description.

Table 34 - callStartStop - incoming

Tag Related USB Reports

Transponder related USB reports force the microcontroller and the AUDR UHF reader to communicate with UHF RFID tags. The RF- power at the antenna needs to be enabled and at least one tag should be in the RF-field coverage of the reader.

callInventory

This function performs a gen2 protocol inventory round according to parameters given by **configGen2()**.

Byte	0	1	2
Content	0x31(ID)	3(length)	start

Table 35 - callInventory - outgoing

start: 1 -> start a new round, 2 -> deliver next tag

The device reports back all tags in a burst mode.

Byte	0	1	2	3	4	5	6 .. 6 + epclen
Content	0x32(ID)	length	tags_left	epclen+pclen	pc[0]	pc[1]	epc

Table 36 - callInventory - incoming

With byte 2 the controller reports how many tags are found by the inventory command. After issuing the first inventory report and with start-byte = 2 the controller reports back the count of tags not inventoried yet. This information is used to inform the host how often he has to call the inventory command in order to inventory all available tags. The tag information is kept in the microcontroller's tag list. No tag information is deleted.

callInventoryRSSIInternal

This function performs a gen2 protocol inventory round according to parameters given by **configGen2()**.

Byte	0	1	2
Content	0x43(ID)	3(length)	start

Table 37 - callInventoryRSSIInternal - outgoing

start: 1 -> start a new round
start: 2 -> deliver next tag

The device reports back all tags in a burst mode.

Byte	0	1	2	3	4 .. 6	7
Content	0x44(ID)	length	tags_left	RSSI_value	base_freq	epclen+pclen

8	9	10 .. 10 + epclen
pc[0]	pc[1]	epc

Table 38 - callInventoryRSSIInternal – incoming

- RSSI_value: upper 4 bits I channel, lower 4 bits Q channel
- base_freq: base frequency at which the tag was found.

With byte 2 the controller reports how many tags are found by the inventory command. After issuing the first inventory report and with start-byte = 2 the controller reports back the count of tags not inventoried yet. This

information is used to inform the host how often he has to call the inventory command in order to inventory all available tags. The tag information is kept in the microcontroller's tag list. No tag information is deleted.

callInventory6B

This function performs one inventory round using ISO18000-6b protocol. Reading or writing to the tag will not succeed without sending this report first.

Byte	0	1	2	3	4 .. 11	12
Content	0x3F(ID)	12(length)	start	mask	word_data	start_address

Table 39 - callInventory6B – outgoing

- start: 1 -> start a new round
- start: 2 -> deliver next tag
- mask: Mask value for GROUP_SELECT_EQ command, 0 will select all tags
- start_address: address where data comparision will be started
- word_data: data which will be compared

Byte	0	1	2	3	4	5 .. 12	13 .. 15
Content	0x40(ID)	13(length)	tags_left	rssi(planned)	8(epclen)	uid	used freq

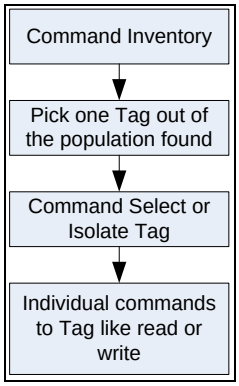
Table 40 - callInventory6B – incoming

With byte 2 the controller reports how many tags are found by the inventory command. After issuing the first inventory report and with start-byte = 2 the controller reports back the count of tags not inventoried yet. This information is used to inform the host how often he has to call the inventory command in order to inventory all available tags. The tag information is kept in the microcontroller's tag list. No tag information is deleted.

callSelectTag

Prior to communicate with one tag the host must isolate one of the found tags. The host needs to send always all EPC bytes to the controller regardless how long the EPC mask is specified. The complete report length is 64 bytes and needs to be taken into account by the host

The correct sequence to operate that command is shown below:



Picture 1 - Gen2 Tag Singulation

This function singulates a Gen2 tag using the given mask for subsequent operations like read/write

Byte	0	1	2	3 .. 3 + mask_length
Content	0x33(ID)	length	mask_length	mask

Table 41 - callSelectTag - outgoing

Byte	0	1	2
Content	0x34(ID)	3(length)	status (Error Byte)

Table 42 - callSelectTag - incoming

callWriteToTag

This function writes to a previously selected Gen2 tag.

