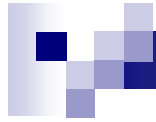


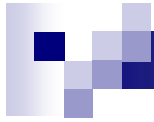


## FW introduction -- A7103 series



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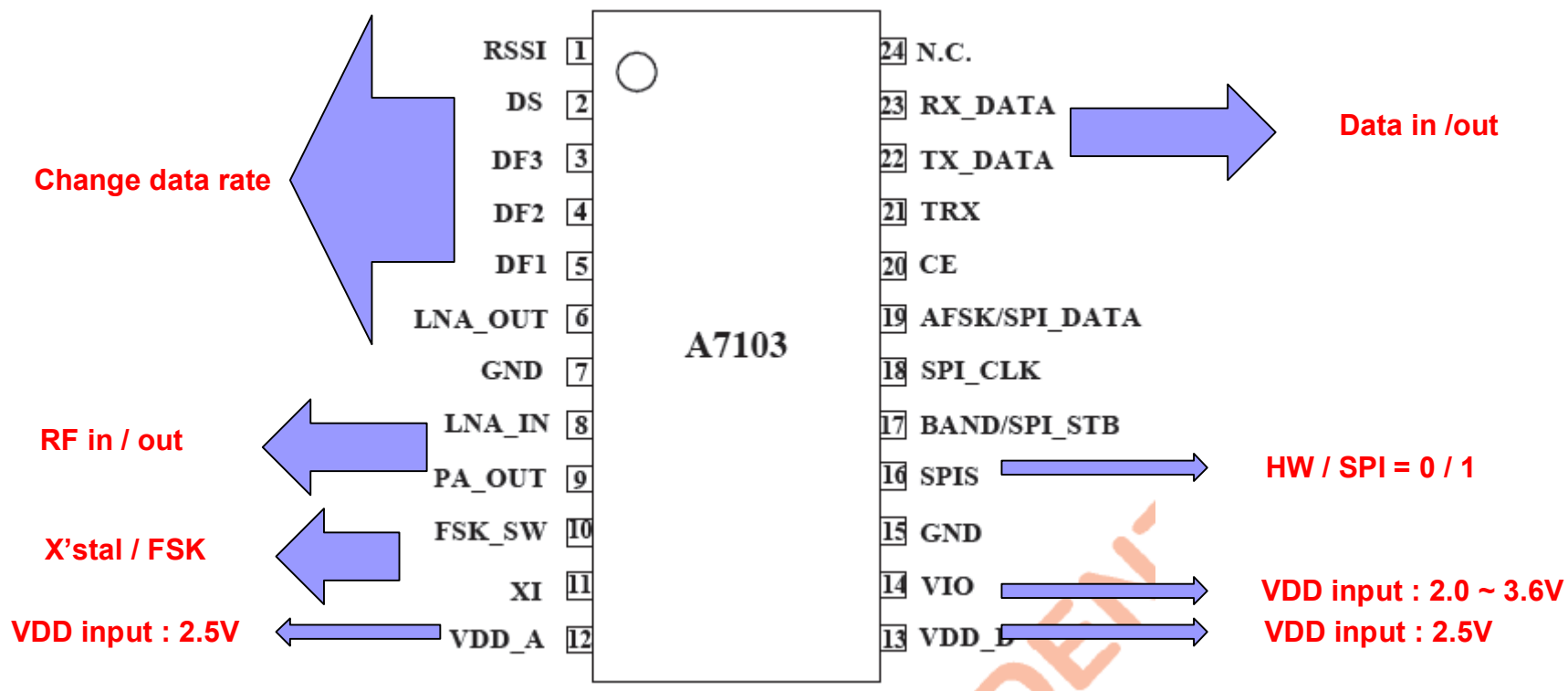
- **A7103**
- **A7201**
- **A7202**
- **A7302**



# A7103

- **RF Frequency :**
  - **315/433MHz(A7103A)**
  - **868/915MHz(A7103B)**
- **RF modulation : ASK / FSK**
- **Data rate : 1-10Kbps(ASK) / 1-20Kbps(FSK)**
- **Operating voltage : 2.2V-3.0V(EXT. 2.5V LDO)**
- **TX/RX current : 18mA[FSK]/10mA[ASK](@10dBm), 9mA**
- **RX sensitivity : -106 ~ -110dBm(2.4Kbps)**
- **Build in Analog RSSI**
- **I/O voltage : 2.0 ~ 3.6V(VIO)**
- **Support SPI & HW modes**

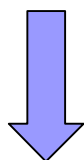
# A7103



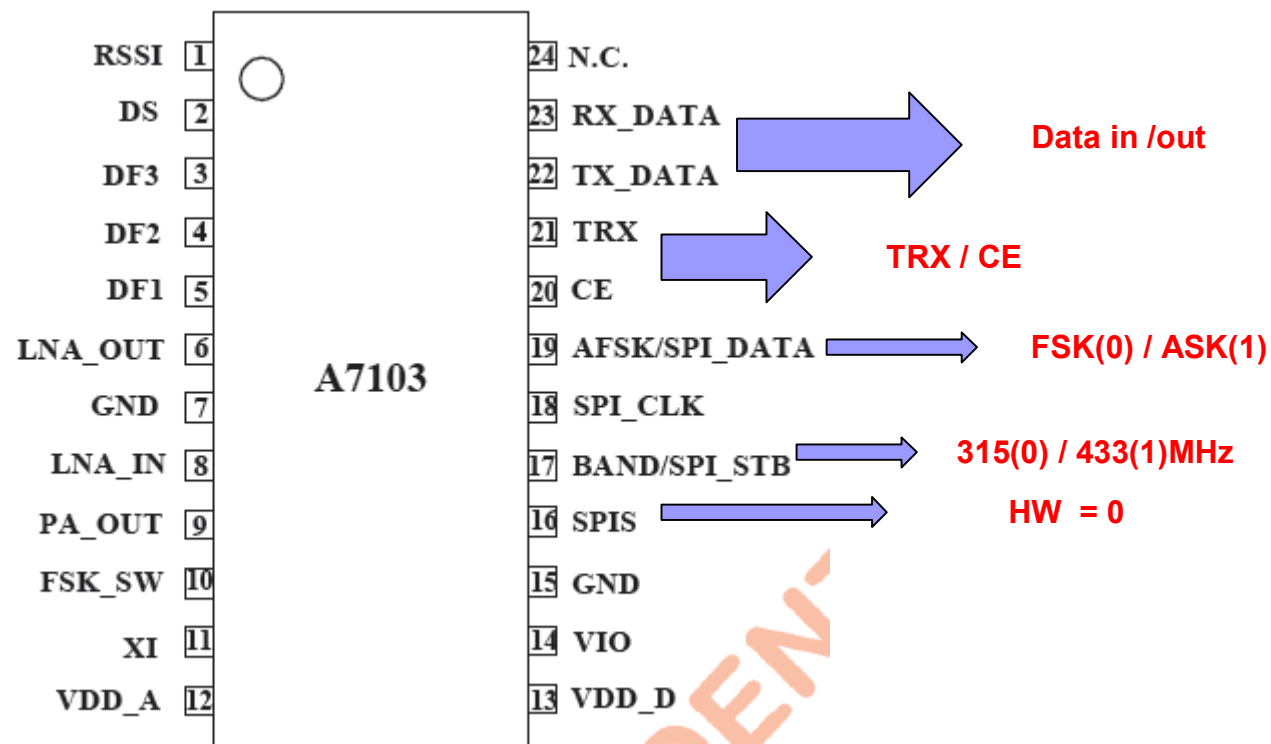
# A7103

## HW mode

RF Freq.



X'stal



# A7103

## HW mode

| Band 315MHz                         |        |                       | Band 434MHz                          |        |                       |
|-------------------------------------|--------|-----------------------|--------------------------------------|--------|-----------------------|
| Xtal (MHz)                          | Pin 17 | F <sub>RF</sub> (MHz) | Xtal (MHz)                           | Pin 17 | F <sub>RF</sub> (MHz) |
| 13.0498                             | 0      | 303                   | 13.2785                              | 1      | 424.5                 |
| 13.064                              | 0      | 303.33                | 13.3337                              | 1      | 426.2625              |
| 13.0853                             | 0      | 303.825               | 13.3407                              | 1      | 426.4875              |
| 13.0875                             | 0      | 303.875               | 13.3517                              | 1      | 426.8375              |
| 13.1036                             | 0      | 304.25                | 13.4663                              | 1      | 430.5                 |
| 13.1144                             | 0      | 304.5                 | 13.5445                              | 1      | 433                   |
| 13.2866                             | 0      | 308.5                 | 13.5288                              | 1      | 432.5                 |
| 13.3513                             | 0      | 310                   | 13.542                               | 1      | 432.92                |
| 13.3943                             | 0      | 311                   | 13.546                               | 1      | 433.05                |
| 13.397                              | 0      | 311.062               | 13.5576                              | 1      | 433.42                |
| 13.502                              | 0      | 313.5                 | 13.56                                | 1      | 433.496               |
| 13.5235                             | 0      | 314                   | 13.5717                              | 1      | 433.87                |
| 13.545                              | 0      | 314.5                 | 13.5732                              | 1      | 433.92                |
| 13.56                               | 0      | 314.846               | 13.5804                              | 1      | 434.15                |
| 13.5666                             | 0      | 315                   | 13.5889                              | 1      | 434.42                |
| 13.5732                             | 0      | 315.1527              | 13.8181                              | 1      | 441.75                |
| 13.5752                             | 0      | 315.2                 |                                      |        |                       |
| 13.5881                             | 0      | 315.5                 |                                      |        |                       |
| 13.6097                             | 0      | 316                   |                                      |        |                       |
| 13.6442                             | 0      | 316.8                 |                                      |        |                       |
| 13.6958                             | 0      | 318                   |                                      |        |                       |
| $F_{RF} = F_{XTAL} \times 743 / 32$ |        |                       | $F_{RF} = F_{XTAL} \times 1023 / 32$ |        |                       |

Table 9.3.2 Xtal selection guide in HW control mode



# A7103

## HW mode

| Default setting in HW Mode |                      |
|----------------------------|----------------------|
| TX Power                   | Max (typical 10 dBm) |
| IFB [1:0]                  | [10] (mid)           |
| AGC                        | Enable               |

Table 9.3.3 Default settings in HW control mode.

