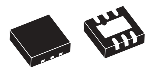
XRAG2

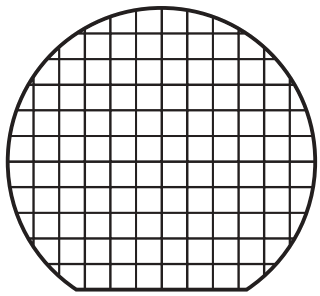
432-bit UHF, EPCglobal Class1 Generation2 and ISO 18000-6C, contactless memory chip with user memory

Features

- EPCglobal class 1 generation 2 RFID UHF specification (revision 1.0.9)
- Passive operation (no battery required)
- UHF carrier frequencies from 860 MHz to 960 MHz ISM band
- To the XRAG2:
  - Asynchronous 90% SSB-ASK, DSB-ASK or PR-ASK modulation using pulse interval encoding (Up to 128Kbit/s)
- From the XRAG2:
  - Backscattered reflective answers using FM0 or Miller bit coding (up to 640 Kbits/s)
- 432-bit memory with two possible configurations:
  - 3 memory banks to store up to 256-bit EPC code: 64-bit TID, 304-bit EPC and 64-bit reserved banks
  - 4 memory banks to store up to 128-EPC code: 128-bit user, 64-bit TID, 176-bit EPC and 64-bit reserved banks
- Supports EPC and ISO TID
- Multisession protocol
- Anti-collision functionality
- Inventory, Read, Write and Erase features
- Kill command
- 100 ms programming time (max) for 288-bit (EPC code, Protocol Control bits and CRC16) programming
- More than 10,000 Write/Erase cycles
- More than 40 years' data retention
- Packages
  - ECOPACK® (RoHS compliant)



UFDFPN6(1)
1.8 × 2 mm (MA)



Unsawn unbumped wafers
or
sawn and bumped wafers

1. Preliminary data.

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1 Description

The XRAG2 is a full-featured, low-cost integrated circuit for use in radio frequency identification (RFID) transponders (XRAG2s) operating at UHF frequencies. It is a 432-bit memory organized as 3 or 4 memory banks of 16-bit words as shown in *Figure 4* and *Figure 5*.

When connected to an antenna, the operating power is derived from the RF energy produced by the RFID reader and incoming data are demodulated and decoded from the received double-side band amplitude shift keying (DSB-ASK), single-side band amplitude shift keying (SSB-ASK) or phase-reversal amplitude shift keying (PR-ASK) modulation signal. Outgoing data are generated by antenna reflectivity variation using either FM0 or the Miller bit coding principle (chosen by the reader).

Communications between the reader and the XRAG2 are Half-duplex, which means that the XRAG2s does not decode reader commands while back scattering.

The data transfer rate is defined by the local UHF frequency regulation.

The XRAG2 complies with the EPC Global Class-1 Generation-2 UHF RFID specification, revision 1.0.9, for the radio-frequency power and signal interface.

Figure 1. Pad connections

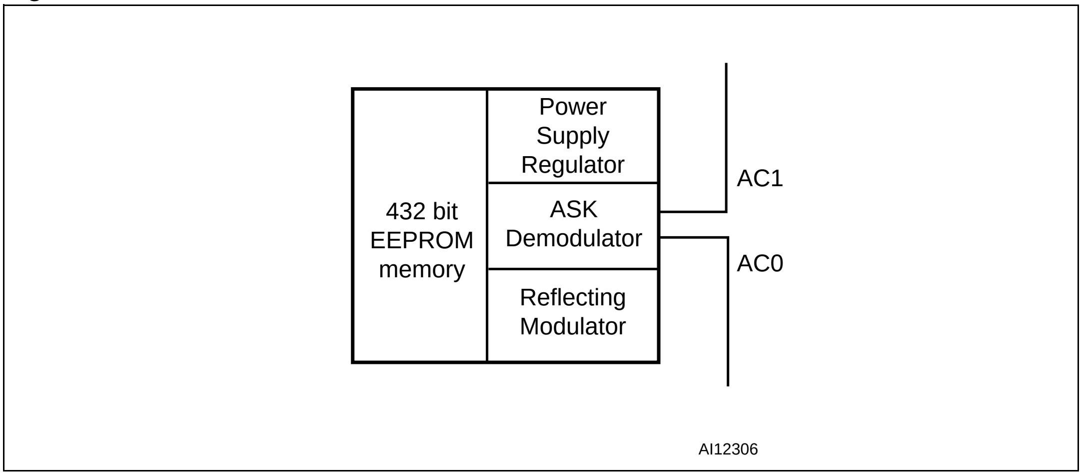


Figure 2. Die floor plan

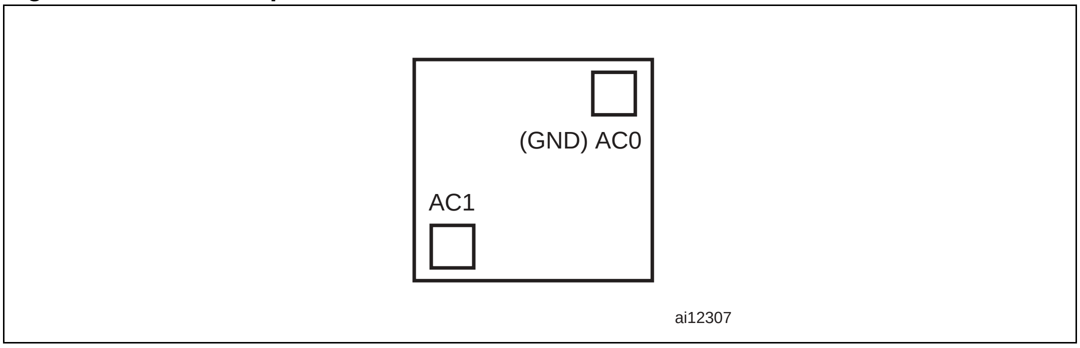


Table 1. Signal names

Signal name	Function
AC1	Antenna pad
AC0 (GND)	Antenna pad

The dialog between the reader and the XRAG2 is conducted through the following consecutive operations:

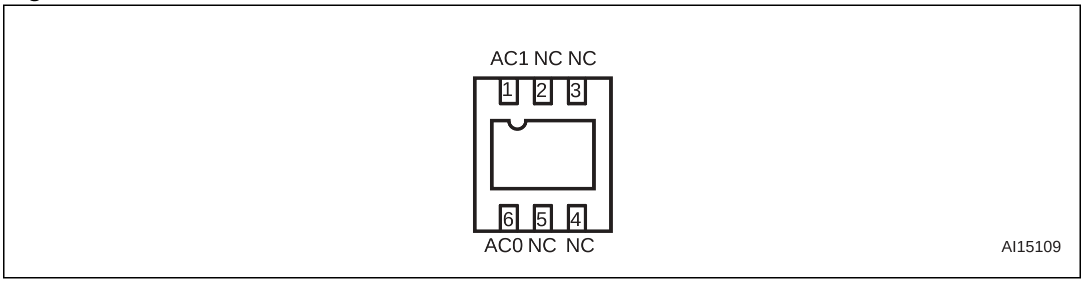
- activation of the XRAG2 by the UHF operating field of the reader
- transmission of a command by the reader
- transmission of a response by the XRAG2

This technique is called RTF (reader talk first).

The XRAG2 is specifically designed for extended-range applications that need automatic item identification. The XRAG2 provides a fast and flexible anti-collision protocol that is robust under noisy and unpredictable RF conditions typical of RFID applications. The XRAG2 EEPROM memory can be read and written, which enables users to program the EPC code and user memory on site, if desired.

The TID memory is written by STMicroelectronics during the manufacturing process.

Figure 3. UFDFPN connections



1. There is an exposed central pad on the underside of the UFDFPN package. This is pulled, internally, to V_{SS}, and must not be allowed to be connected to any other voltage or signal line on the PCB.
2. See *Package mechanical data* section for package dimensions, and how to identify pin-1.