Byte	0	1	2	3	4 .. 7	8	9 .. 9 + 2 * data_len
Content	0x35(ID)	length	mem_type	address	acces_pw	data_len	data

Table 43 - callWriteToTag - outgoing

- access_pw: if access password is non-zero the tag will be accessed first
- mem_type:
  - 0:reserved membank
  - 1:EPC membank
  - 2:TID membank
  - 3:USER membank
- data_len: data length in 16-bit words

Byte	0	1	2	3
Content	0x36(ID)	3(length)	status (Error Byte)	num_words_written

Table 44 - callWriteToTag – incoming

writeToTag6B

This function writes data to a tag using ISO18000-6b protocol command WRITE.

Byte	0	1	2 .. 9	10	11	12 .. 12+length_to_write
Content	0x47(ID)	length	uid	addr	length_to_write	data

Table 45 - writeToTag6B - outgoing

Byte	0	1	2
Content	0x48(ID)	3(length)	0 for success

Table 46 - writeToTag6B – incoming

callReadFromTag

This function reads from a previously selected gen2 tag.

Byte	0	1	2	3	4
Content	0x37(ID)	length	mem_type	address	data_len

Table 47 - callReadFromTag - outgoing

- mem_type:
  - 0:reserved membank
  - 1:EPC membank
  - 2:TID membank
  - 3:USER membank
- data_len: data length to read in 16-bit words

Byte	0	1	2	3
Content	0x38(ID)	length	Status (Error Byte)	num_words_read

Table 48 - callReadFromTag - incoming

readFromTag6B

This function reads from a tag using ISO18000-6b protocol command READ_VARIABLE.

Byte	0	1	2 .. 9	10	11
Content	0x49(ID)	12(length)	uid	addr	length_to_read

Table 49 - readFromTag6B - outgoing

Byte	0	1	2	3	4 .. 4+length_to_read
Content	0x50(ID)	64(length)	0 for success	length of data	data

Table 50 - readFromTag6B - outgoing

callLockUnlock

This report locks a gen2 tag.

Byte	0	1	2	3	4 .. 7
Content	0x3B(ID)	8(length)	lock_unlock	memory_space	access password

Table 51 - callLockUnlock - outgoing

- lock_unlock:
  0 Unlock
  1 Lock
  2 Permalock
  3 Lock & Permalock

- memory_space:
  0 Kill password
  1 Access password
  2 EPC
  3 TID

Byte	0	1	2
Content	0x3C(ID)	3(length)	Status (Error Byte)

Table 52 - callLockUnlock - incoming

callKillTag

This function kills a gen2 tag.

Byte	0	1	2 .. 5	6
Content	0x3D(ID)	7(length)	kill password	recom

Table 53 - callKillTag - outgoing

recom: see GEN2 standard: table on "XPC_W1 LSBs and a Tag's recomissioned status"

Byte	0	1	2
Content	0x3E(ID)	3(length)	Status (Error Byte)

Table 54 - callKillTag - incoming

callNXPCommands

This function sends special NXP command to NXP gen2 tags.

EAS command

Byte	0	1	2	3	4 .. 7
Content	0x45(ID)	10(length)	1	eas_on	access pw

Table 55 - callNXPCommands - EAS command - outgoing

Set / Reset Protect

Byte	0	1	2	3	4 .. 7
Content	0x45(ID)	10(length)	2	set_protect	access pw

Table 56 - callNXPCommands - Set / Reset Protect - outgoing

Calibrate

Byte	0	1	2	3	4 .. 7
Content	0x45(ID)	10(length)	8	not_used	access pw

Table 57 - callNXPCommands - Calibrate - outgoing

Change Config

Byte	0	1	2	3	4 .. 7	8..9
Content	0x45(ID)	10(length)	9	not_used	access pw	config

Table 58 - callNXPCommands - Change Config - outgoing

To all NXP related the report the device responds:

Byte	0	1	2	3 .. 4
Content	0x46(ID)	5(length)	Status (Error Byte)	config word (only change config)