# A7103

## Settling time

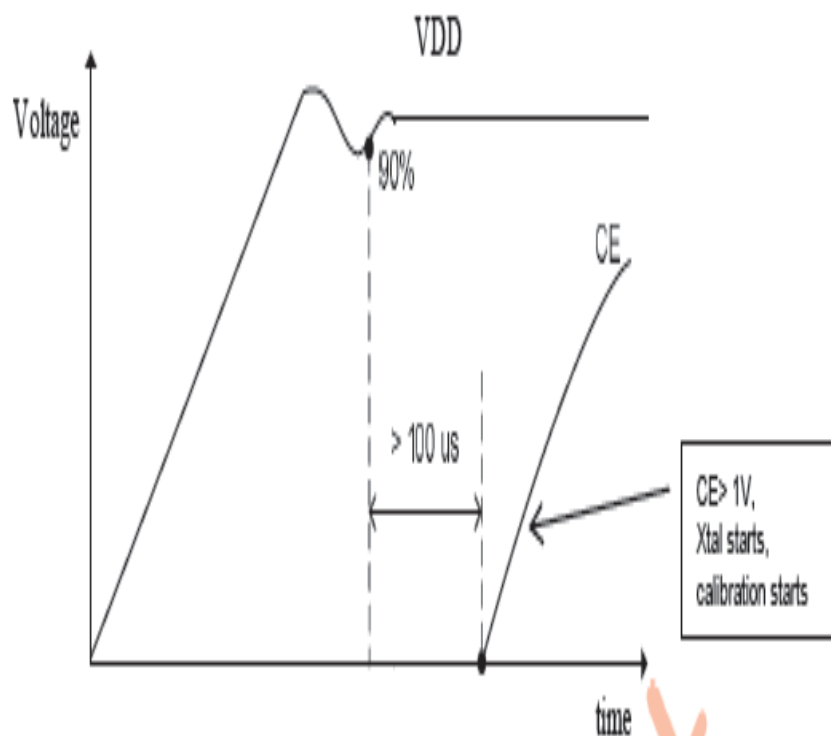


Fig 9.5.2. CE pin is controlled by MCU for a correct start up sequence.

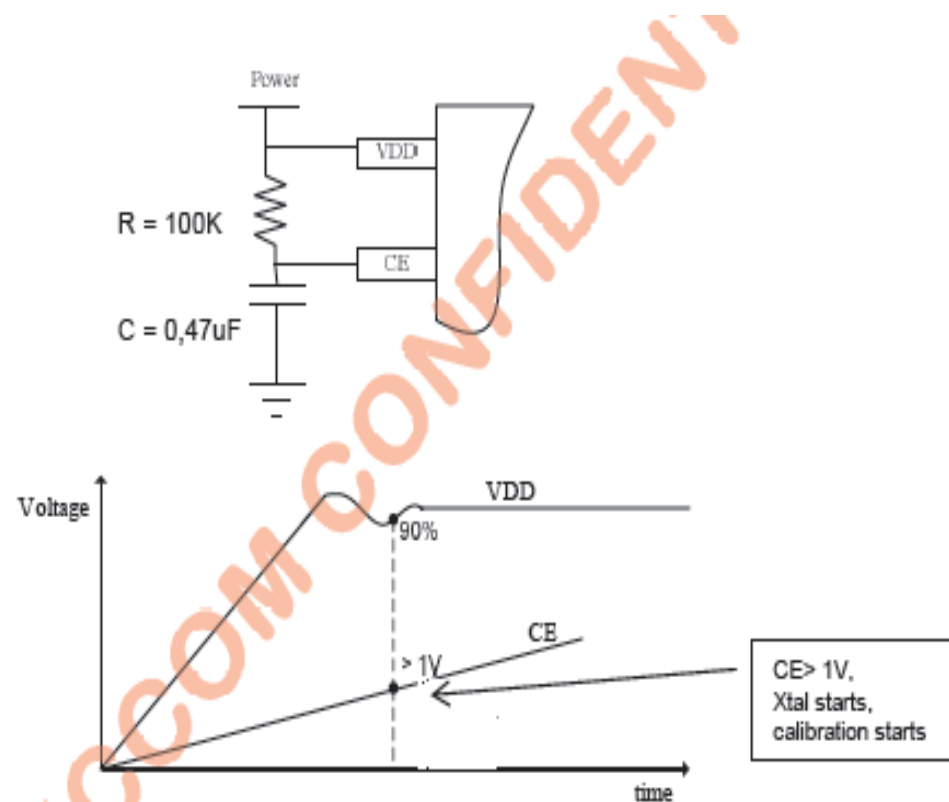


Fig 9.5.1. An extra RC delay on CE pin for correct start up sequence.



# A7103

**868/915MHz**

## Settling time - 15/433MHz

| Settling Time (Typical) |               |        |
|-------------------------|---------------|--------|
| Xtal settling           | Without Ccomp | 1.2 ms |
|                         | With Ccomp    | 6 ms   |
| TX settling time        |               | 0.3 ms |
| RX settling time        |               | 3 ms   |

Table 9.5.1 Typical settling time

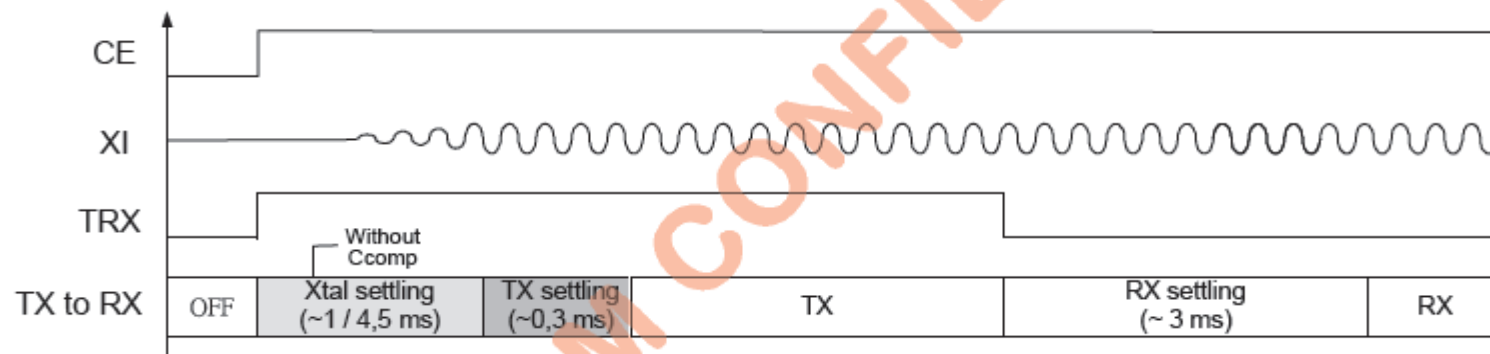


Fig 9.5.3 Settling time from shut down mode to TX mode.

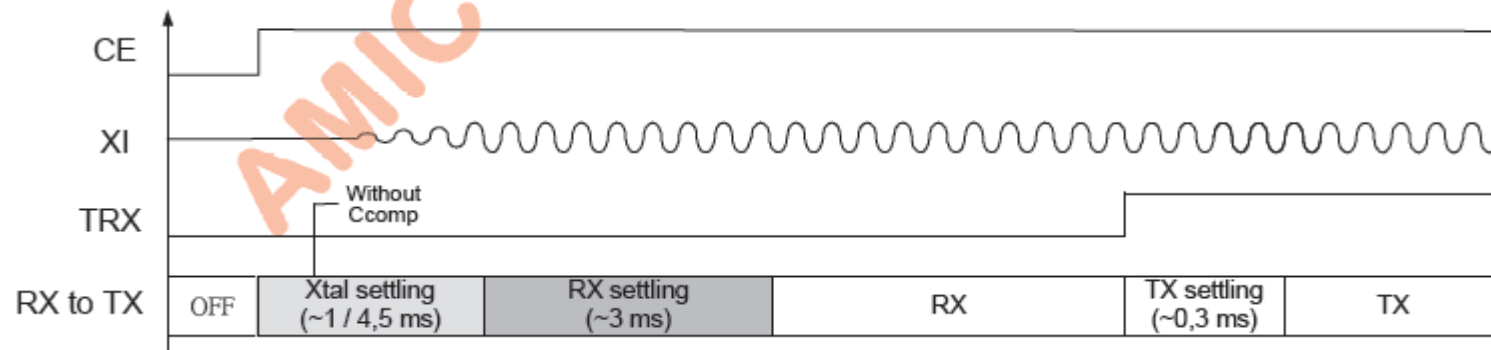


Fig 9.5.4 Settling time from shut down mode to RX mode.