2 XRAG2 memory mapping

The XRAG2 is a 432-bit memory organized in three memory banks (without the user memory) or four memory bank (with the user memory) depending on the size of the EPC code chosen by the user. Each bank is organized as 16-bit words. The reader can read part or all of each memory bank by 16-bit words. Using the Write command, the device is written a 16-bit word at a time. The BlockWrite command allows readers to write up to 4 words at a time. The BlockErase command allows readers to erase several words at a time (from two words to the entire memory bank).

The bank number and memory organization depend on the size of the EPC contents programmed in the EPC_length field stored in the first five bits of the Protocol Control (PC) word.

The sixteen Protocol Control bits are located at memory bit addresses 10h-1Fh of the EPC bank, as defined in the *EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9*.

The XRAG2 memory organization is automatically adjusted under the following conditions:

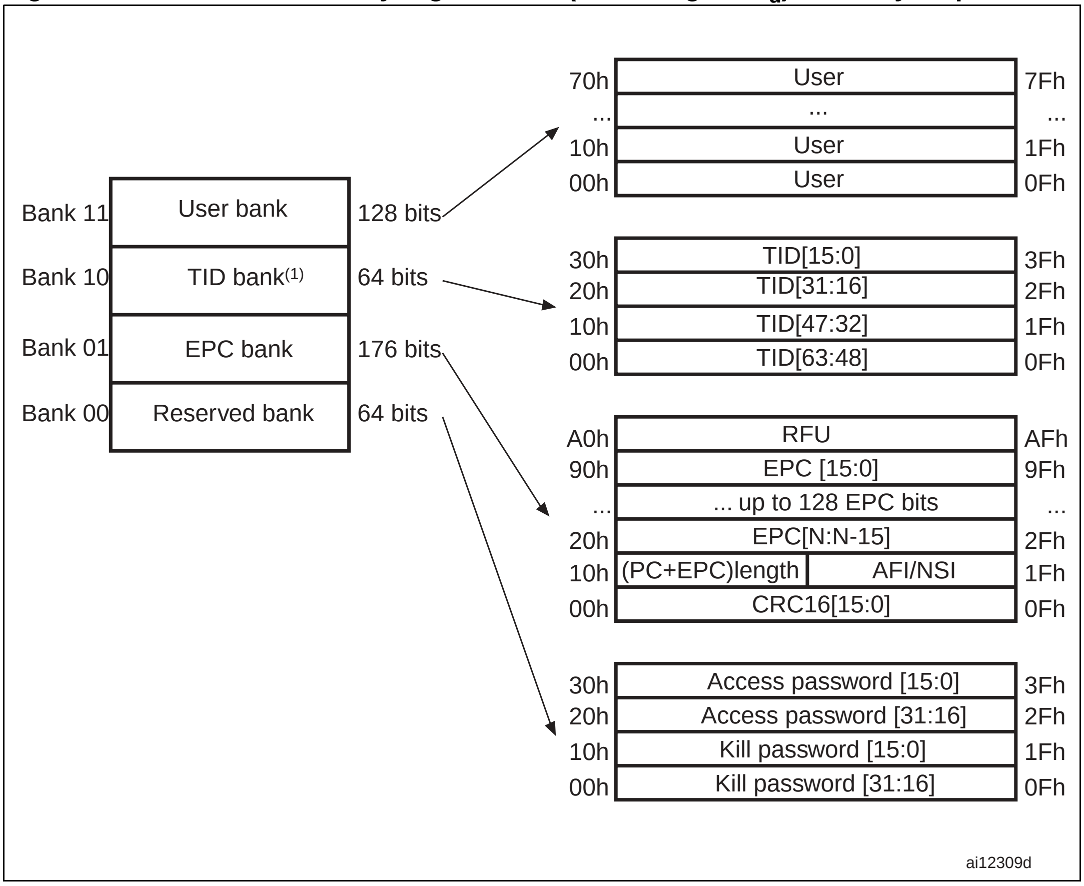
- for EPC_length values below or equal to 9_d, the XRAG2 memory organization features a:
  - 64-bit Reserved bank,
  - 176-bit EPC bank for 128-bit EPC code storage,
  - 64-bit TID bank,
  - 128-bit User bank,

The memory map corresponding to this configuration is shown in *Figure 4*.

- for EPC_length values above 9_d, the XRAG2 memory organization features a:
  - 64-bit Reserved bank,
  - 304-bit EPC bank for 256-bit EPC code storage,
  - 64-bit TID bank.

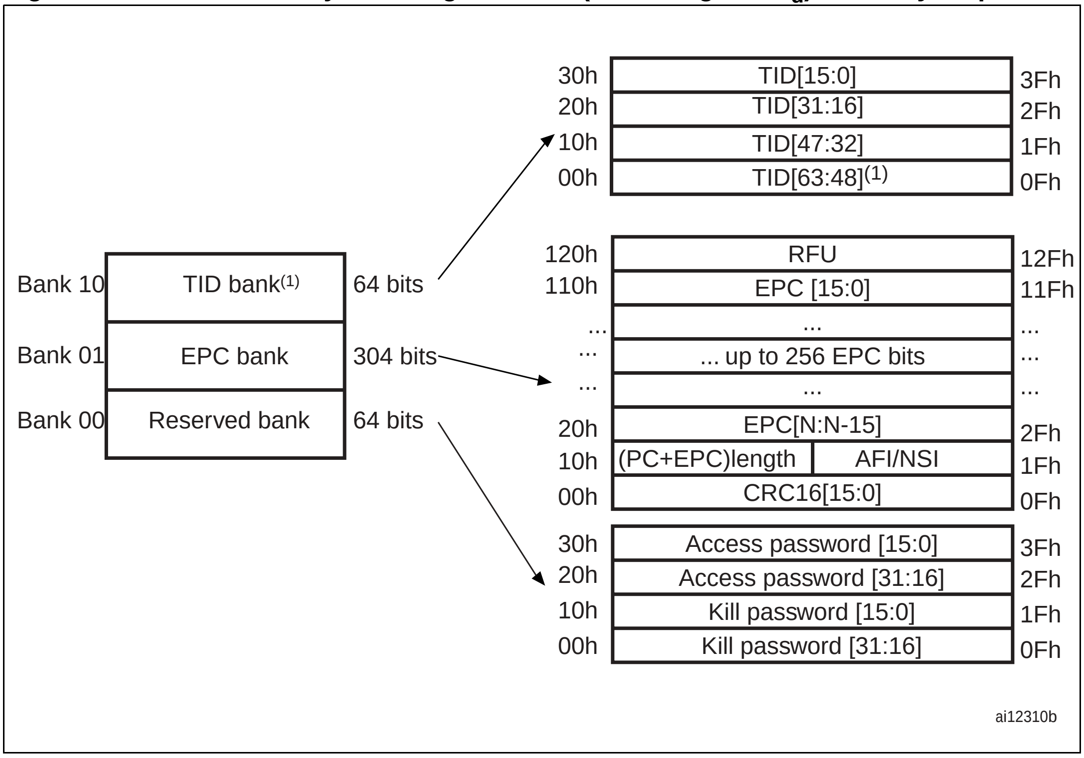
The memory map corresponding to this configuration is shown in *Figure 5*.

Figure 4. Four bank memory organization (EPC_length $\leq 9_d$), memory map



1. See *Table 2* and *Table 3* for description of EPC and ISO TID coding.

Figure 5. Three memory bank organization (EPC_length > 9_d), memory map:



1. See *Table 2* and *Table 3* for description of EPC and ISO TID coding.

2.1 Tag identification (TID) structure

The 64-bit TID memory content is written by STMicroelectronics according to the ISO 15963 Technical Report in order to follow the ISO 18000 standard recommendations. XRAG2 can be delivered with either ISO TID or EPC TID. *Table 2* and *Table 3* show the TID structure in each case.