Table 59 - callNXPCommands - incoming

Error Byte

Some report frames which are sent from the controller to the host computer include an error byte:

Value	Error-Code Name	Description
0x00	GEN2_OK	No Error
0x01	GEN2_ERR_REQRN	Error sending ReqRN.
0x02	GEN2_ERR_ACCESS	Error sending Access password.
0x03	GEN2_ERR_KILL	Error sending Kill.
0x04	GEN2_ERR_NOREPLY	Error no reply received.
0x05	GEN2_ERR_LOCK	Error locking command.
0x06	GEN2_ERR_BLOCKWRITE	Error Blockwrite.
0x07	GEN2_ERR_BLOCKERASE	Error Blockerase.
0x08	GEN2_ERR_READ	Error Reading.
0x09	GEN2_ERR_SELECT	Error when selecting tag.
0x0A	GEN2_ERR_CHANNEL_TIMEOUT	Error RF channel timed out.
0x80	Other Error	Catch-all for errors not covered by other codes.
0x83	Memory Overrun	The specified memory location does not exist or the EPC length field is supported by the Tag
0x84	Memory locked	The specified memory location is locked and/or permalocked and is either nor writeable or not readable.
0x8B	Insufficient power	The Tag has insufficient power to perform the memory – write operation.
0x8F	Non-specific error	The Tag does not support error-specific codes
0xFF		No response from the Tag (time out)

Table 60: Error Byte

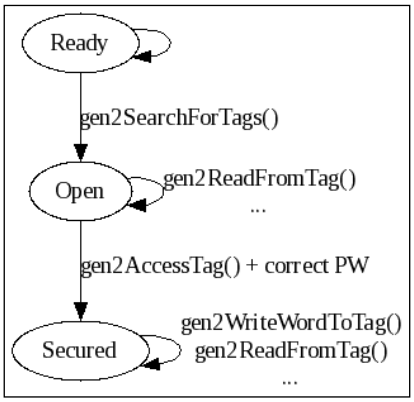
Protocol Layer - Gen2

Data Type	Function
unsigned	gen2SearchForTags (**Tag** *tags, u8 maxtags, u8 ***mask**, u8 length, u8 q, **bool**(*cbContinueScanning)(void), **bool** useMaskToSelect)
unsigned	gen2SearchForTagsFast (**Tag** ***tags_**, u8 maxtags, u8 ***mask**, u8 length, u8 q, **bool**(*cbContinueScanning)(void))
u8	gen2AccessTag (**Tag** *tag, u8 *password)
u8	gen2LockTag (**Tag** *tag, u8 *mask_action)
u8	gen2KillTag (**Tag** *tag, u8 *password, u8 rfu)
u8	gen2WriteWordToTag (**Tag** *tag, u8 memBank, u8 wordPtr, u8 *databuf)
u8	gen2NXPChangeConfig (**Tag** *tag, u8 *databuf)
u8	gen2ReadFromTag (**Tag** *tag, u8 memBank, u8 wordPtr, u8 wordCount, u8 *destbuf)
u8	gen2SetProtectBit (**Tag** *tag)
u8	gen2ReSetProtectBit (**Tag** *tag, u8 *password)
u8	gen2ChangeEAS (**Tag** *tag, u8 value)
u8	gen2Calibrate (**Tag** *tag)
void	gen2PrintTagInfo (**Tag** *tag, u8 epclen, u8 tagNr)
void	gen2Configure (const struct gen2Config *config)
void	gen2Open (const struct gen2Config *config)
void	gen2Close (void)