# A7103

## Preamble

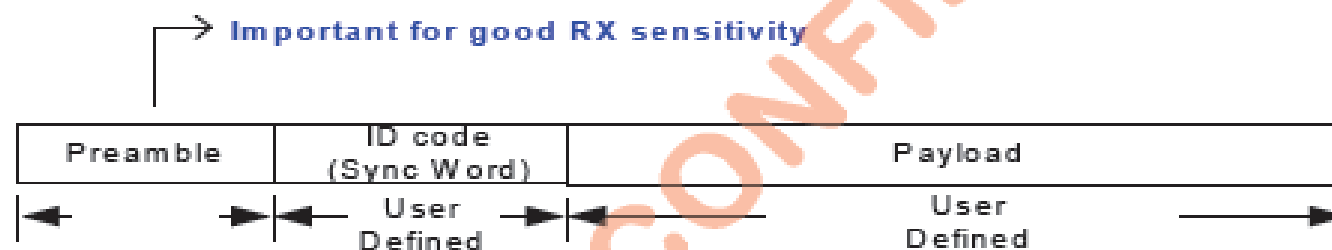


Figure 9.6.1 Packet Format

|                 | ASK                                                                                                                  | FSK                                  |
|-----------------|----------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| Preamble Format | <p>Long high period + Short low period</p>                                                                           | <p>64 bits of alternate 0 and 1.</p> |
| Data rate       | 9,6Kbps, High = 2,8 ms, Low = 1,2 ms<br>4,8Kbps, High = 2,8 ms, Low = 1,2 ms<br>2,4Kbps, High = 5,6 ms, Low = 2,4 ms | 1K ~ 20Kbps                          |

Table 9.6.1 Preamble Format

### Payload:

Payload is a carrier-information by user definition. Please noted, in ASK modulation, Do NOT apply data pattern in continuous low for over 40 ms. Otherwise, AGC circuit will operate abnormal.

# A7103

## RSSI – SPI(en/disable)

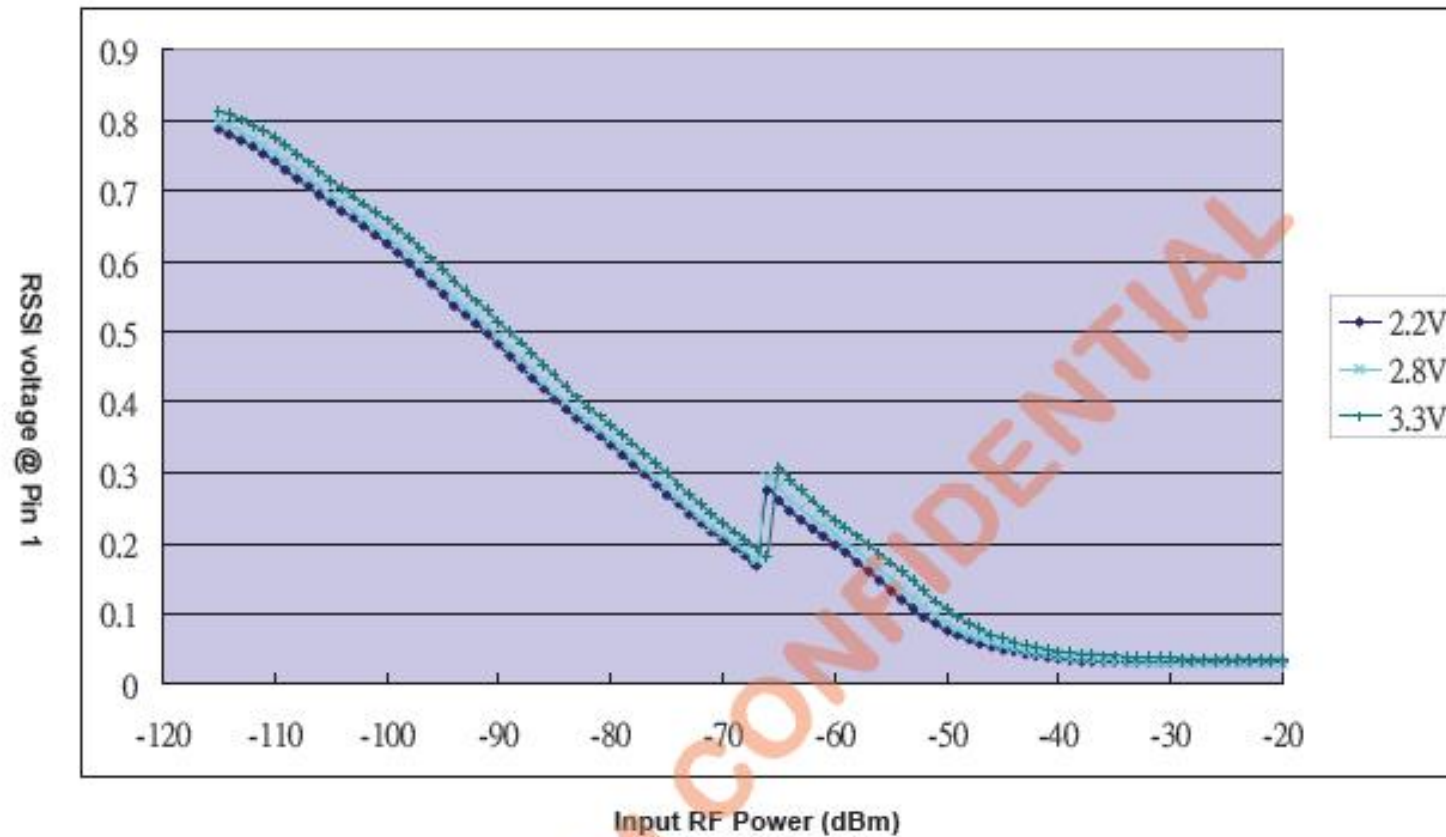
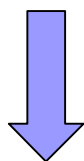


Figure 9.7.1 Typical RSSI curve at 434MHz

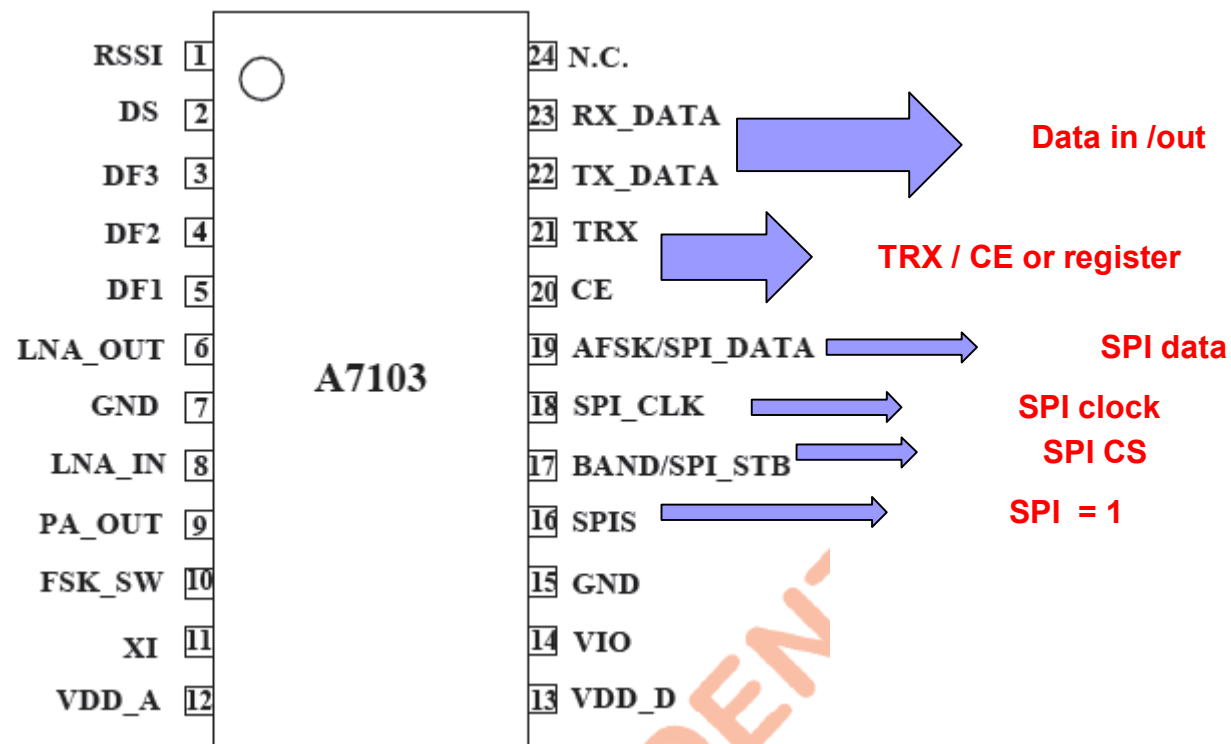
# A7103

## SPI mode

RF Freq.



SPI register



# A7103

## SPI mode

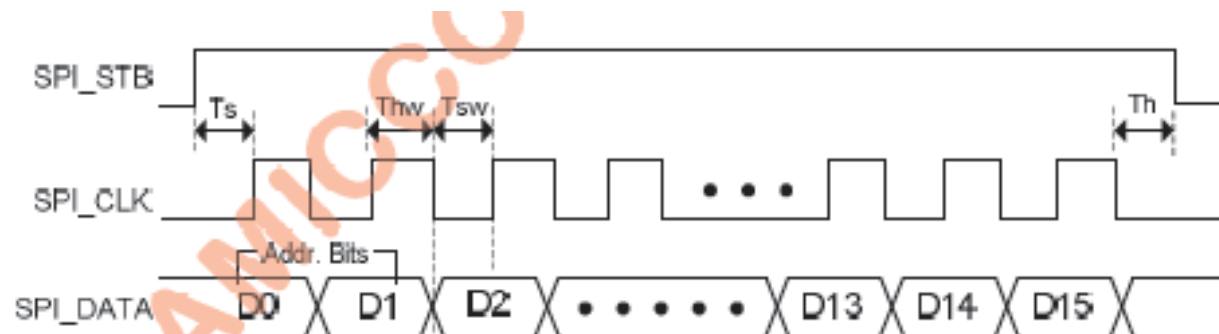


Fig 9.4.1.1 SPI timing chart

| Parameter | Description         | Min | Max | Unit |
|-----------|---------------------|-----|-----|------|
| Fc        | SPI Clock Frequency |     | 4   | MHz  |
| Ts        | SPI_STB Setup Time  | 50  |     | ns   |
| Thw       | SPI_DATA Hold Time  | 50  |     | ns   |
| Tsw       | SPI_DATA Setup Time | 50  |     | ns   |
| Th        | SPI_STB Hold Time   | 50  |     | ns   |

Table 9.4.1.1 SPI timing characteristic

# A7103

## SPI mode

R[1:0]: Xtal reference frequency.

| R [1:0] | Xtal (MHz)     | R counter | Note                                                |
|---------|----------------|-----------|-----------------------------------------------------|
| 11      | Reserved       | Reserved  |                                                     |
| 10      | 12             | 15        | PLL ref. freq = 800KHz, PLL step = RF step = 800KHz |
| 01      | 13.5732 /13.56 | 16        | PLL ref. freq = 848KHz, PLL step = RF step = 848KHz |
| 00      | 16             | 20        | PLL ref. freq = 800KHz, PLL step = RF step = 800KHz |

NB, NA: Used to define wanted  $F_{RF}$  of PLL (see below table).