Table 2. Structure of ISO TID

	b0 b1b2 b3 b4 b5	b6 b7 b8 b9b10b11 b12 b13 b14 b15	
30h	42 bits		3Fh
20h	ST		2Fh
10h	09h	Reserved	1Fh
00h	E0h	02h	0Fh

Table 3. Structure of EPC TID

	b0 b1b2 b3 b4 b5b6 b7 b8 b9b10 b11 b12 b13 b14 b15
30h	32 bits
20h	ST reserved
10h	7240h
00h	E200h

- Tag mask-identifier 007h for STMicroelectronics
- Tag model number 240h for XRAG2

2.2 Initial delivery state

XRAG2 devices are delivered as follows:

- Reserved bank, with Access and Kill passwords set to 00000000h
- Protocol Control word programmed to 3000h (96 bits long EPC code)
- EPC bank, all 00h except for PC word
- TID bank programmed and locked as described in *Section 2.1: Tag identification (TID) structure*
- User bank, All 00h

3 XRAG2 command list

The XRAG2 offers Select, Inventory, and Access commands sets as described in the EPCglobal class 1 generation 2 UHF RFID specification, revision 1.0.9:

- Select command set:
  - Select
- Inventory command set:
  - Query
  - QueryAdjust
  - QueryRep
  - ACK
  - NAK
- Access command set:
  - Req_RN
  - Read
  - Write
  - Kill
  - Lock
  - Access
  - BlockWrite
  - BlockErase

For a detailed description of the commands, see *Section 8: XRAG2 command descriptions*.

4 Operating frequency and temperature

The XRAG2 RF interface and voltage multiplier convert RF energy provided by the reader into the DC power required for the XRAG2 to operate.

The XRAG2 operates in the 860MHz to 960MHz frequency range, as specified in the EPCglobal class-1 generation-2 UHF RFID specification, revision 1.0.9.

When connected to an antenna, the operating frequency is fixed by the antenna's tuning frequency and bandwidth.

Table 4. XRAG2 operating temperature range

Parameter	Symbol	Min	Max	Units
Operating temperature	t_{op}	-20	55	°C

When connected to an antenna, the operating temperature range is determined by the antenna material capabilities.

5 Reader-to-tag protocol

5.1 Reader-to-tag Power-Up and Power-Down

The reader power-up and power-down waveform, and timing requirements are specified in the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9.

5.2 Reader-to-tag RF modulation

A reader can communicate with the tag by modulating the RF carrier using DSB-ASK, SSB-ASK or PR-ASK, as specified in EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9.

Figure 6. Reader-to-tag RF envelop

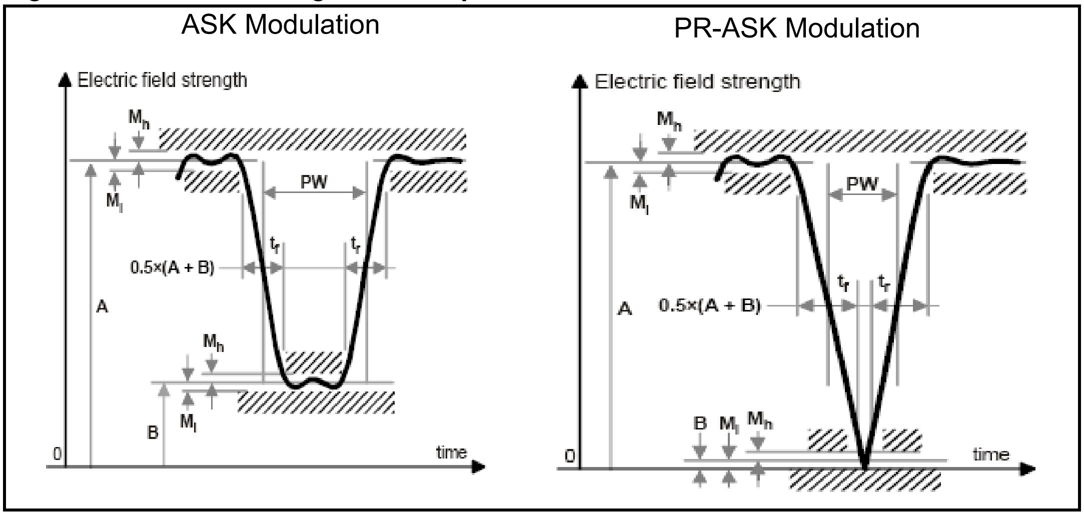


Table 5. RF envelop parameters(1)

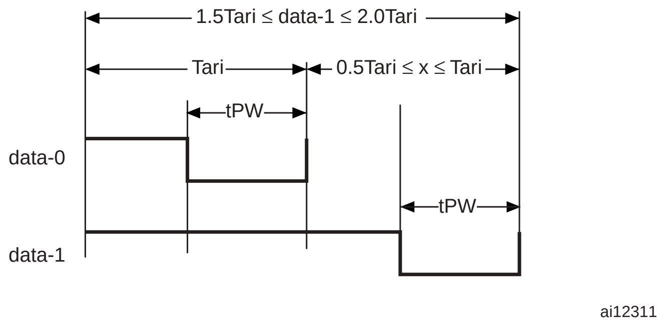
Parameter	Symbol	Min	Typical	Max	Units
Modulation depth	(A-B)/A	80	90	100	%
RF envelop ripple	M_h=M_l	0		0.05(A-B)	V/m
RF envelop rise and fall time	$t_{r,10\text{-}90\%}$ and $t_{f,\ 90\text{-}10\%}$	0		0.33 Tari	µs

1. Characterized only.

5.3 Reader-to-tag data encoding

A reader communicates with the tag using Pulse Interval Encoding (PIE), as specified in EPCglobal class-1 generation-2 UHF RFID specification.

Figure 7. PIE encoding



Pulse modulation depth, rise time, fall time, Tari, RF Pulse Width (t_{PW}) and RF envelope are specified in the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9.

Table 6. PIE parameters(1)

Parameter	Symbol	Min	Max	Units
RF pulse width	t_{PW}(2)	max (2.265 Tari)	0.525 Tari	µs
Tari(3)	Tari	6.25	25	µs

1. Characterized only.
2. t_{PW} is the pulse width duration and corresponds to a negative pulse width (RF interruption period).
3. Tari is the reference time for reader-to-tag signaling, and is the duration of a ‘0’.

5.4 Reader-to-tag communication start and calibration

As specified in the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9, a reader begins signaling to the tag with a preamble or frame-sync sequence.

A preamble sequence must precede a Query command to calibrate data rates during communication from the reader to the tag and from the tag to the reader (see *Figure 8*). The preamble denotes the start of an inventory round. The preamble is composed of the delimiter, RTCal and TRCAL symbols:

- RTcal corresponds to the duration of a ‘0’ and a ‘1’. When receiving the preamble, the tag computes pivot = RTCAL/2 and decodes further coming data symbol shorter than pivot as ‘0’, and data symbol longer than pivot as ‘1’.
- TRcal in addition to the Divide ratio (DR) parameter transmitted in the Query command is used by readers to specify the tag-to-reader backscatter link frequency
  - data rate for FM0 tag-to-reader base band modulation: LF=DR/TRcal
  - data rates for Miller tag-to-reader subcarrier modulation: LF/M (M specified during Query command)

A frame-sync sequence must precede all other signaling (see *Figure 9*).

