

**Silicon identification**

This errata sheet applies to the STMicroelectronic's SPIRIT1.

The full list of part numbers is shown in the table below.

**Table 1: Device summary**

Part numbers	Device info (stored in register 0xF0 and 0xF1)	Comment
SPIRIT1QTR	0x0130	Cut 3.0
Preliminary engineering samples	0x0103 or 0x0104	Cut 2.1

# Contents

<b>1</b>	<b>Limitations .....</b>	<b>4</b>
1.1	Automatic VCO calibration .....	4
1.1.1	Part number affected .....	4
1.1.2	Description .....	4
1.1.3	Workaround .....	4
1.2	Extra current consumption after power-on .....	5
1.2.1	Part number affected .....	5
1.2.2	Description .....	5
1.2.3	Workaround .....	5
1.3	With STack packet format, last byte missed from RX FIFO .....	6
1.3.1	Part number affected .....	6
1.3.2	Description .....	6
1.3.3	Workaround .....	6
1.4	Transmission issue after a reception with auto ACK .....	6
1.4.1	Part number affected .....	6
1.4.2	Description .....	6
1.4.3	Workaround .....	6
1.5	Termination of CSMA algorithm in back off mode .....	7
1.5.1	Part number affected .....	7
1.5.2	Description .....	7
1.5.3	Workaround .....	7
1.6	Failure of TX FIFO auto-reload during the automatic retransmission .....	7
1.6.1	Part number affected .....	7
1.6.2	Description .....	7
1.6.3	Workaround .....	7
1.7	Sensitivity issue at low battery voltage .....	8
1.7.1	Part number affected .....	8
1.7.2	Description .....	8
1.7.3	Workaround .....	8
<b>2</b>	<b>Limitations on preliminary engineering samples .....</b>	<b>9</b>
2.1	Bad RCO automatic calibration if the crystal frequency ( $f_{XO}$ ) is 24 MHz, 25 MHz, or 26 MHz .....	9
2.1.1	Part number affected .....	9
2.1.2	Description .....	9
2.1.3	Workaround .....	9

2.2	Receiver frequency offset if the crystal frequency ( $f_{xo}$ ) is 48 MHz, 50 MHz, or 52 MHz.....	10
2.2.1	Part number affected .....	10
2.2.2	Description.....	10
2.2.3	Workaround .....	10
2.3	RX startup failure .....	10
2.3.1	Part number affected .....	10
2.3.2	Description.....	10
2.3.3	Workaround .....	10
<b>3</b>	<b>Revision history .....</b>	<b>11</b>

# 1 Limitations

## 1.1 Automatic VCO calibration

### 1.1.1 Part number affected

SPIRIT1QTR and preliminary engineering samples.

### 1.1.2 Description

In sporadic cases, the VCO calibrator sets an inaccurate calibration word. This can cause an error, the inability to communicate, during the carrier frequency.

### 1.1.3 Workaround

The following workaround is to use manual calibration and store the calibration word in the micro for each center frequency that the application intends to use. This manual calibration procedure should be repeated periodically to compensate for the temperature variation.

The steps are as follows:

1. Set the T split time to the longest value (3.47 ns) to facilitate calibrator operation, write 1 in SEL\_TSPLIT, register SYNTH\_CONFIG[0] (register address 0x9F). It is recommended to set this register during radio initialization.
2. If the reference clock is 48 MHz, 50 MHz or 52 MHz and the reference divider is not enabled, it must be enabled. Write 1 in the REFDIV bitfield, register SYNTH\_CONFIG (register address 0x9E), and set the center frequency using the reference divider.
3. The VCO current must be increased by writing 0x19 in the register VCO\_CONFIG (register address 0xA1).
4. Enable automatic calibration of the VCO, writing 1 in VCO\_CALIBRATION, register PROTOCOL[2] (register address 0x50).
5. This step must be carried out only when the device is used as a transmitter.
  - a. Send a LOCKTX command and wait for the SPIRIT1 to go into LOCK state.
  - b. Read the VCO calibration word from VCO\_CALIBR\_DATA, register RCO\_VCO\_CALIBR\_OUT[0] (register address 0xE5). Write the value read into the VCO\_CALIBR\_TX, in register RCO\_VCO\_CALIBR\_IN[1] (register address 0x6E); optionally this value can be saved in the micro NVM.
  - c. Send a READY command and wait for SPIRIT1 to go into READY state.
6. This step must be carried out only if the device is used as a receiver.
  - a. Send a LOCKRX command and wait for the SPIRIT1 to go into LOCK state.
  - b. Read the VCO calibration word from VCO\_CALIBR\_DATA, register RCO\_VCO\_CALIBR\_OUT[0] (register address 0xE5). Write the value read into the VCO\_CALIBR\_RX, in register RCO\_VCO\_CALIBR\_IN[0] (register address 0x6F); optionally this value can be saved in the micro NVM.
  - c. Send a READY command and wait for SPIRIT1 to go into READY state.
7. Disable the automatic calibration of the VCO, write 0 in VCO\_CALIBRATION, register PROTOCOL[2] (register address 0x50).
8. Restore the VCO current by writing 0x11 in the register VCO\_CONFIG (register address 0xA1).
9. If step 2 was executed, restore the reference divider state. Write 0 in the REFDIV bitfield, register SYNTH\_CONFIG (register address 0x9E). Again, set the center frequency.