NA[3:0]: NA is odd (1 / 3 / 5 / 7) and complement.

NB[7:0]: NB is (5 ~ 40) and complement.

| Formula                                              |    |                                                      | Example of 433.92 MHz                     |                                  |                                                         |
|------------------------------------------------------|----|------------------------------------------------------|-------------------------------------------|----------------------------------|---------------------------------------------------------|
| $N = 16NB + NA$<br>$F_{RF} = F_{XTAL} \times N / 2R$ |    |                                                      | NA = 15 = [1111b]                         | NA 1's complement = [0000b]      |                                                         |
|                                                      |    |                                                      | NB = 63 = [0011-1111b]                    | NB 1's complement = [1100-0000b] |                                                         |
|                                                      |    |                                                      | N = 16 x 63 + 15 = 1023                   |                                  |                                                         |
|                                                      |    |                                                      | R = 16 (F <sub>XTAL</sub> = 13.5732MHz)   |                                  |                                                         |
|                                                      |    |                                                      | F <sub>RF</sub> = 13.5732 x 1023 / 2 / 16 | F <sub>RF</sub> = 433.92 MHz     |                                                         |
| Band 315MHz                                          |    |                                                      | Band 434MHz                               |                                  |                                                         |
| NA                                                   | NB | Example                                              | NA                                        | NB                               | Example                                                 |
| 1                                                    | 43 | $F_{RF}$<br>= 13.56 x (743) / 2 / 16<br>= 314.84 MHz | 1                                         | 62                               | $F_{RF}$<br>= 13.5732 x (1023) / 2 / 16<br>= 433.92 MHz |
| 3                                                    | 44 |                                                      | 3                                         | 63                               |                                                         |
| 5                                                    | 45 |                                                      | 5                                         | 64                               |                                                         |
| 7                                                    | 46 |                                                      | 7                                         | 65                               |                                                         |
| 9                                                    | 47 |                                                      | 9                                         | 66                               |                                                         |
| 11                                                   |    |                                                      | 11                                        |                                  |                                                         |
| 13                                                   |    |                                                      | 13                                        |                                  |                                                         |
| 15                                                   |    |                                                      | 15                                        |                                  |                                                         |

# A7103 RF Module



# A7103 EK kit

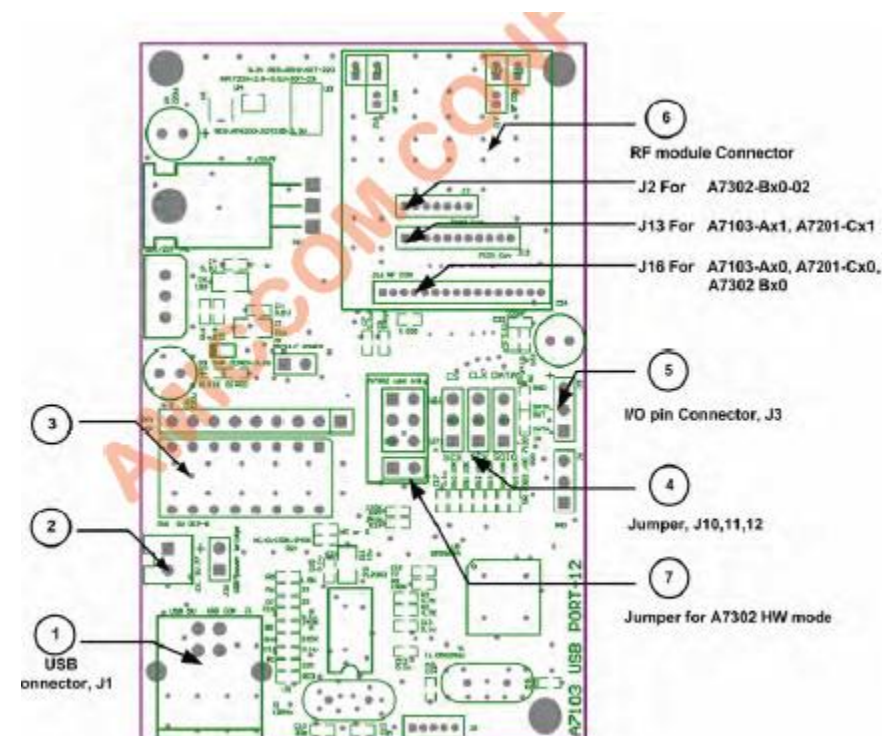
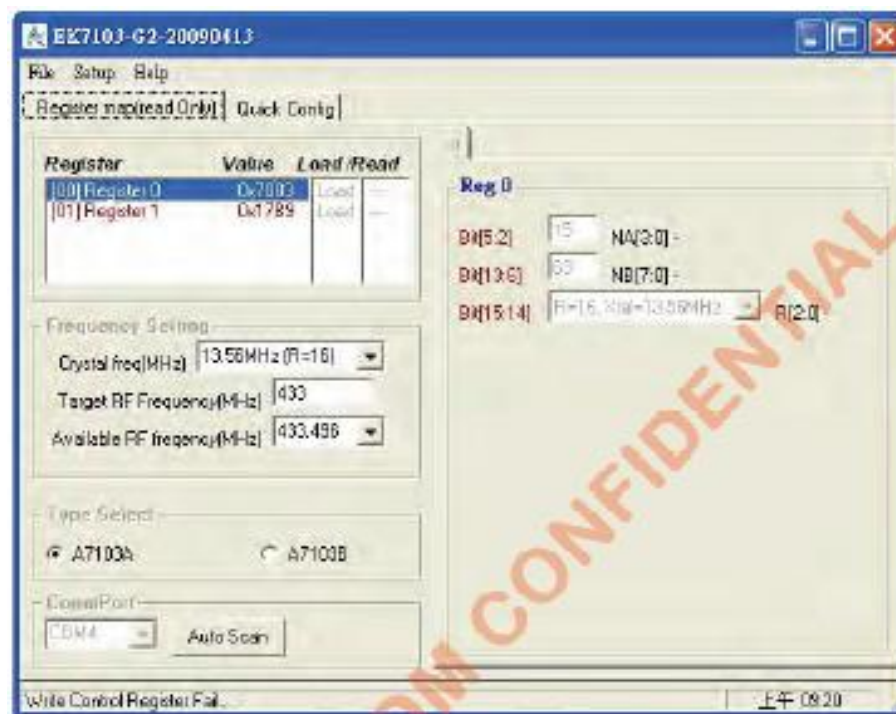
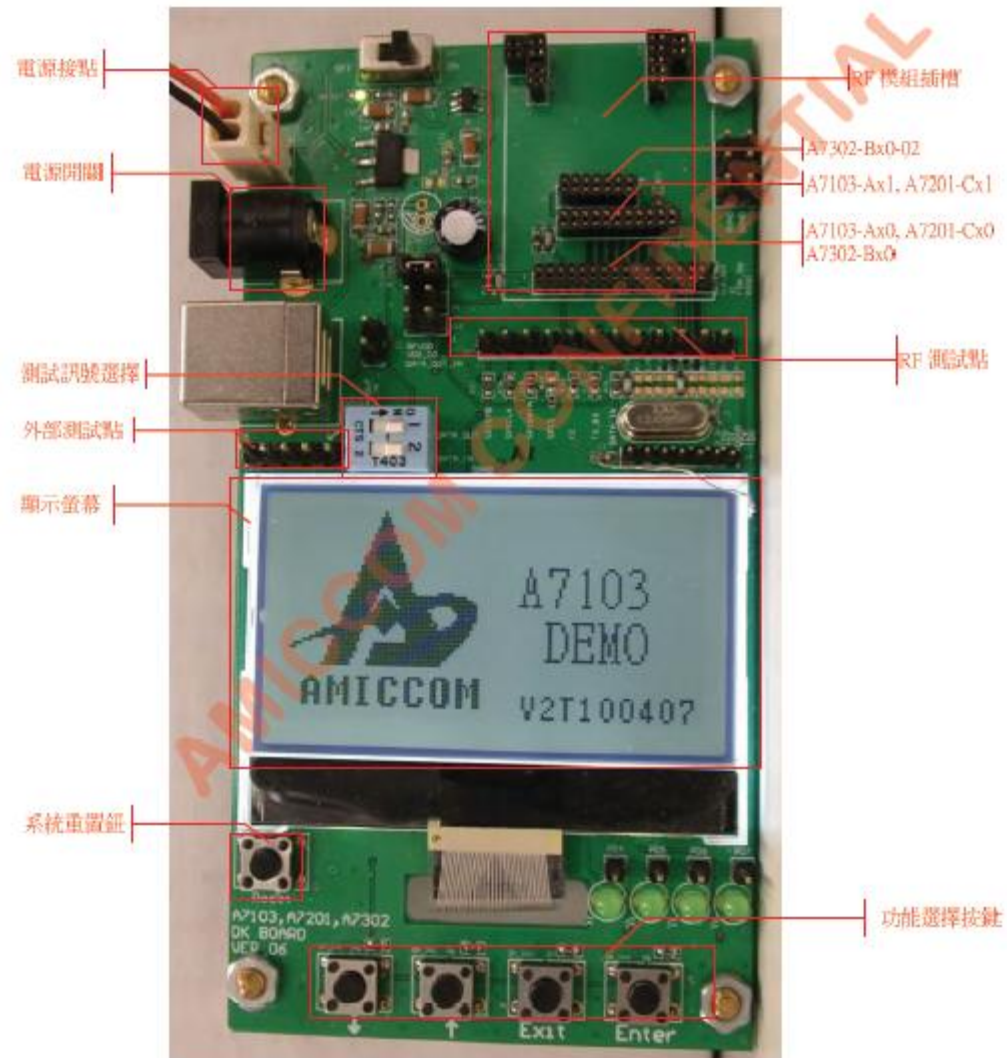
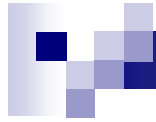