Figure 8. Preamble timings

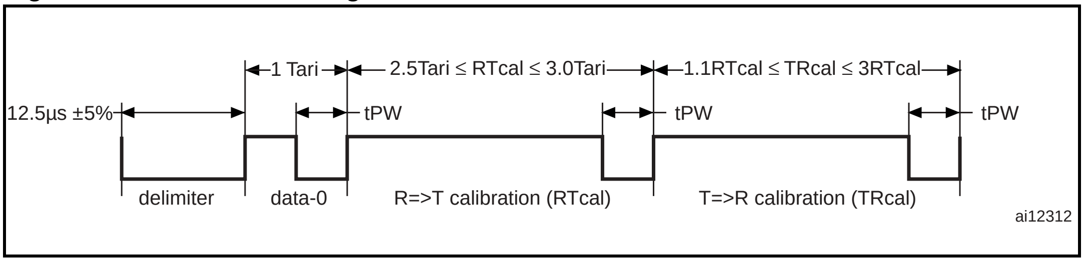


Figure 9. Frame-sync sequence timings

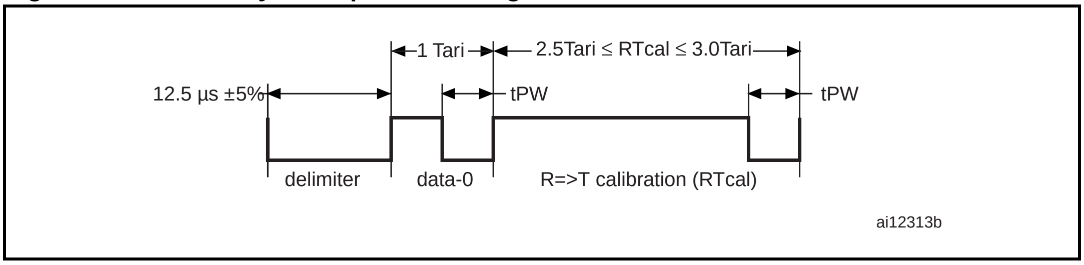


Table 7. Reader to tag frame-sync and preamble timings[(1)]

Parameter	Symbol	Min	Typ	Max	Tolerance	Units
Delimiter	Delimiter		12.5		5%	µs
Reader-to-tag calibration timing	RTcal	2.5		3	1%	Tari
Tag-to-reader calibration timing	TRcal	1.1		3	1%	RT_{CAL}

1. Characterized only.

Preamble and frame-sync format and timings follow the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9.

6 Tag-to-reader protocol

During answer frames, the tag backscatters data in accordance to the encoding format and data rate chosen by the reader during the Query command starting the inventory round. The tag backscatters data to the reader by modulating its antenna reflection coefficient.

6.1 Tag-to-reader data encoding

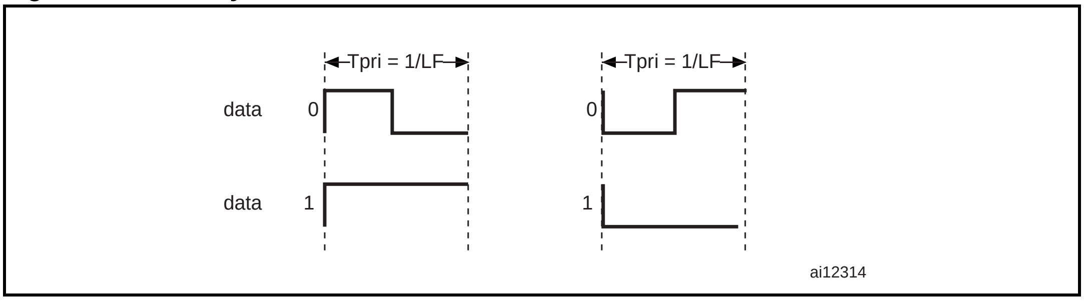
As specified in the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9, the tag encodes the backscattered data as either FM0 base band (biphase space) or Miller modulation of a subcarrier at the data rate requested by the reader.

High values represented on *Figure 10*, *Figure 11*, *Figure 13*, *Figure 14*, *Figure 15*, and *Figure 16* correspond to the tag antenna's reflecting power.

6.1.1 Tag-to-reader FM0 encoding

As specified in the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9, Tag-to-reader FM0 modulation is chosen by the reader by setting the Subcarrier Number parameter (M) to 1 in the query command starting the inventory round.

Figure 10. FM0 symbols

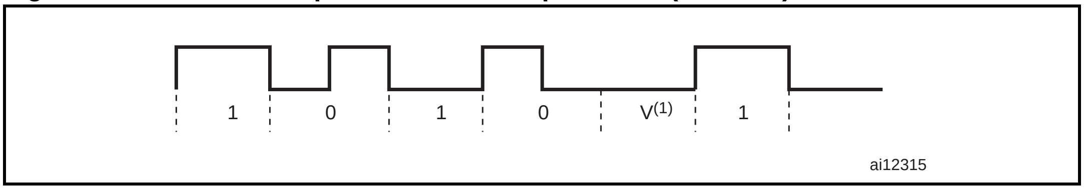


Tag-to-reader link frequency is defined in *Section 5.4: Reader-to-tag communication start and calibration*.

6.1.2 Tag-to-reader FM0 preamble

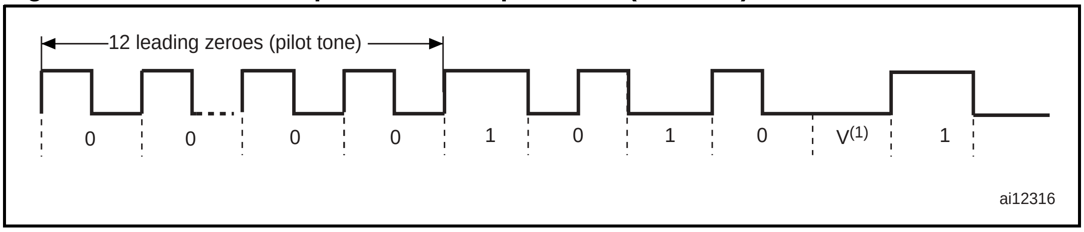
As defined in the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9, the tag can start FM0 backscattering using a 12 0's pilot tone, depending on the value of the TRext parameter sent during the Query command that initiates the inventory round. *Figure 11* and *Figure 12* show the two possible FM0 modulation answer preamble formats according to the TRext parameter value.

Figure 11. FM0 answer preamble without pilot tone (TRext=0).



1. V = violation.

Figure 12. FM0 answer preamble with pilot tone (TRext=1).

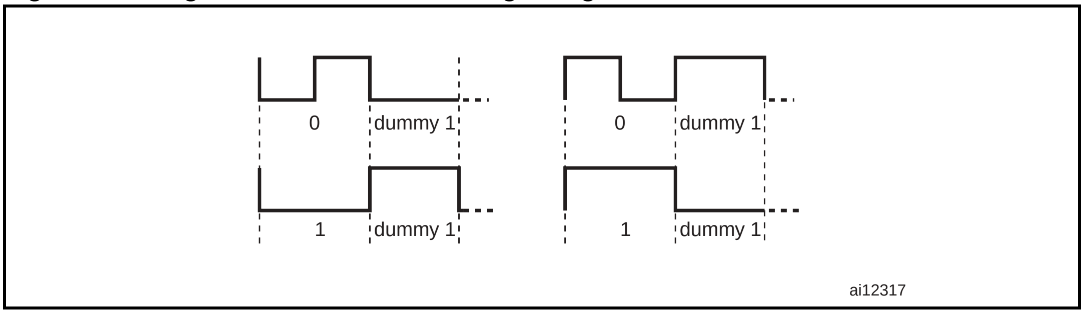


1. V = violation.

6.1.3 Tag-to-reader FM0 end of signaling

As specified in the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9, the tag ends transmissions with a dummy ‘1’. *Figure 13* shows the different possibilities occurring during communications.

