

# **Super-Regeneration RF Receiver**

## **W55RFS27R3C**

### **Data Sheet**

# Contents

|   |           |
|---|-----------|
| <b>General Description</b>                        | <b>3</b>  |
| 1.1 W55RFS27R3C Features .....                    | 3         |
| 1.2 W55RFS27R3C Pad Definition .....              | 4         |
| 1.2.1 W55RFS27R3C Pad Description .....           | 4         |
| <b>System Description</b>                         | <b>6</b>  |
| 2.1 W55RFS27R3C System Block Diagram.....         | 6         |
| 2.2 W55RFS27R3C Functional Description .....      | 7         |
| <b>Electronic Characteristics</b>                 | <b>7</b>  |
| 3.1 W55RFS27R3C Absolute Maximum Ratings.....     | 7         |
| 3.2 W55RFS27R3C DC Characteristics.....           | 8         |
| 3.3 W55RFS27R3C Ordering Information .....        | 8         |
| 3.4 W55RFS27R3C Package Information.....          | 9         |
| 3.4.1 W55RFS27R3C Bonding Pad List.....           | 9         |
| 3.4.2 W55RFS27R3C Bonding Pad Diagram .....       | 9         |
| <b>Design Information</b>                         | <b>10</b> |
| 4.1 W55RFS27R3C Reference Design .....            | 10        |
| 4.1.1 W55RFS27R3C Application Circuit.....        | 10        |
| 4.2 W55RFS27R3C Data Sheet Document History ..... | 11        |

# General Description

nuvoTon W55RFS27R3C is a fully integrated S-R (Super-regeneration) RF receiver with full-function of baseband control command decoder for application of R/C vehicle, toy, or wireless data communication. W55RFS27R3C provides both *uC-mode* for simple logic interface to general purpose of micro-controller and *manual-mode* for baseband control command decoder.

*Manual-mode* is designed with Winbond patented *ChannelShared<sup>WB</sup>* protocol for multi-player application. Up to 3 players is allowed simultaneously playing in the same frequency band. There are 6 functions available in *Manual-mode*, i.e.,

Forward, Backward, Left-turn, Right-turn, and two other reserved functions F1, F2 for light, horn or other control function.

*uC-mode* can be controlled by general purpose micro-controller to support R/C toy, or wireless data communication.

The associate transmitter W55RFS27T3B provides the FCC/ETSI regulation provisions for 27MHz, 40MHz, and 49MHz S-R (Super-regeneration) demodulation and wide range of operating voltage 2.1V ~ 5.5V for 2-battery or 3-battery R/C toy application.

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## 1.1 W55RFS27R3C Features

- ❑ Winbond patented *ChannelShared<sup>WB</sup>* protocol enables maximum 3 players simultaneously playing in one frequency band.
- ❑ On-chip LNA provides very good isolation so that receivers can work together without interference.
- ❑ Enhanced receiver circuit provides higher sensitivity than traditional super-regenerative circuits.
- ❑ Operating frequency: 27MHz to 49MHz (depend on oscillator frequency)
- ❑ Very low operating voltage: 2.2V ~ 5.5V
- ❑ Receiving data rates up to 2.5Kbps for 50% duty cycle
- ❑ Supports 6-function of R/C toy baseband control command decoder
- ❑ Power down current consumption less than 1uA
- ❑ Less manual adjustment needed in production
- ❑ Lower manufacture production cost
- ❑ Associate transmitter W55RFS27T3B compliant to FCC part 15 Subpart C 15.227 / ETSI 300 220-1 low-power & short-range device requirements
- ❑ Operating temperature: 0°C ~ 70°C