Fig. 1 Topside of evaluation board

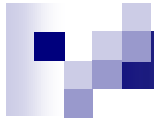


# A7103 DK kit





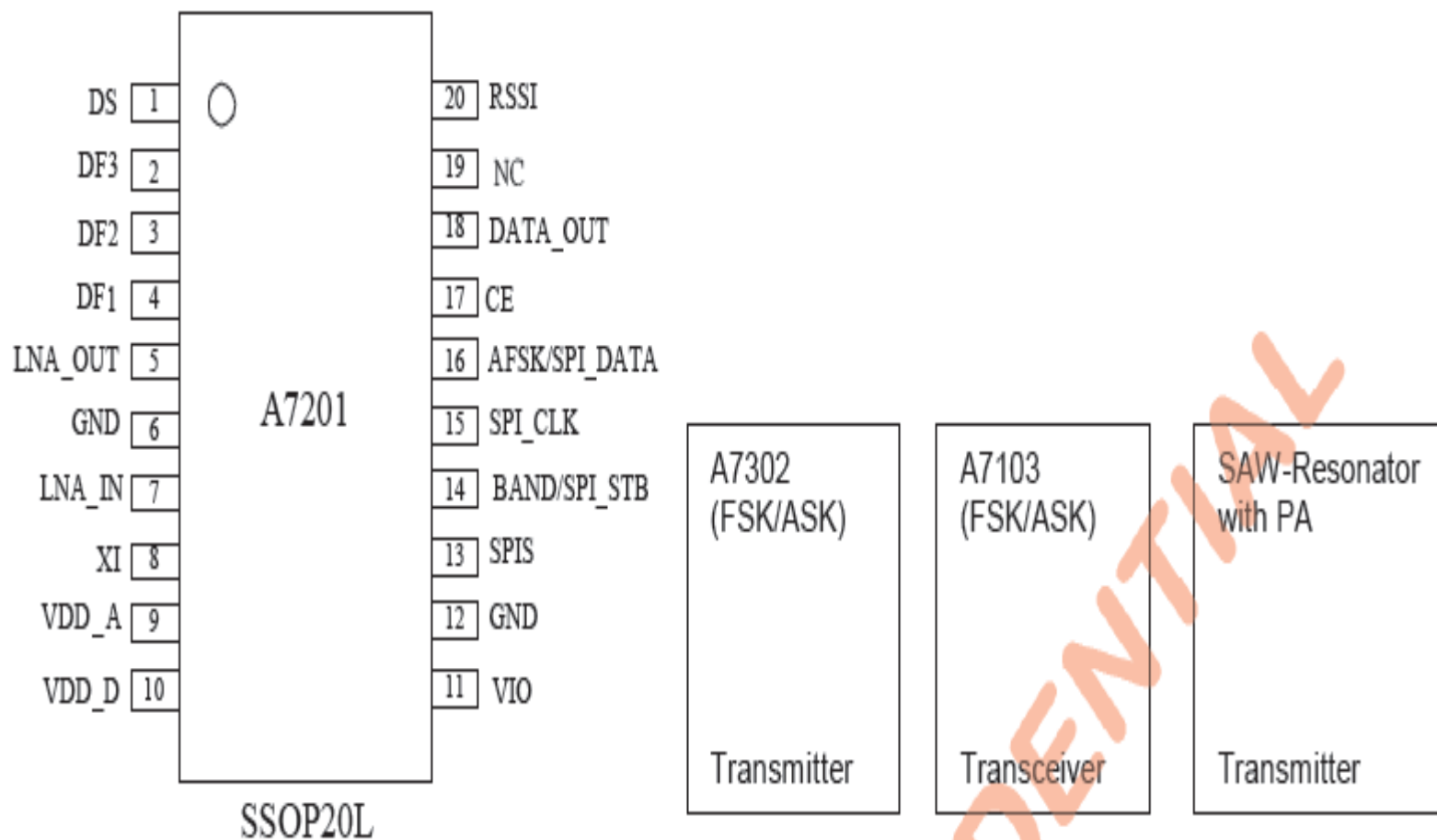
# A7103 TF kit

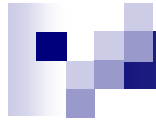


# A7201

- **RF Frequency :**
  - **315/433MHz(A7201A)**
  - **868/915MHz(A7201B)**
- **RF modulation : ASK / FSK**
- **Data rate : 1-10Kbps(ASK) / 1-20Kbps(FSK)**
- **Operating voltage : 2.2V-3.0V(EXT. 2.5V LDO)**
- **RX current : 9mA**
- **RX sensitivity : -106 ~ -110dBm(2.4Kbps)**
- **Build in Analog RSSI**
- **I/O voltage : 2.0 ~ 3.6V(VIO)**
- **Support SPI & HW modes**

# A7201

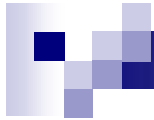




# A7201

## Development tools

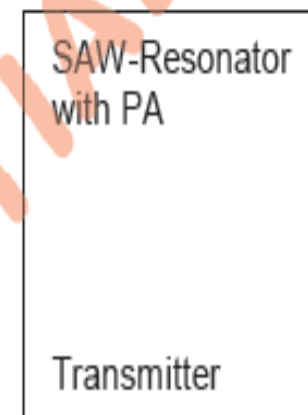
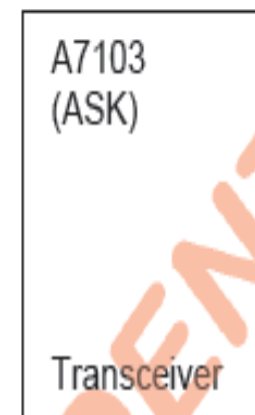
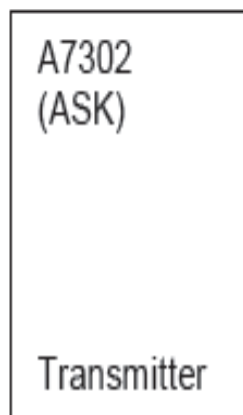
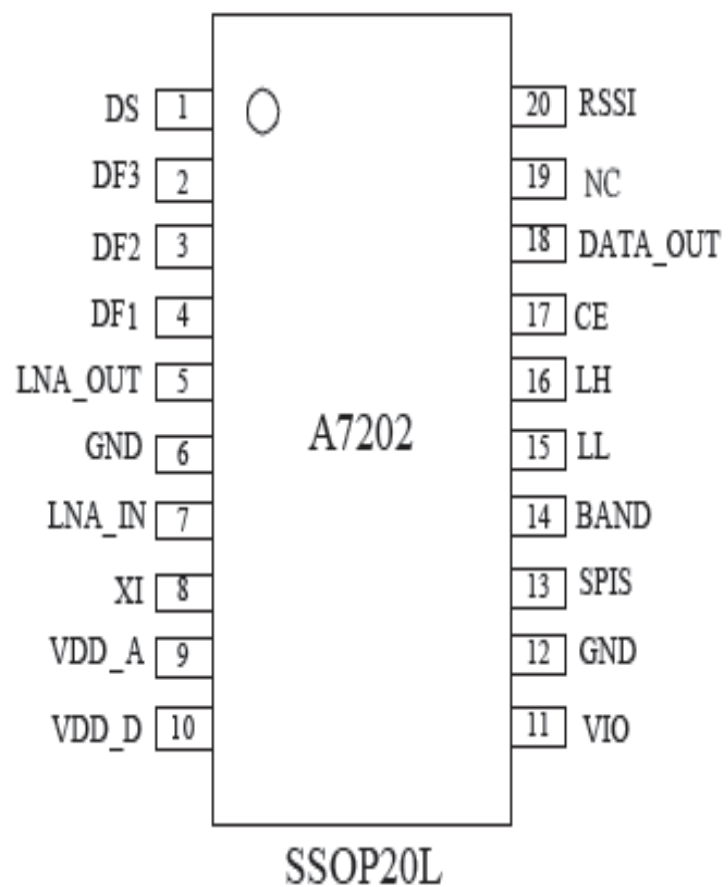
**Module / reference code / EK / DK / TF**

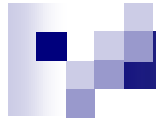


# A7202

- **RF Frequency :**
  - **315/433MHz(A7202A)**
  - **868/915MHz(A7202B)**
- **RF modulation : ASK**
- **Data rate : 1-10Kbps(ASK)**
- **Operating voltage : 2.2V-3.0V(EXT. 2.5V LDO)**
- **RX current : 9mA**
- **RX sensitivity : -106 ~ -110dBm(2.4Kbps)**
- **Build in Analog RSSI**
- **I/O voltage : 2.0 ~ 3.6V(VIO)**
- **Support HW modes**