Figure 13. Tag-to-reader FM0 end of signaling



6.1.4 Tag-to-reader FM0 data rate

The Tag provides all FM0 backscattering modulation data rate specified in the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9:

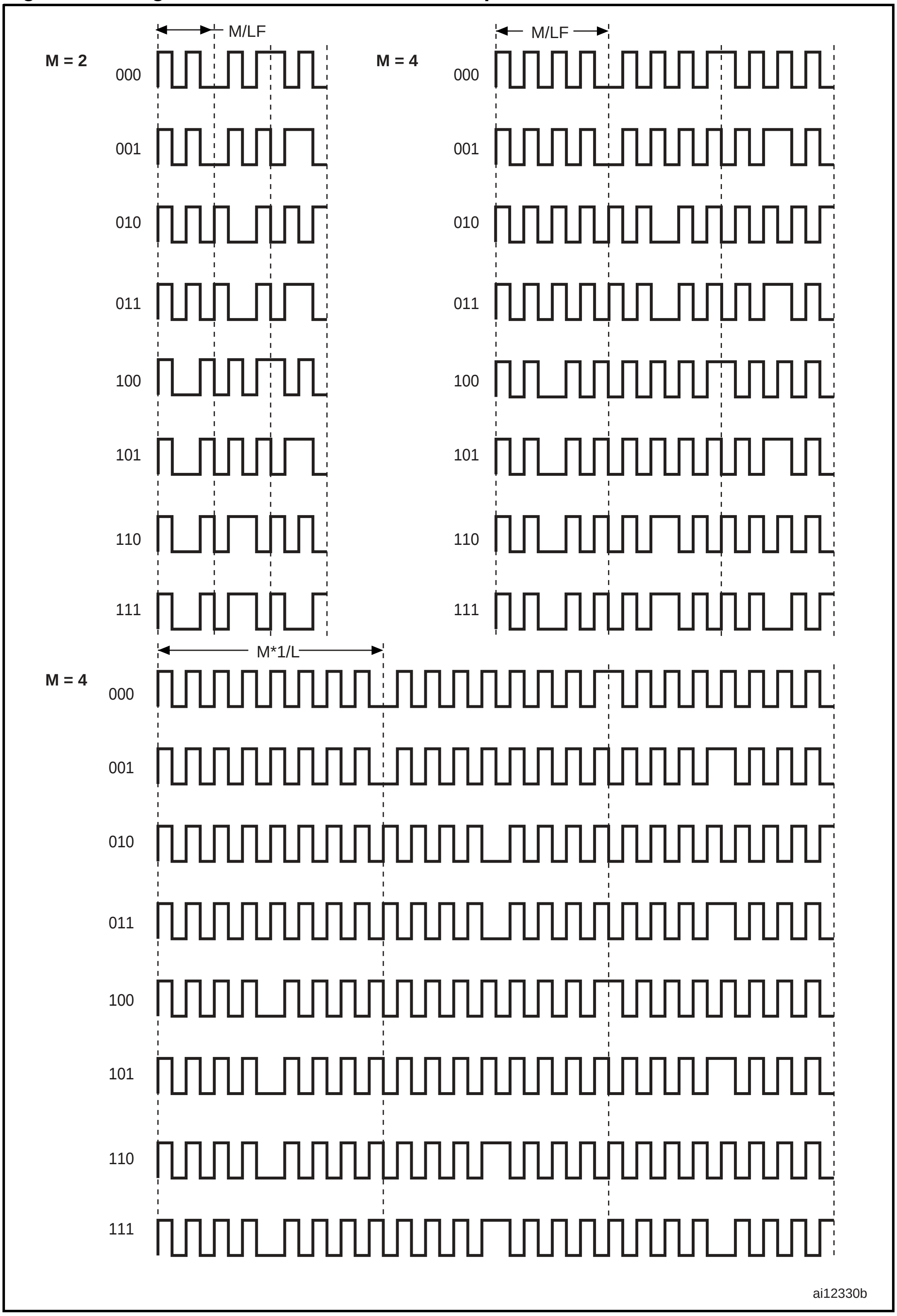
$$40 \text{ Kbps} \leq LF \leq 640 \text{ Kbps}$$

6.1.5 Tag-to-reader Miller-modulated subcarrier encoding

The tag provides tag-to-reader Miller subcarrier modulation as specified in EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9.

The tag-to-reader Miller subcarrier modulation is chosen by the reader by setting the Subcarrier Number parameter (M) to 2, 4 or 8 during the Query command starting the inventory round. *Figure 14* shows Miller subcarrier modulation sequence examples for M=2, M=4 and M=8.

Figure 14. Tag-to-reader Miller subcarrier sequences

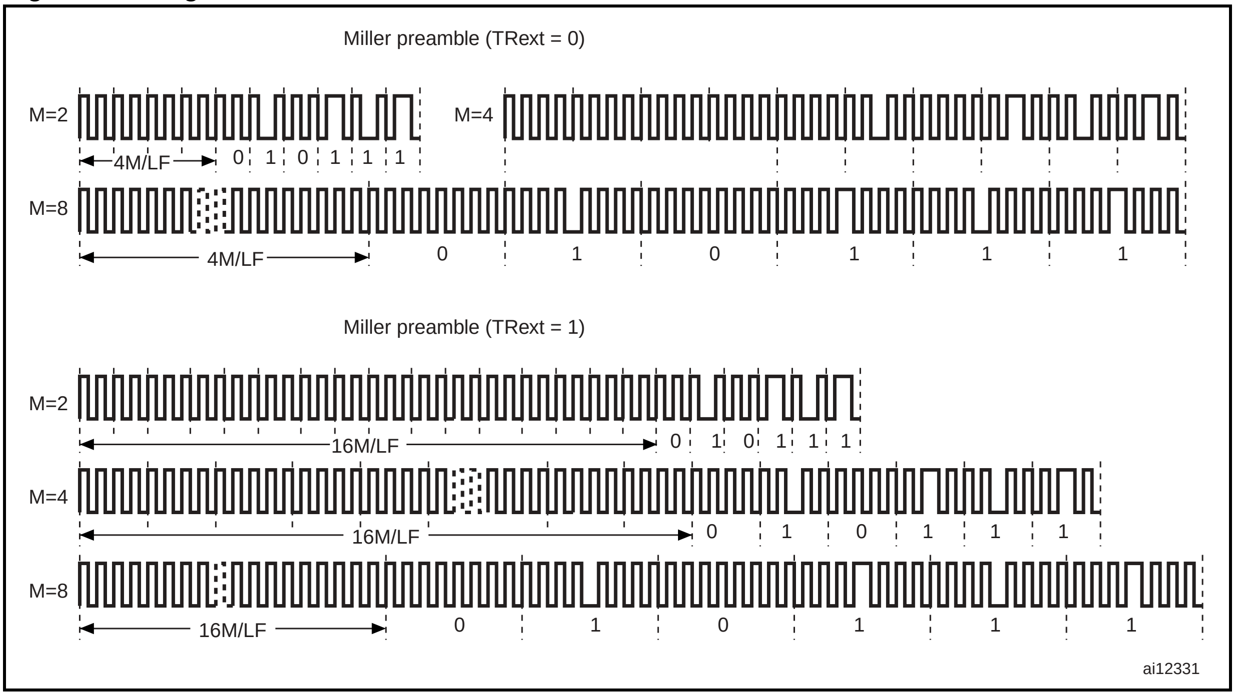


6.1.6 Tag-to-reader Miller sub carrier modulation preamble

As for the FM0 base band modulation, the Tag supports the two Miller subcarrier modulation preamble formats, according to the TRext parameter, as specified in the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9.

Figure 15 shows Miller preamble according to the value of the TRext parameter of the Query command starting the inventory round.