It is strongly suggested to repeat this sequence if the ambient temperature changes by many degrees.

## 1.2 Extra current consumption after power-on

### 1.2.1 Part number affected

SPIRIT1QTR and preliminary engineering samples.

### 1.2.2 Description

In some samples, when a supply voltage below 2.6 V is applied to SPIRIT1 from a no power condition, an extra current is added to the typical current consumption. In the following table, the current consumption in SHUTDOWN state is reported according to the supply voltage.

Table 2: Current consumption in SHUTDOWN state

VBAT [V]	IBAT [ $\mu$ A]
2.4	~150
2.2	~110
2.0	~74
1.8	~22

### 1.2.3 Workaround

In order to avoid this extra current, after the supply voltage below 2.6 V is provided to SPIRIT1, SPIRIT1 must exit from the SHUTDOWN state and the following operations must be done:

1. Write 0xCA in the register PM\_TEST, register address 0xB2
2. Write 0x04 in the register TEST\_SELECT, register address 0xA8
3. Write 0x00 in the register TEST\_SELECT, register address 0xA8

Between steps 2 and 3, some microseconds are needed. This small delay is automatically made by the second SPI operation (considering an SPI clock of max 10 MHz).

With this sequence, the extra current is erased. The workaround must be repeated only when a voltage supply below 2.6 V is applied to SPIRIT1 from a no power condition. A reset operation made by the SRES command or by driving the SDN pin to put SPIRIT1 in SHUTDOWN does not cause the issue again.

## **1.3 With STack packet format, last byte missed from RX FIFO**

### **1.3.1 Part number affected**

SPIRIT1QTR and preliminary engineering samples.

### **1.3.2 Description**

Using the STack packet format and no CRC field, the reading from RX FIFO to the last received byte, is not possible.

### **1.3.3 Workaround**

By configuring the packet handler with at least one byte of CRC, the problem is solved. If the CRC is not required in the application, configure one byte of CRC in the receiver only, to read the payload correctly from RX FIFO.

## **1.4 Transmission issue after a reception with auto ACK**

### **1.4.1 Part number affected**

SPIRIT1QTR and preliminary engineering samples.

### **1.4.2 Description**

The problem appears when the STack packet format and the automatic acknowledgment are used. If, during a receipt operation, no packet is correctly received and therefore no ACK packet is sent, at the next transmission of the packet with an ACK request (automatic acknowledgement must be disabled in this condition), the automatic reception phase is aborted.

### **1.4.3 Workaround**

Making a dummy transmission (with PA off and the highest data rate) between the reception phase with no ACK packet transmitted and the desired transmission with ACK request.

## **1.5 Termination of CSMA algorithm in back off mode**

### **1.5.1 Part number affected**

SPIRIT1QTR and preliminary engineering samples.

### **1.5.2 Description**

The maximum number of reached back offs does not indicate the end of the algorithm: another transmission is tried after this event.

### **1.5.3 Workaround**

In order to correctly detect the event of the maximum number of reached back offs, the following steps are suggested:

1. Set the desired maximum number of back offs and add one
2. When the event of the maximum number of back offs occurs:
  - a. disable the CSMA
  - b. send the SABORT command

This allows the CSMA, in back off mode, to be ended in a controlled way

## **1.6 Failure of TX FIFO auto-reload during the automatic retransmission**

### **1.6.1 Part number affected**

SPIRIT1QTR and preliminary engineering samples.

### **1.6.2 Description**

Under the following conditions:

- STack packet format
- Automatic re-transmission
- Maximum number of re-transmissions greater than 1

Occasionally, the third packet transmitted and the next consecutive packets have the payload shifted by two bytes.

### **1.6.3 Workaround**

The situation can be detected and the corrupted re-transmissions avoided using the following procedure.

At the second RX phase waiting the ACK packet, if the ACK packet is not received correctly and the number of bytes into the TX FIFO is not 0, then the NMAX\_RETX must be changed to 1 to abort the retransmission.

## 1.7 Sensitivity issue at low battery voltage

### 1.7.1 Part number affected

SPIRIT1QTR and preliminary engineering samples.

### 1.7.2 Description

The RX sensitivity performance of SPIRIT1 is degraded when the VBAT goes below 1.9 V. The sensitivity degrades proportional down to 1.8V where the worst sensitivity performance is achieved. The following table shows an example of the impact of VBAT on sensitivity performances.

**Table 3: Impact of VBAT on sensitivity performances**

VBAT (mV)	Sensitivity (dBm)
1800	-82
1820	-85.5
1840	-96
1860	-104
1880	-105.5
1900	-105.5
1920	-105
1940	-105.5
1960	-105

#### Test conditions

Modulation: 2FSK, Datarate: 38.4 kbps, Frequency deviation: 20 kHz, Channel bandwidth: 100 kHz, and PER: 1 %.