# A7202



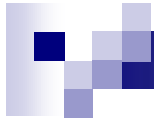


# A7202

## Development tools

**Module / reference code / EK / DK / TF**

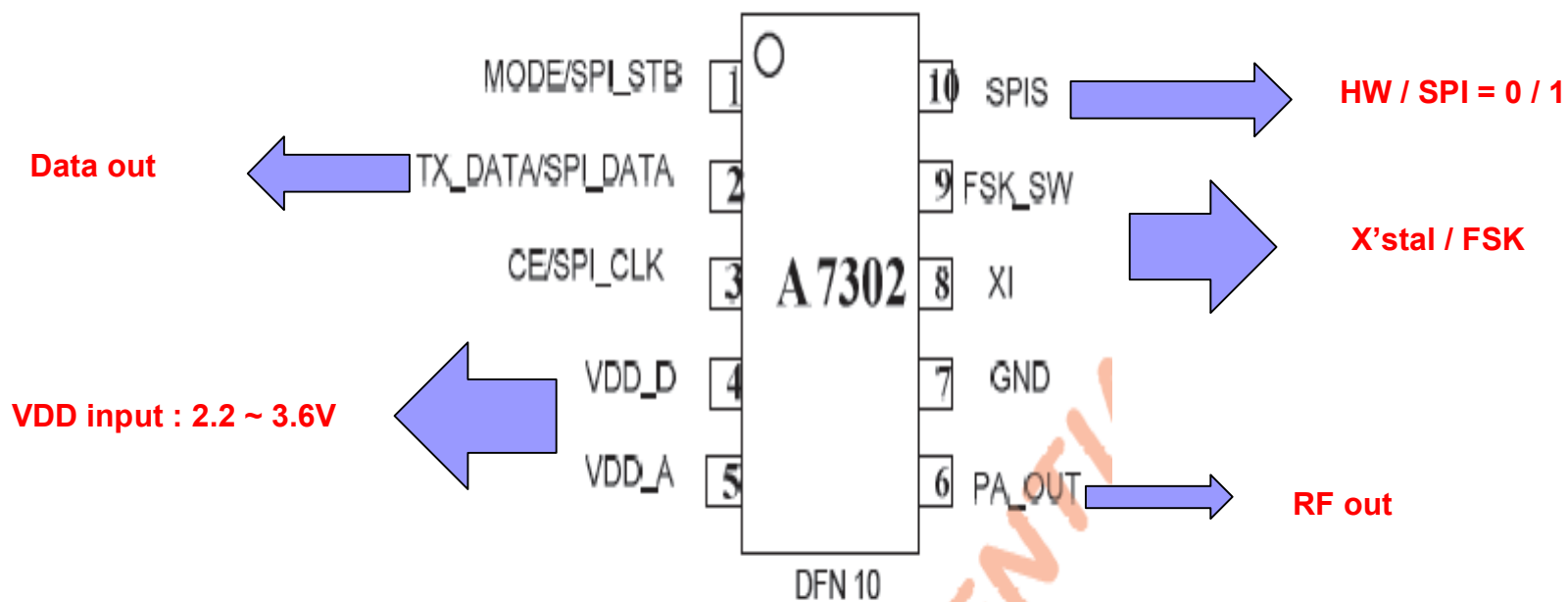




# A7302

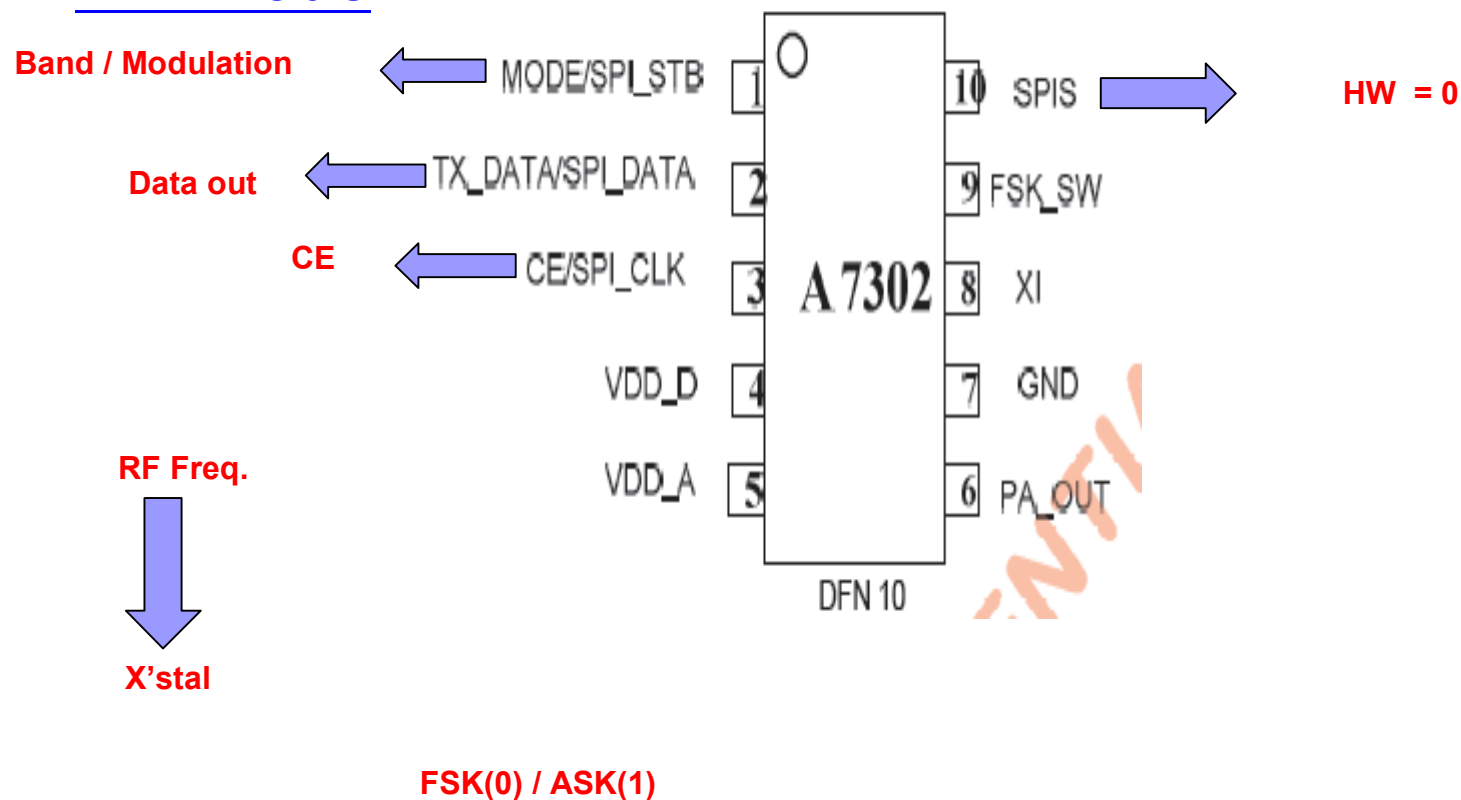
- **RF Frequency :**
  - **315/433MHz(A7302C)**
  - **868/915MHz(A7302D)**
- **RF modulation : ASK / FSK**
- **Data rate : 1-10Kbps(ASK) / 1-20Kbps(FSK)**
- **Operating voltage : 2.2V-3.0V(EXT. 2.5V LDO)**
- **TX current : 14mA[FSK]/8.8mA[ASK](@10dBm)**
- **I/O voltage : 2.0 ~ 3.6V(VIO)**
- **Support SPI & HW modes**

# A7302



# A7302

## HW mode



# A7302

## HW mode

| 310MHz ~ 330MHz                          |      |                       | 425MHz ~ 445MHz                          |      |                       |
|------------------------------------------|------|-----------------------|------------------------------------------|------|-----------------------|
| Crystal (MHz)                            | SPIS | F <sub>RF</sub> (MHz) | Crystal (MHz)                            | SPIS | F <sub>RF</sub> (MHz) |
| 9.6875                                   | 0    | 310                   | 13.4531                                  | 0    | 430.5                 |
| 9.7187                                   | 0    | 311                   | 13.5                                     | 0    | 432                   |
| 9.7206                                   | 0    | 311.062               | 13.5156                                  | 0    | 432.5                 |
| 9.7968                                   | 0    | 313.5                 | 13.5287                                  | 0    | 432.92                |
| 9.8125                                   | 0    | 314                   | 13.5328                                  | 0    | 433.05                |
| 9.8281                                   | 0    | 314.5                 | 13.5443                                  | 0    | 433.42                |
| 9.8389                                   | 0    | 314.846               | 13.5467                                  | 0    | 433.496               |
| 9.8437                                   | 0    | 315                   | 13.5584                                  | 0    | 433.87                |
| 9.8485                                   | 0    | 315.1527              | 13.56                                    | 0    | 433.92                |
| 9.85                                     | 0    | 315.2                 | 13.5671                                  | 0    | 434.15                |
| 9.8593                                   | 0    | 315.5                 | 13.5756                                  | 0    | 434.42                |
| 9.875                                    | 0    | 316                   |                                          |      |                       |
| 9.9                                      | 0    | 316.8                 |                                          |      |                       |
| 9.9375                                   | 0    | 318                   |                                          |      |                       |
| F <sub>RF</sub> = F <sub>XTAL</sub> x 32 |      |                       | F <sub>RF</sub> = F <sub>XTAL</sub> x 32 |      |                       |

Table 9.2.3 Crystal selection guide in HW control mode



# A7302

## HW mode

| Default setting in HW Mode |                |
|----------------------------|----------------|
| TX Power                   | typical 10 dBm |
| R [1:0]                    | R = 2          |
| N                          | N=128          |
| PLL Comparison freq.       | 6.78MHz        |

Table 9.2.1 Default settings in HW control mode.