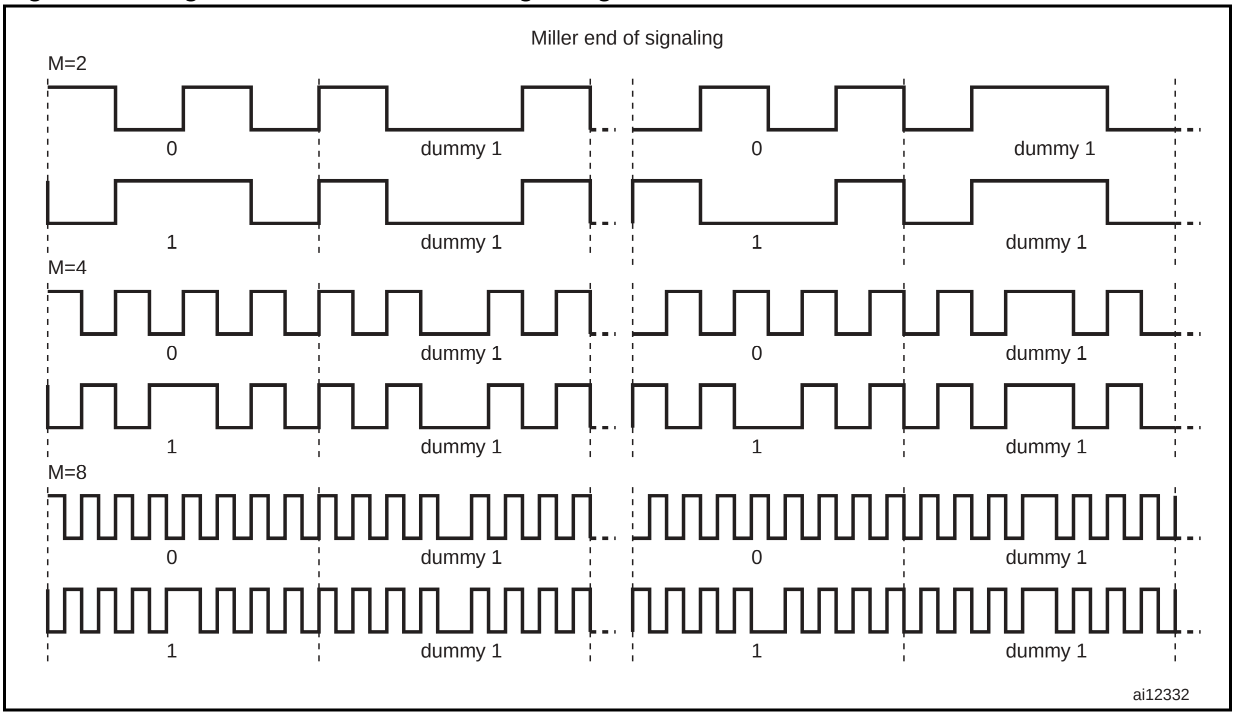
Figure 15. Tag-to-reader Miller Preamble



6.1.7 Tag-to-reader Miller subcarrier modulation end of signaling

In accordance with the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9, the tag miller subcarrier modulation signaling ends with a dummy ‘1’. *Figure 16* shows the different possible Miller subcarrier modulation end of signaling sequences.

Figure 16. Tag-to-reader Miller end of signaling



6.2 Tag-to-reader Miller signaling data rates

The tag supports all Miller subcarrier modulation data rates specified in the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9:

$320 \text{ Kbps} \geq \text{Miller}_{\text{datarate (M=2)}} \geq 20 \text{ Kbps}$

$160 \text{ Kbps} \geq \text{Miller}_{\text{datarate (M=4)}} \geq 10 \text{ Kbps}$

$80 \text{ Kbps} \geq \text{Miller}_{\text{datarate (M=8)}} \geq 5 \text{ Kbps}$

7 Tag-to-reader communication timings

The tag complies with the reader-to-tag and tag-to-reader link timing requirements of the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9.

Table 8. Tag-to-Reader link frequency and tolerance(1)

Divide ratio DR	TRcal (µs ±1%)	Link frequency LF (kHz)
64/3	33.3	640
	33.3 < TRcal < 66.7	320 < LF < 640
	66.7	320
	66.7 < TRcal < 83.3	256 < LF < 320
	83.3	256
	83.3 < TRcal ≤ 133.3	160 ≤ LF < 256
	133.3 < TRcal ≤ 200	107 ≤ LF < 160
	200 < TRcal ≤ 225	95 ≤ LF < 107
8	17.2 ≤ TRcal < 25	320 < LF ≤ 465
	25	320
	25 < TRcal < 31.25	256 < LF < 320
	31.25	256
	31.25 < TRcal < 50	160< LF < 256
	50	160
	50 < TRcal ≤ 75	107 ≤ LF < 160
	75 < TRcal ≤ 200	40 ≤ LF < 160

1. Characterized only.

Table 9. Tag-to-Reader data rates(1)

Number of subcarrier cycles per symbol (M)	Modulation type	Data rate (kbps)
1	FM0 baseband	LF
2	Miller subcarrier	LF/2
4	Miller subcarrier	LF/4
8	Miller subcarrier	LF/8

1. Characterized only.

8 XRAG2 command descriptions

The XRAG2 offers Select, Inventory, and Access command sets as described in EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9.

8.1 Select command set

8.1.1 Select

The XRAG2 supports the Select command as described in the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9.

This command defines a tag population based on user-defined criteria for the next inventory and access operations.

Readers can use one or more Select commands to select a particular tag population before inventory.

8.2 Inventory command set

8.2.1 Query

The XRAG2 supports the Query command as described in the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9.

This command initiates and specifies an inventory round. The Query command also specifies the tag-to-reader data rate and coding scheme (FM0 or Miller).

8.2.2 QueryRep

The XRAG2 supports the QueryRep command as described in the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9.

This command instructs tags participating in the inventory round to decrement their slot counter. If slot=0 after decrementing, tag backscatters a 16-bit Random Number (RN16).

8.2.3 QueryAdjust

The XRAG2 supports the QueryAdjust command as described in the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9.

This command increments, decrements or leaves unchanged the number of slots in the inventory round without changing any other parameter of the round.

8.2.4 ACK

The XRAG2 supports the ACK command as described in the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9.

This command acknowledges a single tag in the Reply state. The tag enters the Acknowledged state and replies by backscattering its PC, EPC and CRC16.

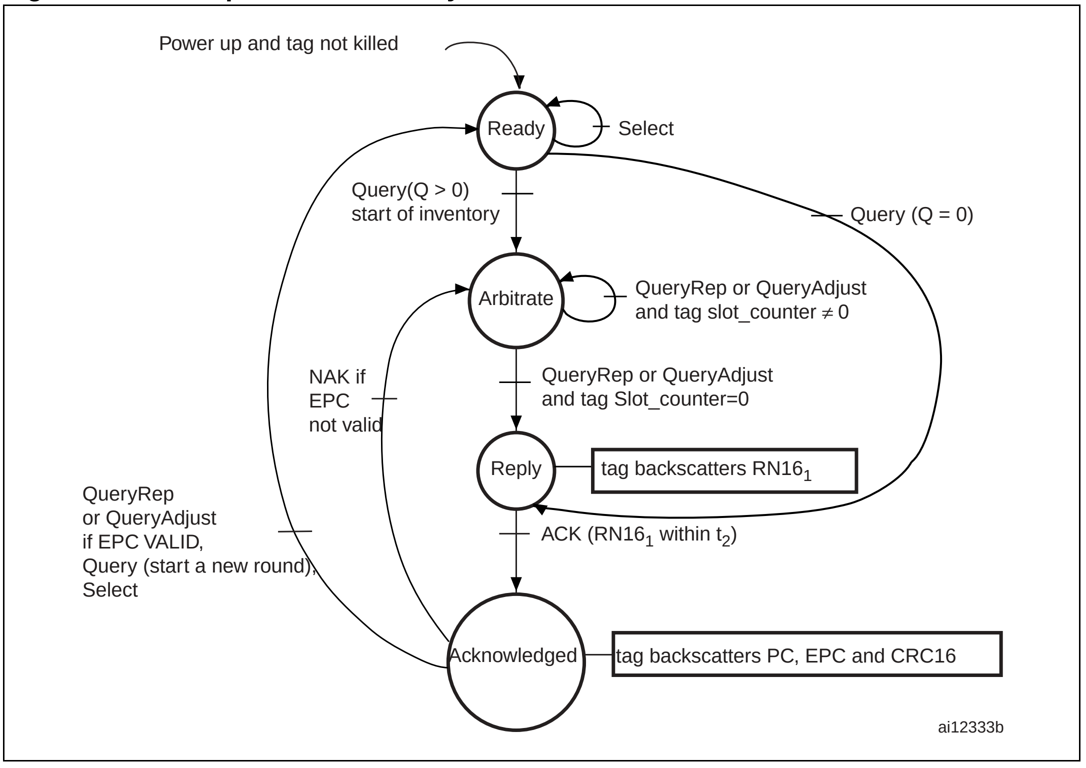
8.2.5 NAK

The XRAG2 supports the NAK command as described in the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9.