Table 61 - Gen2 Functions

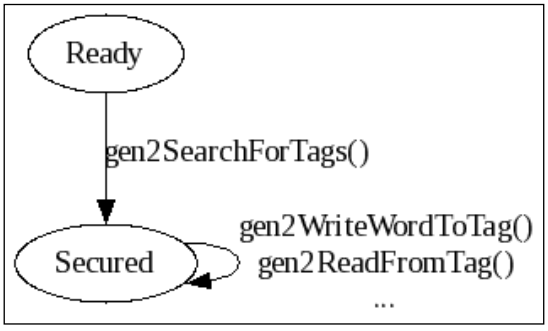
- Before calling any of the functions the AUDR UHF reader chip needs to be initialized using AUDR UHF readerInitialize().
- Next the function gen2Open() needs to be called for opening a session.
- gen2SearchForTags() should be called to identify the tags in reach. Typically tag singulation is done next.
- In order to do so gen2SearchForTags() is called again provided a proper mask to singulate (select) a tag.
- In this case only one tag is returned by gen2SearchForTags().
- This tag is then in the Open/Secured state and may be accessed using the other Gen2 functions (gen2WriteWordToTag(), gen2ReadFromTag(), ...).
- When finished with gen2 operations this session should be closed using gen2Close().

State Diagram:



Picture 2 - Gen2 - State Diagram

State Diagram – Tag has no password set:

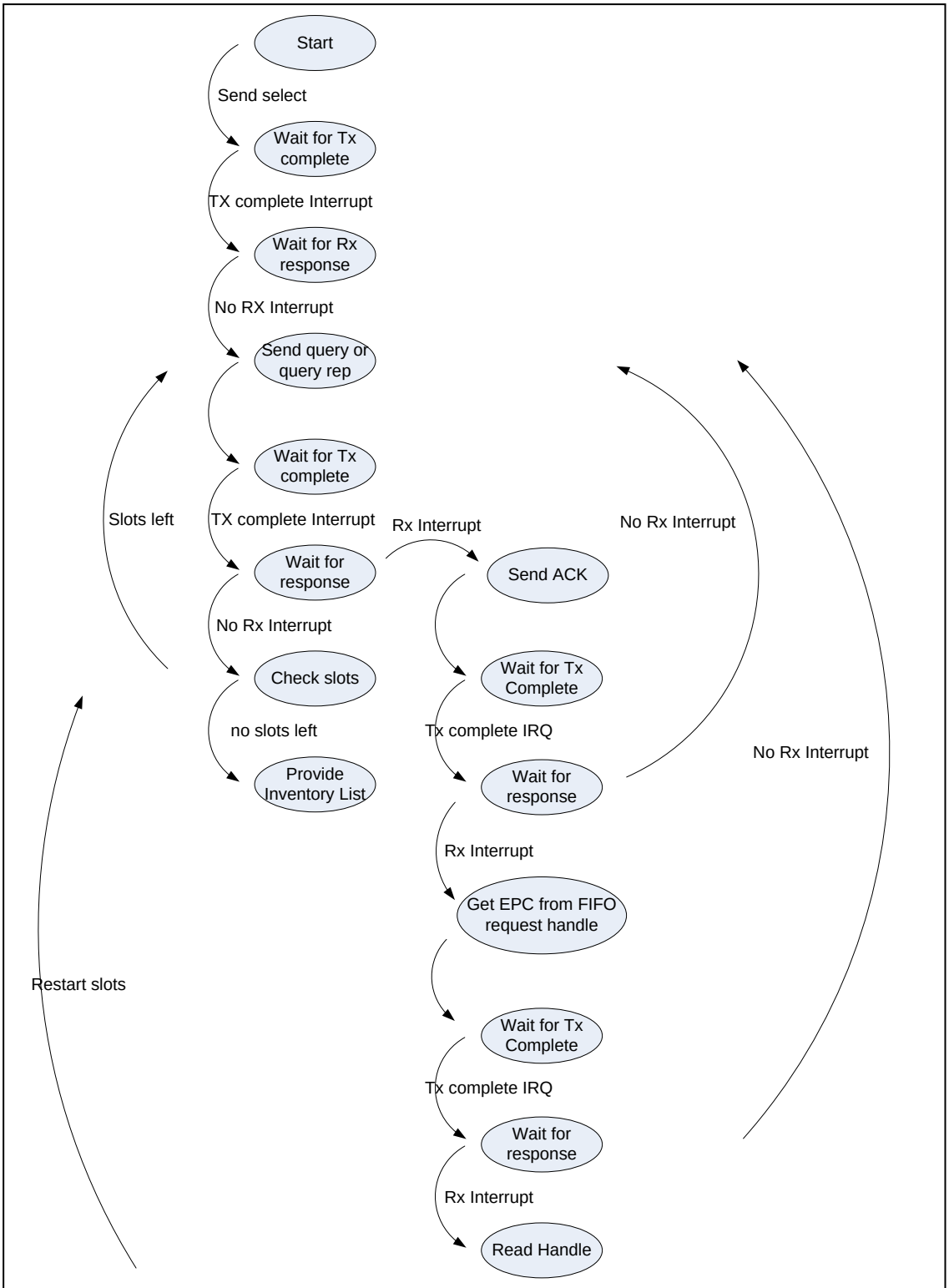


Picture 3 - Gen2 - State Diagram (no password set)