# A7302

## Settling time

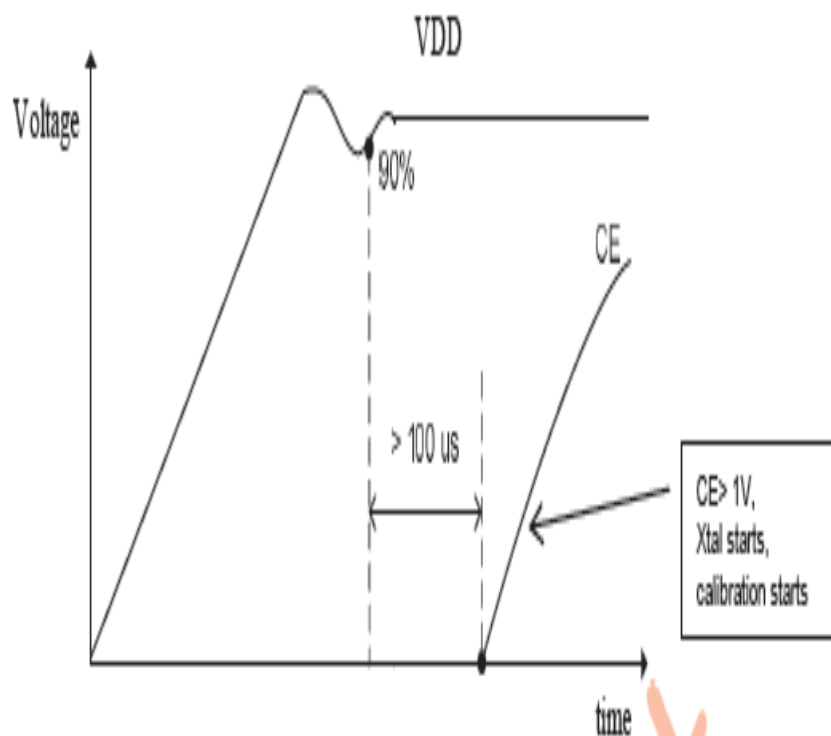


Fig 9.5.2. CE pin is controlled by MCU for a correct start up sequence.

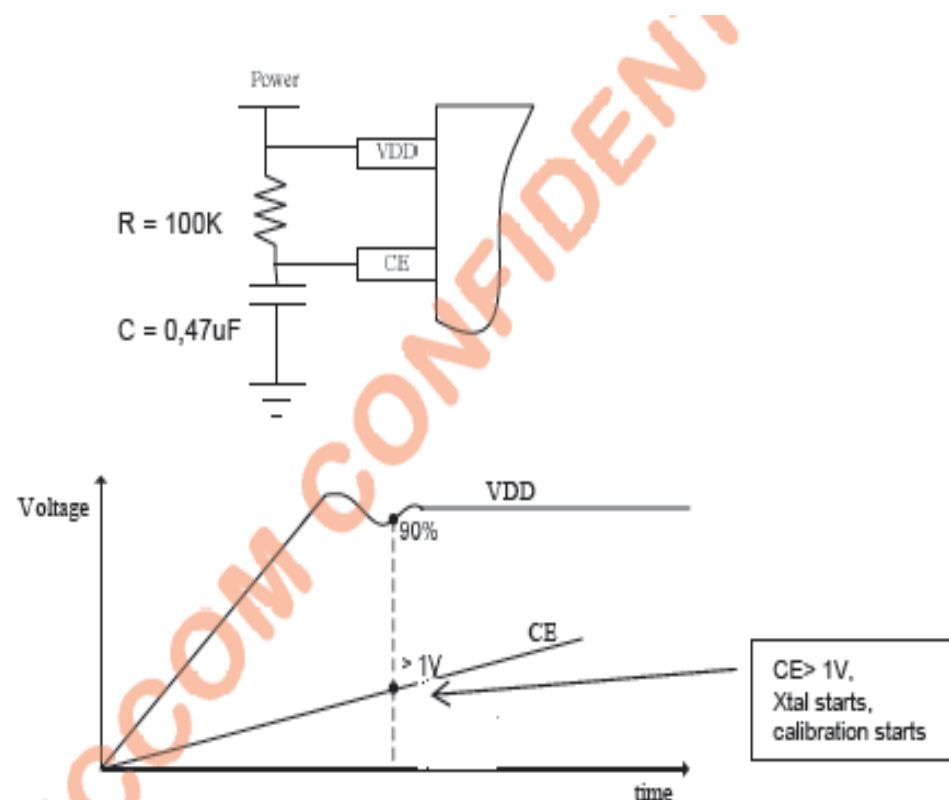


Fig 9.5.1. An extra RC delay on CE pin for correct start up sequence.

# A7302

## Settling time

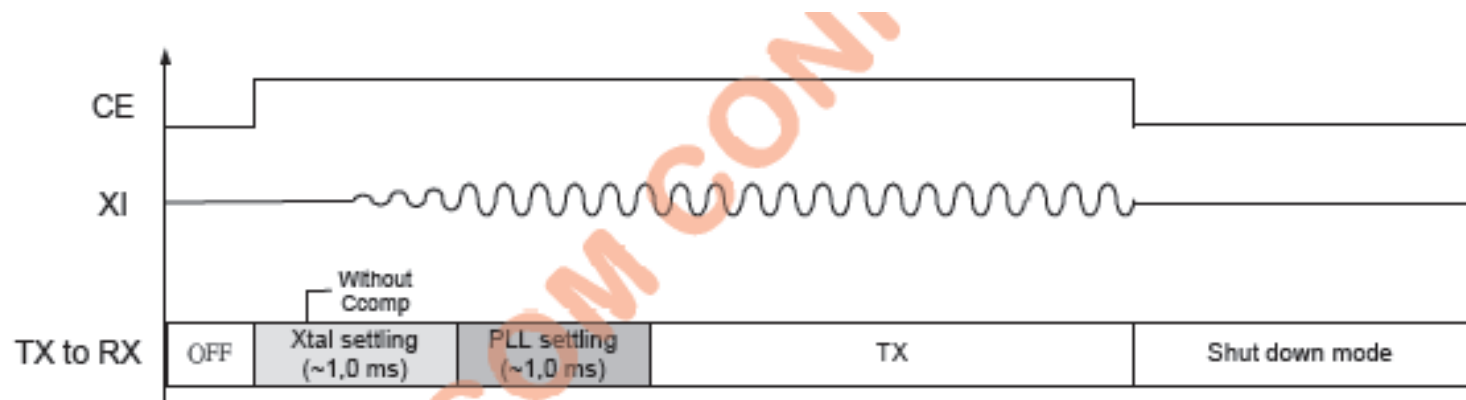


Fig 9.4.3 Settling time from shut down mode to TX mode.

| Settling Time (Typical) |               |      |
|-------------------------|---------------|------|
| Xtal settling           | Without Ccomp | 1 ms |
|                         | With Ccomp    | 5 ms |
| PLL settling time       |               | 1 ms |

Table 9.4.1 Typical settling time

# A7302

## Preamble

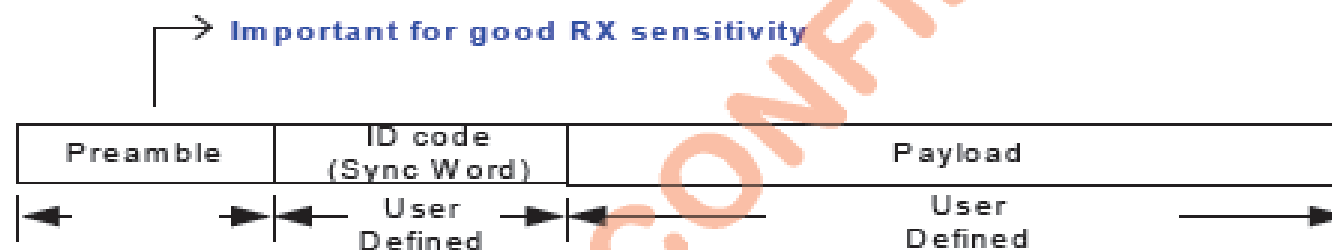


Figure 9.6.1 Packet Format

|                 | ASK                                                                                                                  | FSK                                  |
|-----------------|----------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| Preamble Format | <p>Long high period + Short low period</p>                                                                           | <p>64 bits of alternate 0 and 1.</p> |
| Data rate       | 9,6Kbps, High = 2,8 ms, Low = 1,2 ms<br>4,8Kbps, High = 2,8 ms, Low = 1,2 ms<br>2,4Kbps, High = 5,6 ms, Low = 2,4 ms | 1K ~ 20Kbps                          |

Table 9.6.1 Preamble Format

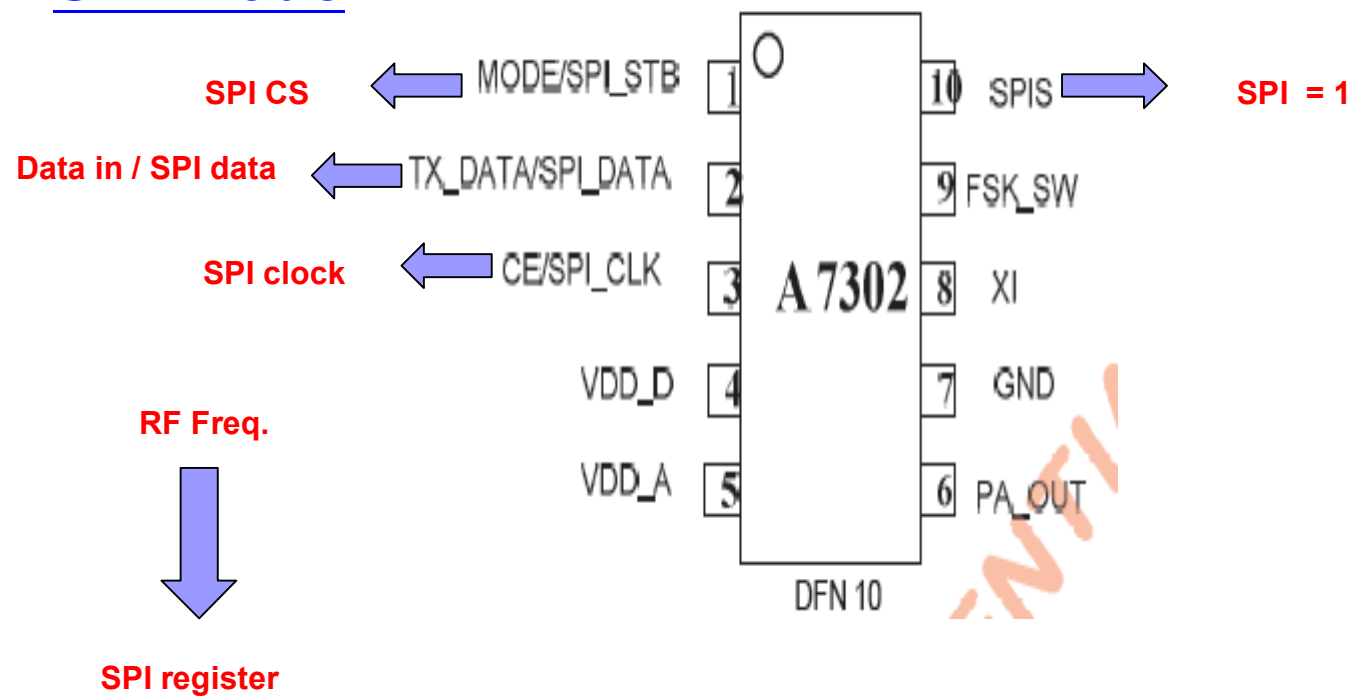
### Payload:

Payload is a carrier-information by user definition. Please noted, in ASK modulation, Do NOT apply data pattern in continuous low for over 40 ms. Otherwise, AGC circuit will operate abnormal.