This command restores tags to the Arbitrate state. Tags in Reply or Killed state remain in the same state.

The algorithm for a single tag or multiple tag inventory is shown in *Figure 17*.

Figure 17. Example of an inventory round



1. Please refer to EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9 for a complete description of each command and all state transition cases.

Figure 18. Reader-to-tag and tag-to-reader communication timings

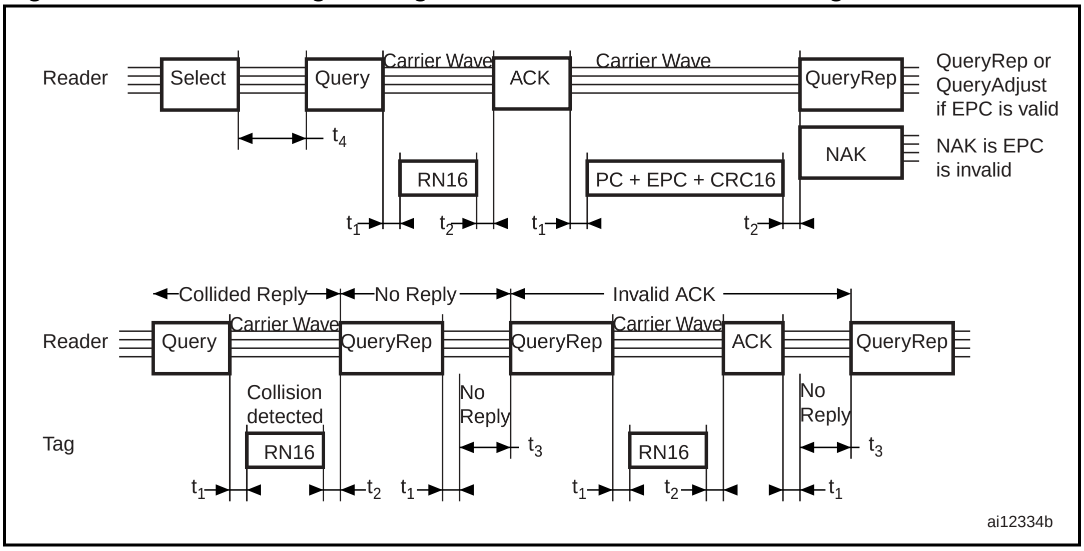


Table 10. Reader-to-tag and tag-to-Reader communication timings(1) (2) (3) (4)

Parameter	Description	Conditions	Min	Nominal	Max
T_1(5)	Delay between end of Reader command and beginning of tag answer.	Measured between the last rising edge of Reader command signaling and the first rising edge of tag reply	max(RTcal, 10 T_{pri}) × (1_FT) – 2µs	max (RTcal, 10 T_{pri})	max(RTcal, 10 T_{pri}) × (1_FT) + 2µs
T_2(6)	Delay between tag reply and next Reader command.	Measured from the last falling edge of the last bit of tag reply to the first falling edge of reader command signaling.	3.0 T_{pri}		20 T_{pri}
T_3	Reader waits T_1 before issuing new command when the tag does not reply.		0 T_{pri}		
T_4	Minimum time between reader command		2.0 RTcal		

1. T_{pri} = *1/ LF, denotes either the period of an FM0 symbol or a single Miller subcarrier.*
2. Characterized only.
3. If a Reader issues a new command during an tag reply, it does not demodulate the command.
4. See EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9 for more detailed information.
5. FT is the tag-to-reader link frequency tolerance.
6. maximum value of T_2 only applies on tags in Reply or Acknowledged state. In this case, if T_2 expires:
   – without receiving a valid command, the tag returns to the Arbitrate state
   – during the reception of a valid command, the tag executes the command
   – during the reception of an invalid command, the tag returns to the Arbitrate state upon determining that the command is invalid
   – In all other states, the maximum value of T_2 does not apply.

8.3 Access command set

The set of access commands comprises **Req_RN**, **Access**, **Read**, **Write**, **BlockWrite**, **BlockErase**, **Kill** and **Lock**.

As described in the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9, the XRAG2 executes **Req_RN** from the Acknowledged, Open, or Secured states.

The XRAG2 executes **Read**, **Write**, **BlockWrite** and **BlockErase** instructions from the Secured state. If allowed by the lock status of the addressed location, the **Read**, **Write**, **BlockWrite** and **BlockErase** instructions can be executed from the Open state.

The XRAG2 executes the **Kill** and **Access** commands from the Open or Secured states.

The XRAG2 executes the **Lock** command only from the Secured state.

8.3.1 Req_RN

The XRAG2 supports the Req_RN command as described in the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9.

The Req_RN command instructs the tag in Acknowledged, Open or Secured state to backscatter a new RN16. If the tag is in the Acknowledged state, the new RN16 becomes the handle of the tag for all subsequent access commands. The handle is a tag identification number used for subsequent access commands. If the tag is in the Open or Secured state, a new RN16 is backscattered without changing the tag handle.

8.3.2 Access

The XRAG2 supports the Access command as described in the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9.

The Access command allows the reader to put tags with non-zero access passwords in the Secured state.

8.3.3 Read

The XRAG2 supports the Read command as described in the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9.

The Read command allows the reader to read a part or all of the tag Reserved, EPC, TID or User memory banks.

8.3.4 Write

The XRAG2 supports the Write command as described in the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9.

The Write command allows the reader to write a 16-bit word into the Reserved, EPC, or User memory bank. The 16-bit data word is cover-coded by the reader during the Write command using a new RN16 number generated using a Req_RN instruction before each Write command. The Write cycle executes an auto-erase cycle before word programming. After completion of the Write operation, the XRAG2 backscatters a single bit header (0b), its handle and a CRC16 within t_{WRITE}. The XRAG2 backscatters the non-specific error code 0Fh within t_{WRITE} if an error is encountered during the transmission of the Write command. The duration of the Write cycle t_{WRITE} is specified in *Table 11*.

8.3.5 BlockWrite

The XRAG2 supports the BlockWrite command as described in the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9.

The BlockWrite command allows the reader to program blocks of multiple 16-bit words (up to 4 words) into the Reserved, EPC, and User memory banks in a single operation. Prior to a BlockWrite operation, the block must be erased using a BlockErase command. If not, the current data is ORed with new data sent during the BlockWrite command.
After completion of the BlockWrite operation, the XRAG2 backscatters a single bit header (0b), its handle and a CRC16 within $t_{BLOCKWRITE}$. The XRAG2 backscatters the non-specific error code 0Fh within $t_{BLOCKWRITE}$ if an error is encountered during the transmission of the BlockWrite command.
The duration of the BlockWrite cycle $t_{BLOCKWRITE}$ is specified in *Table 11*.

8.3.6 BlockErase

The XRAG2 supports the Block Erase command as described in the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9.

The BlockErase command allows the reader to erase blocks of multiple 16-bit words (up to the complete memory bank) into the Reserved, EPC, or User memory banks in a single operation.
After completion of the BlockErase operation, XRAG2 backscatters a single bit header (0b), its Handle and a CRC16 within $t_{BLOCKERASE}$. XRAG2 backscatters the non specific error code 0Fh within $t_{BLOCKERASE}$ if an error is encountered during the sending of the BlockErase command.
The duration of the BlockErase cycle $t_{BLOCKERASE}$ is specified in *Table 11*.

8.3.7 Kill

The XRAG2 supports the KILL command as described in the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9.

The Kill command allows readers to permanently disable a tag.

8.3.8 Lock

The XRAG2 supports the Lock command as described in the EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9.