Typical Use-Case:

```
Tag tags[16];
 struct gen2Config config = {GEN2_LF_160, GEN2_COD_MILLER2, GEN2_IINV_S0, 1};
 unsigned n;
 u8 buf[4];
 ...
 readerInitialize(912000);

 gen2Open(&config);

 n = gen2SearchForTags(tags,16,0,0,4);
 if ( n == 0) return;

 //Pick one of the tags based on the contents of tags. Here we use the very first tag

 if (gen2ReadFromTag(tags+0, MEM_USER, 0, 2, buf))
    return;

 buf[0] ^= 0xff; buf[1]^= 0x55; // change the data

 if (gen2WriteWordToTag( tags+0, MEM_USER, 0,  buf))
 { // wrote back one of the two read words
    gen2Close();
    return;
 }

 //...

 gen2Close();
```

One of the more complex flowcharts is the Inventory algorithm in which the 6c anti-collision is executed.

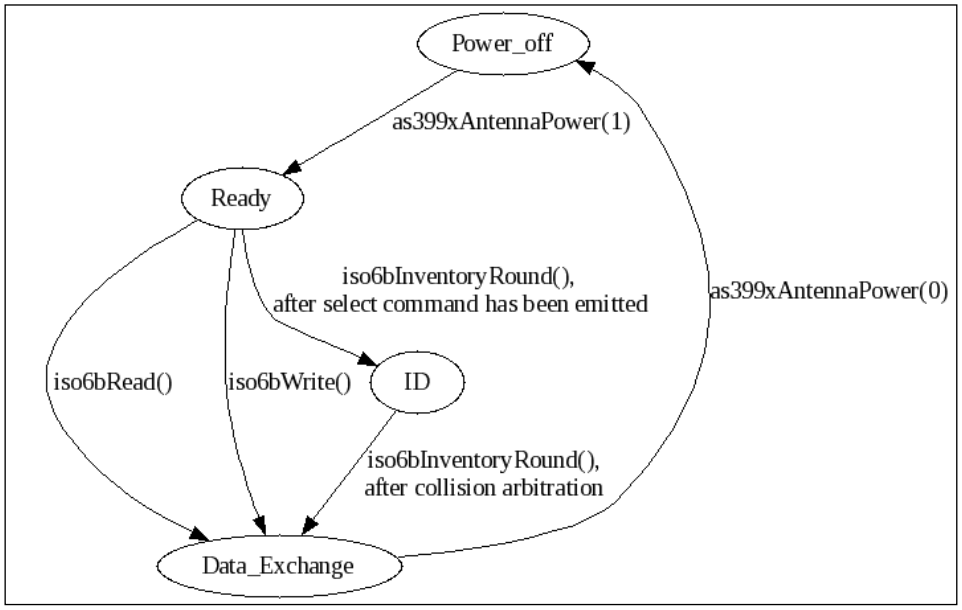


Picture 4: Gen2 Anti Collision – State Diagram

Protocol Layer - ISO6B

Before calling any of the functions herein the AUDR UHF READER needs to be initialized using AS339xreaderInitialize(). Thereafter the function iso6bOpen() needs to be called for opening a session.