### 1.7.3 Workaround

No workaround exists for this issue and customers are recommended to use VBAT  $\geq 2$  V if the sensitivity degradation is not acceptable in their application.



## 2 Limitations on preliminary engineering samples

The limitations listed in this section apply only to preliminary engineering samples that have been delivered in the earlier version with the development kits.

### 2.1 Bad RCO automatic calibration if the crystal frequency ( $f_{xo}$ ) is 24 MHz, 25 MHz, or 26 MHz

#### 2.1.1 Part number affected

Preliminary engineering samples

#### 2.1.2 Description

By default, the digital clock divider is enabled and this allows it to work with an  $f_{xo}$  of 48 MHz, 50 MHz, or 52 MHz. But with an  $f_{xo}$  of 24 MHz, 25 MHz, or 26 MHz, the RCO calibration word is not correct. As a result, the RCO cannot be used and SPIRIT1 cannot go into the SLEEP state.

#### 2.1.3 Workaround

The digital clock divider must be disabled in a safe way. The procedure must be executed at device startup (from SHUTDOWN to READY) and after each SRES command. The steps are as follows:

1. Send an SRES command (command code 0x70)
2. Disable the RCO automatic calibration by writing 0 in the RCO\_CALIBRATION bitfield, register PROTOCOL[2] (register address 0x50).
3. Send a STANDBY command (command code 0x63)
4. Disable the divider of the digital part by writing 1 in the PD\_CLKDIV bitfield, register XO\_RCO\_TEST (register address 0xB4).
5. Enable the RCO automatic calibration by writing 1 in the RCO\_CALIBRATION bitfield, register PROTOCOL[2] (register address 0x50).
6. Send a READY command (command code 0x62)

Please ensure that no additional delay is inserted between step 1 and step 2.

## 2.2 Receiver frequency offset if the crystal frequency ( $f_{xo}$ ) is 48 MHz, 50 MHz, or 52 MHz

### 2.2.1 Part number affected

Preliminary engineering samples.

### 2.2.2 Description

When  $f_{xo}$  is 48 MHz, 50 MHz, or 52 MHz, there is a positive offset on the frequency set that is equal to the intermediate frequency (IF) setting, the recommended value of which is 480 kHz. For this reason, the receiver is not centered at the desired frequency. A workaround to fix this situation consists of manually changing the center frequency when switching between RX and TX, and vice-versa. This means that automatic acknowledgment, automatic retransmission, and CSMA do not work if  $f_{xo}$  is 48 MHz, 50 MHz, or 52 MHz.

### 2.2.3 Workaround

A value equal to IF must be added to the center frequency of the receiver only. For example, if the center frequency chosen is 868.000 MHz, for the receiver only the center frequency programmed must be 868.480 MHz. It is important to notice that when SPIRIT1 is switched back to transmission mode, the desired frequency (without offset) is set.

## 2.3 RX startup failure

### 2.3.1 Part number affected

Preliminary engineering samples.

### 2.3.2 Description

In some samples, the reception operation sometimes fails to start; the local oscillator frequency is incorrectly set and the receiver is not able to receive at the desired frequency. This is more frequent in the high frequency band.

### 2.3.3 Workaround

In order to safely start the reception operation, follow the steps below:

1. After an RX command (command code 0x61)
2. Write 1 in the VCO\_L\_SEL or VCO\_H\_SEL bitfields, register SYNTH\_CONFIG[1] (register address 0x9E), according to which VCO is not used. In this way both the VCO\_L\_SEL and VCO\_H\_SEL are 1.
3. Wait about 50  $\mu$ s
4. Write 0 in VCO\_L\_SEL or VCO\_H\_SEL according to which VCO is not used

### 3 Revision history

Table 4: Document revision history

Date	Revision	Changes
04-May-2012	1	Initial release
08-May-2012	2	Updated device information in <a href="#">Table 1: "Device summary"</a>
05-Oct-2012	3	Updated device information in <a href="#">Table 1: "Device summary"</a> Inserted <a href="#">Section 1.1: "Automatic VCO calibration"</a> Minor text changes
06-Feb-2013	4	Added <a href="#">Section 1.3: "With SStack packet format, last byte missed from RX FIFO"</a> , <a href="#">Section 1.4: "Transmission issue after a reception with auto ACK"</a> , <a href="#">Section 1.5: "Termination of CSMA algorithm in back off mode"</a> , <a href="#">Section 1.6: "Failure of TX FIFO auto-reload during the automatic retransmission"</a> . Minor text changes
21-Mar-2013	5	Added <a href="#">Section 1.2: "Extra current consumption after power-on"</a>
28-Jan-2015	6	Added <a href="#">Section 1.7: "Sensitivity issue at low battery voltage"</a> Minor text changes

**IMPORTANT NOTICE – PLEASE READ CAREFULLY**

STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST's terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers' products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2015 STMicroelectronics – All rights reserved