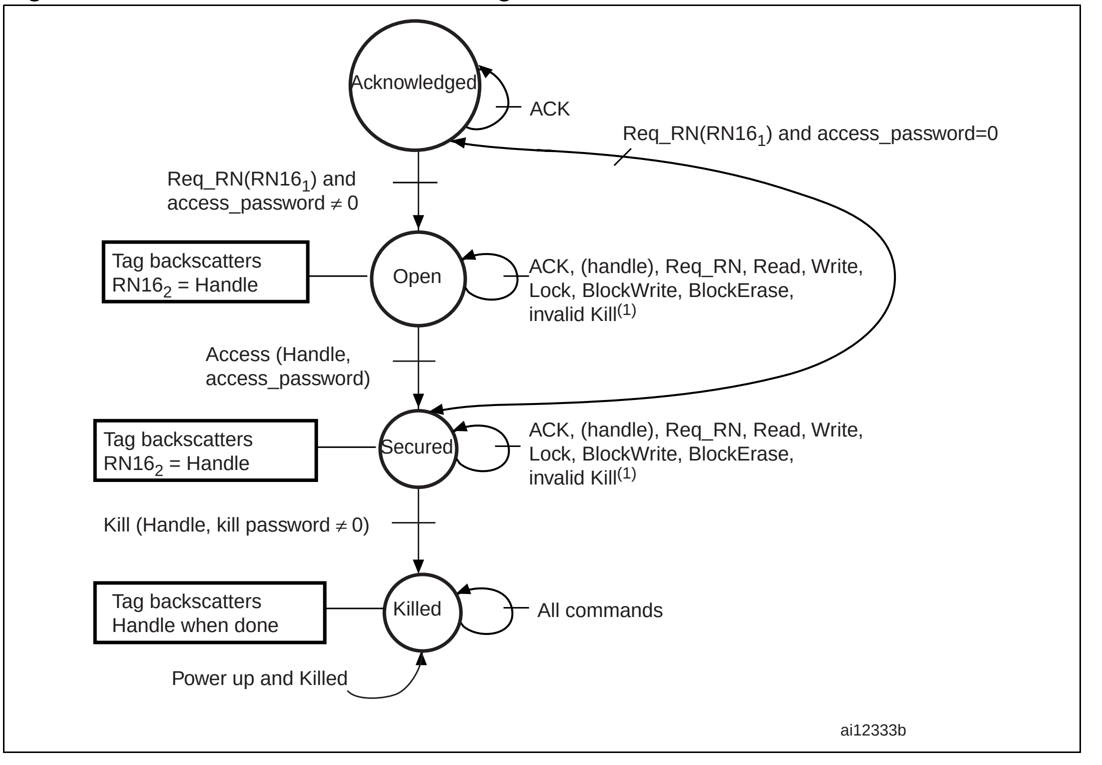
The Lock command allows the reader to lock individual passwords and memory banks thereby preventing or allowing subsequent writes and/or reads of these passwords and memory banks. The status of the passwords and memory banks can be permanently locked (permalocked).

Table 11. XRAG2 Write, BlockWrite and BlockErase parameters(1)

Parameter	Description	Min	Max	Unit
t_{WRITE}	Write cycle time		20	ms
$t_{BLOCKWRITE}$	BlockWrite cycle time		20	ms
$t_{BLOCKERASE}$	BlockErase cycle time		20	ms

1. Characterized only.

Figure 19. Access command state diagram



1. Please refer to *EPCglobal Class 1 generation 2 RFID UHF specification, revision 1.0.9* for a complete description of each command, state transition cases, and tag reply.

9 XRAG2 impedance parameters

The XRAG2 provides the parameters specified in tables *12* and *13*. The equivalent impedance model for measurement is based on a resistance and a capacitance connected in series with the external antenna.

Table 12. XRAG2 parameters

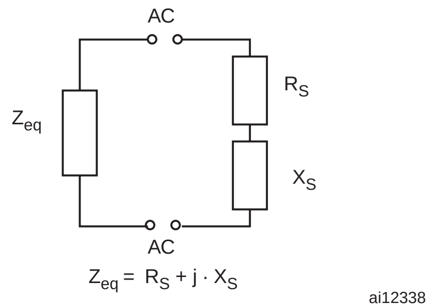
Symbol	Description	Conditions	Min	Max	Unit
T_{STG}	Storage temperature	Wafer	15	25	°C
				23	months
V_{ESD}	Electrostatic discharge voltage(1)	Machine model Human body model	–100 –2000	+100 +2000	V V

1. Mil. Std. 883 - Method 3015.

Table 13. XRAG2 impedance parameters

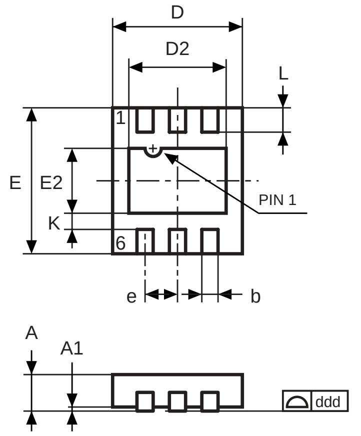
Equivalent serial Model (see *Figure 20*)
Measurement conditions T= +25 °C, regulated internal V_{DD} = 1.45 V Typical value characterized only.
F_c = 915 MHz, R_s = 10 Ω, X_s = –245 Ω

Figure 20. XRAG2 input impedance, equivalent serial circuit



10 Package mechanical data

Figure 21. UFDFPN6 (MLP6) – 6-lead ultra thin fine pitch dual flat package no lead 1.8 x 2 mm, package outline



1. Drawing is not to scale. Preliminary data.

Table 14. UFDFPN6 (MLP6) - 8-lead ultra thin fine pitch dual flat package no lead 1.8 x 2 mm, package mechanical data(1)

Symbol	millimeters			inches(2)		
	Typ	Min	Max	Typ	Min	Max
A	0.55	0.45	0.6	0.022	0.018	0.024
A1	0.02	0	0.05	0.001	0	0.002
b	0.2	0.15	0.25	0.008	0.006	0.01
D	1.8	1.7	1.9	0.071	0.067	0.075
D2	1.3	1.2	1.4	0.051	0.047	0.055
ddd			0.08			0.003
E	2	1.9	2.1	0.079	0.075	0.083
E2	0.95	0.85	1.05	0.037	0.033	0.041
e	0.5	-	-	0.02	-	-
K		0.2			0.008	
L	0.25	0.2	0.3	0.01	0.008	0.012
X	0.2			0.008		

1. Preliminary data.
2. Values in inches are converted from mm and rounded to 4 decimal digits.

11 Part numbering

Table 15. Ordering information scheme

Example:	XRAG2 - W4I / 1GE
Device type	
XRAG2	
Delivery form	
MATG = UFDFPN6 (MLP6) 1.8 × 2 mm, tape & reel packing, ECOPACK® and RoHS compliant, Sb_2O_3-free and TBBA-free[(1)]	
W4I = 180 µm ± 15 µm unsawn inkless wafer	
SBN18I = 180 µm ± 15 µm bumped and sawn inkless wafer on 8 inch frame	
Customer code	
1GE = EPC TID	
1GI = ISO TID	

1. Preliminary data.

For a list of the available options, please see the current memory shortform catalog.

For further information on any aspect of this device, please contact your nearest ST sales office.

12 Revision history

Table 16. Document revision history

Date	Revision	Changes
14-Apr-2006	1	Initial release.
10-Oct-2006	2	End of design phase.
12-Oct-2006	3	X_S value corrected in *Table 13: XRAG2 impedance parameters*.
11-Dec-2006	4	Document status promoted from Preliminary Data to full Datasheet.
15-Nov-2007	5	*Figure 9: Frame-sync sequence timings* modified. Unit of tag-to-reader calibration timing corrected in *Table 7: Reader to tag frame-sync and preamble timings*. *Figure 14: Tag-to-reader Miller subcarrier sequences* modified. Small text changes.
07-Apr-2008	6	Small text changes. *Figure 4: Four bank memory organization (EPC_length ≤9d), memory map* corrected. UFDFPN6 (MLP6) package added (see*Section 10: Package mechanical data* and *Figure 3: UFDFPN connections*).