The following graph shows several states of an ISO 6B tag as well as their transitions based on iso6b* commands:



Picture 5 - ISO6B - State Diagram

Protocol Layer - AS399x_public

Data Type	Function
u16	as399xInitialize (u32 baseFreq)
unsigned char	as399xReadChipVersion (void)
void	as399xSwitchToIdleMode (void)
void	as399xSelectLinkFrequency (u8 a)
void	as399xSetBaseFrequency (u8 regs, u32 frequency)
void	as399xMemoryDump (void)
void	as399xAntennaPower (u8 on)
void	as399xGetRSSI (u16 num_of_ms_to_scan, u8 *rawIQ, s8 *dBm)
void	as399xSaveSensitivity ()
void	as399xRestoreSensitivity ()
s8	as399xSetSensitivity (s8 minimumSignal)
s8	as399xGetSensitivity (void)
u16	as399xGetReflectedPower (void)
void	as399xReset (void)

Table 62 - AS399x_public Functions

Device Specific Functions

Data Type	Function
void	as399xSingleCommand (u8 command)
void	as399xContinuousRead (u8 address, s8 len, u8 *readbuf)
void	as399xFifoRead (s8 len, u8 *readbuf)
u8	as399xSingleRead (u8 address) reentrant
void	as399xWritePredistortion (const u8 *buf)
void	as399xContinuousWrite (u8 address, u8 *buf, s8 len)
void	as399xSingleWrite (u8 address, u8 value)
void	as399xCommandContinuousAddress (u8 *command, u8 com_len, u8 address, u8 *buf, u8 buf_len)
u8	as399xGetFIFOStatus (void)
u8	as399xGetIRQStatus (void)
void	as399xWaitForResponse (u16 waitMask)
void	as399xWaitForResponseTimed (u16 waitMask, u16 ms)
void	as399xEnterDirectMode ()
void	as399xExitDirectMode ()

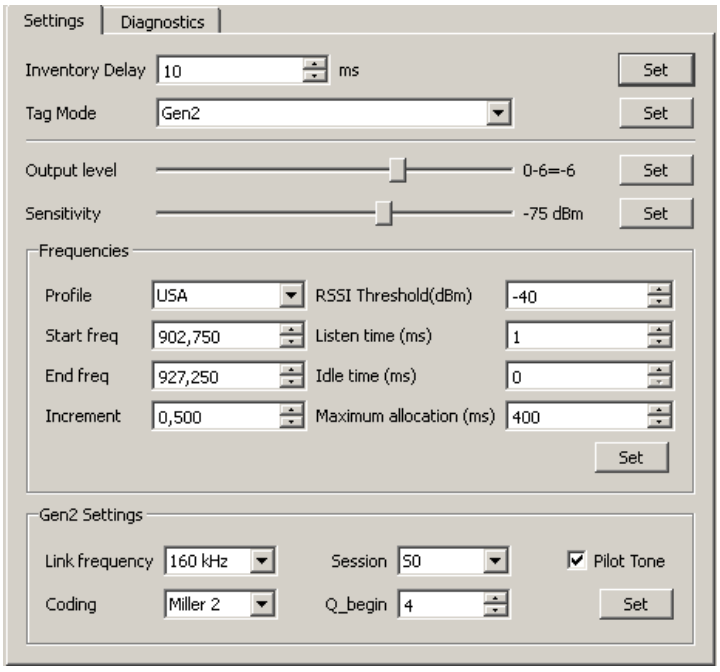
Table 63 - AS399x - Functions

Subject to change without notice

Implementation of frequency hopping

The device is designed for worldwide use. Per default it loads the European frequency setup upon start up. Different setup can be applying the commands described in tables 18 – 25. Nevertheless the default function implemented in firmware after loading the region specific frequencies is as follows.

ARYGON Reader Suite GUI is designed to allow most freedom in select different adoptions in the worldwide setup.



Picture 6 – Parameters

In the frequency section e.g. USA settings:
Each setting can also be manually changed upon user requirements.

The selection of a profile will load region specific settings for:

- Start frequency: The lowest channel frequency
- End frequency: the highest channel frequency
- Increment: The channel spacing between two channels
- RSSSI Threshold: give the opportunity to set a Listen before Talk (LBT) value. In case a LBT is not needed or not wanted, this level should be as high as possible (e.g. -40 dB) The thresholds that can be managed by the system starts at -47 dBm and can reach up to -86 dBm. (Please note that the levels are chip values and can be changed by the external components. That means that Arygon will have a 10 dB higher value than the described value in the GUI)
- Listen time: This time specify how long the reader is listening to the channel. The largest recorded signal during the listen time will determine the channel power.
- Idle time: This time specify the time between two channel hop.
- Maximum allocation time: This time define the maximum time on one frequency.