# A7302

## SPI mode



# A7302

## SPI mode - timing

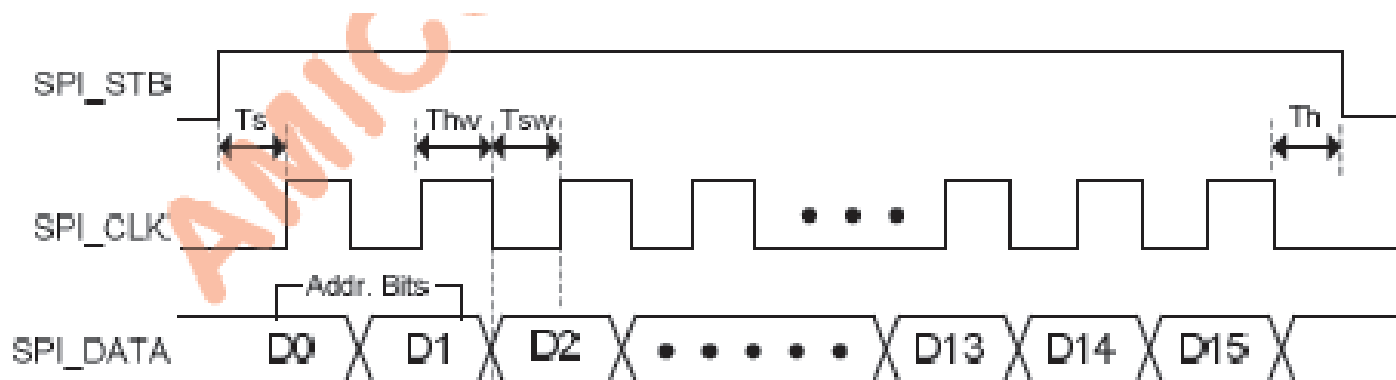


Fig 9.3.1.1 SPI timing chart

| Parameter | Description         | Min | Max | Unit |
|-----------|---------------------|-----|-----|------|
| Fc        | SPI Clock Frequency |     | 4   | MHz  |
| Ts        | SPI_STB Setup Time  | 50  |     | Ns   |
| Thw       | SPI_DATA Hold Time  | 50  |     | Ns   |
| Tsw       | SPI_DATA Setup Time | 50  |     | Ns   |
| Th        | SPI_STB Hold Time   | 50  |     | Ns   |

Table 9.3.1.1 SPI timing characteristic

# A7302

## SPI mode – SPI data / TX data

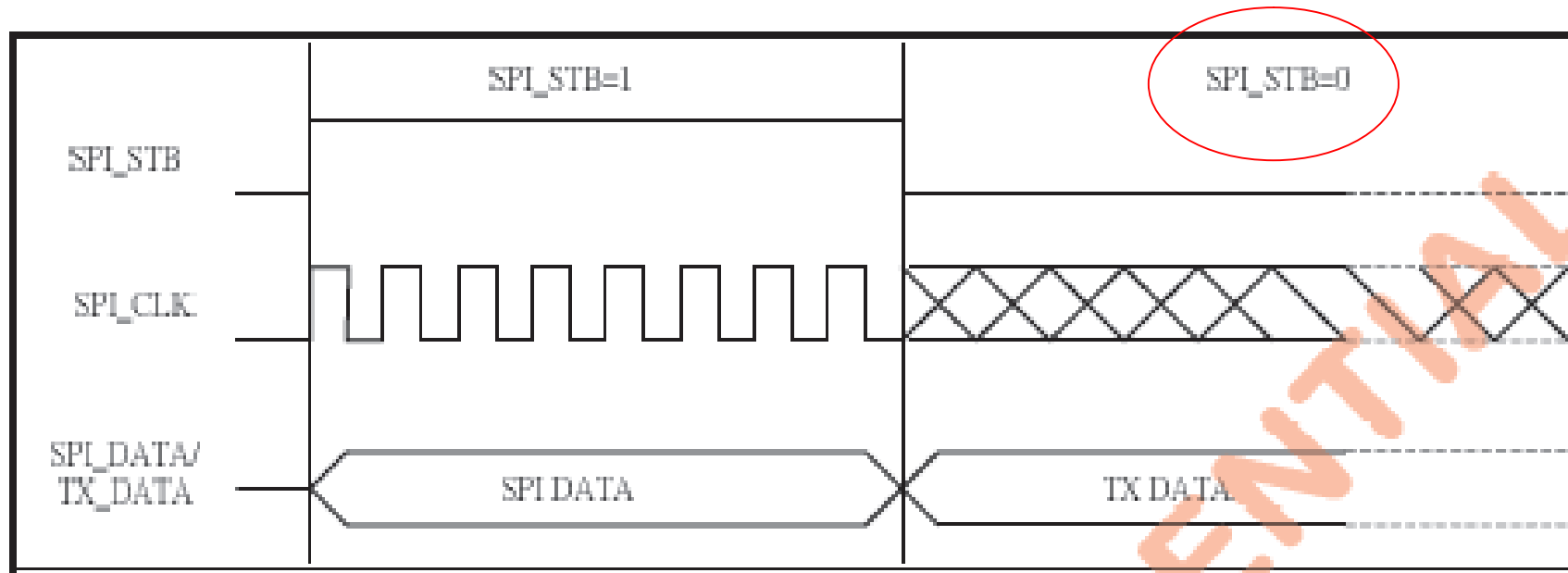


Figure 9.3.1.2 Timing chart of SPI\_STB

# A7302

## SPI mode – Freq.

R[1:0]: Crystal reference frequency.

| R [1:0] | Crystal (MHz) | R counter | Note                                      |
|---------|---------------|-----------|-------------------------------------------|
| 00      | Reserved      | Reserved  |                                           |
| 01      | 12            | 15        | PLL step = 800KHz, RF step = 400 KHz      |
| 10      | 13.56         | 16        | PLL step = 847.5KHz, RF step = 423.75 KHz |
| 11      | 16            | 20        | PLL step = 800KHz, RF step = 400 KHz      |

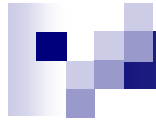
$N = (16 \times NB) + NA$ . NB=46~144, NA=0~15

NB, NA: Used to define wanted  $F_{RF}$  of PLL (see below table).

NA[3:0]: NA is 0 ~ 15.

NB[7:0]: NB is 40~65.

| Formula                                     |    |                                                   | Example                     |                  |                                                 |
|---------------------------------------------|----|---------------------------------------------------|-----------------------------|------------------|-------------------------------------------------|
| N = 16 x NB + NA<br>FRF = FXTAL x N / 2 / R |    |                                                   | NA = 0 = [0000]             |                  |                                                 |
|                                             |    |                                                   | NB = 64 = [0100-0000]       |                  |                                                 |
|                                             |    |                                                   | N = 16 x 64 + 0 = 1024      |                  |                                                 |
|                                             |    |                                                   | R = 16 (FXTAL =13,56MHz)    |                  |                                                 |
|                                             |    |                                                   | FRF = 13,56 x 1024 / 2 / 16 | FRF = 433,92 MHz |                                                 |
| 310MHz ~ 330MHz                             |    |                                                   | 425MHz ~ 445MHz             |                  |                                                 |
| NA                                          | NB | Example                                           | NA                          | NB               | Example                                         |
| 0                                           | 40 | FRF<br>= 13,56 x(16x46+7) /2 /16<br>= 314,846 MHz | 0                           | 60               | FRF<br>= 13,56 x(16x64+0) /2/16<br>= 433,92 MHz |
| 1                                           | 41 |                                                   | 1                           | 61               |                                                 |
| 3                                           | 42 |                                                   | 3                           | 62               |                                                 |
| 4                                           | 43 |                                                   | 4                           | 63               |                                                 |
| 5                                           | 44 |                                                   | 5                           | 64               |                                                 |
| 6                                           | 45 |                                                   | 6                           | 65               |                                                 |
| 7                                           | 46 |                                                   | 7                           |                  |                                                 |
| 8                                           | 47 |                                                   | 8                           |                  |                                                 |
| 9                                           | 48 |                                                   | 9                           |                  |                                                 |
| 10                                          | 49 |                                                   | 10                          |                  |                                                 |
| 11                                          |    |                                                   | 11                          |                  |                                                 |
| 12                                          |    |                                                   | 12                          |                  |                                                 |
| 13                                          |    |                                                   | 13                          |                  |                                                 |
| 14                                          |    |                                                   | 14                          |                  |                                                 |
| 15                                          |    |                                                   | 15                          |                  |                                                 |



# A7302

## Development tools

**Module / reference code / EK / DK / TF**