The profile will be transferred with the “Set” Button to the reader.

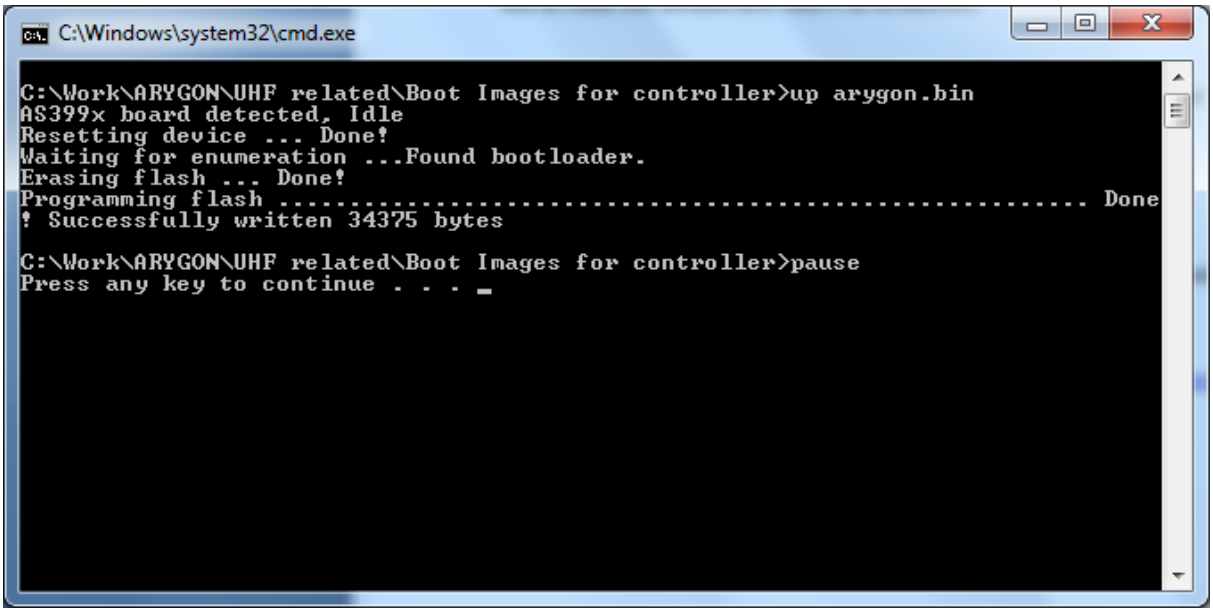
After press the button, the GUI will start to transfer a randomized frequency table List and store it in its memory. Now the reader will change the frequency on every Inventory or Tag command according to the list. Since the Gen2 anti collision round is limited by the slot counter Q, it is possible to calculate the maximum allocated channel time to less than 400ms. Nevertheless it is also possible to limit the channel allocation time with the maximum allocation time. Since Arygon is used as a desktop reader, the user is advised to use a max Q value of less than 4.

The Gen2 settings are for individual Link frequencies.
For USA, it is recommended
Link frequency: 256 kHz
Session:S0
Q_Begin: 4

3. Firmware update of the AUxx reader

Assuming that the boot loader is already loaded into the flash memory the firmware of the AUxx reader system can be updated in an easy way. Care needs to be taken that the ARYGON Reader Suite is not running at the same time during the programming process. To program the AUxx UHF reader system simply double click the batch file “FWupdate_ARYGON_UHF_reader.bat”. The batch file will run the “up.exe” executable which loads the “Arygon.bin” into the micro AUDR‘s flash memory. Therefore those two files need to be present in the same directory as the batch file itself.

When the programming is completed the message “Successfully written xxxx bytes” appears. Hit any key to close the window and return to WINDOWS.



Picture 7: Firmware updating response

The Arygon readers are now able to communicate with the ARYGON Reader Suite via USB.

In case of problems, please contact: info@arygon.com . http://www.arygon.com