## 1.2 W55RFS27R3C Pad Definition

### 1.2.1 W55RFS27R3C Pad Description

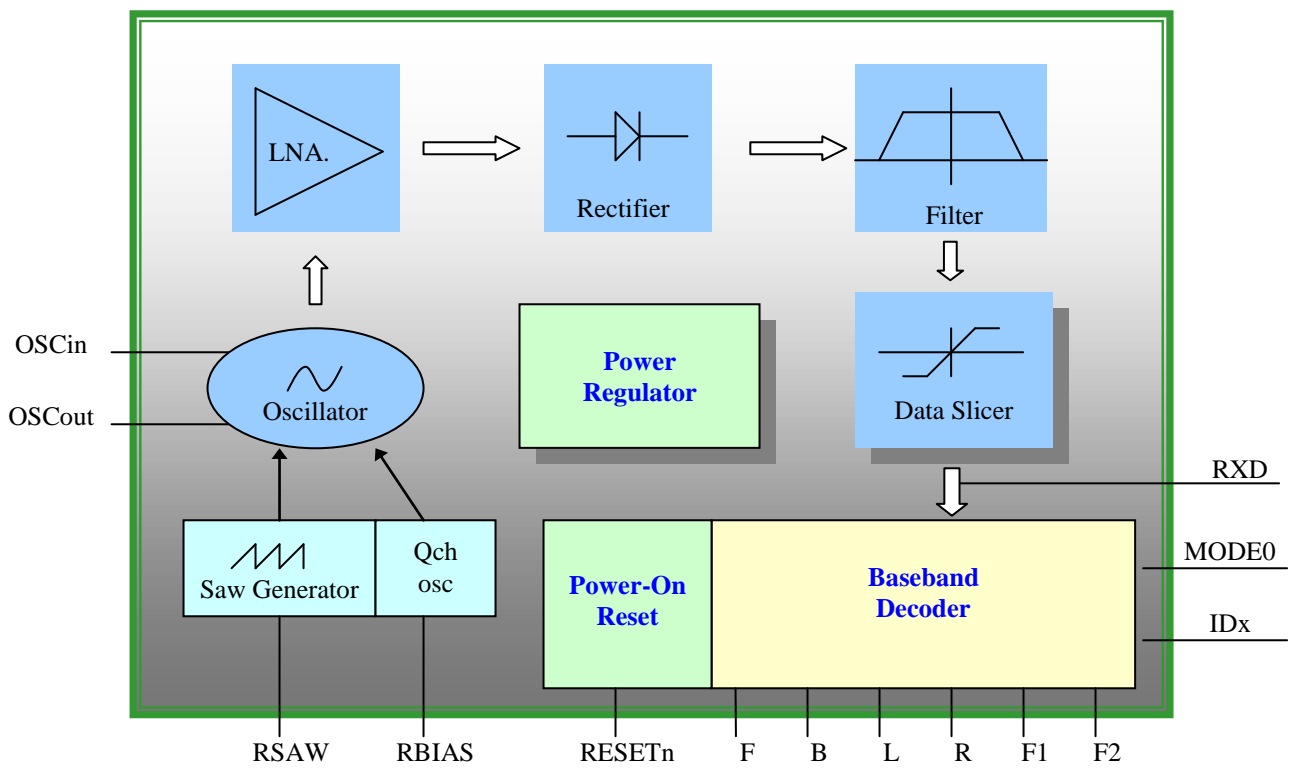
| Symbol             | Pad No. | I/O    | A/D | Functional Description  |
|--------------------|---------|--------|-----|---|
| GND                | 1.      | Ground | A   | Ground return path  |
| CMFB               | 2.      | I/O    | A   | Common-mode feedback capacitor connect  |
| RBIAS              | 3.      | I/O    | A   | Resistor to adjust internal ring-oscillator frequency                                     |
| RSAW               | 4.      | I/O    | A   | Resistor to control internal saw generator  |
| VDDA               | 5.      | Power  | A   | Regulated voltage output  |
| VDDA               | 6.      | Power  | A   | Regulated voltage output  |
| GND_LNA            | 7.      | Ground | A   | LNA Ground return path  |
| VDD_LNA            | 8.      | Power  | A   | LNA power input   |
| SDINGD             | 9.      | Ground | A   | Filter capacitor connect  |
| LNAING             | 10.     | I      | A   | LNA Gate input  |
| LNAINS             | 11.     | I      | A   | LNA Source input  |
| LNAOUT             | 12.     | O      | A   | LNA output(NC)  |
| OSCI <sub>n</sub>  | 13.     | O      | A   | Oscillator tank input   |
| OSCO <sub>ut</sub> | 14.     | O      | A   | Oscillator tank output  |
| GND <sub>A</sub>   | 15.     | O      | A   | Regulator ground return path  |
| Reset <sub>n</sub> | 16.     | I/O    | D   | Reset <sub>n</sub> =0 reset whole circuit, internal pull-high                             |
| Mode               | 17.     | I      | D   | Receiver mode selection, should be "0" when operating                                     |
| ID0                | 18.     | I      | D   | ID setting(LSB) for Channel shared , ID0=ID1 = 1⇒ enter <b>uC-mode</b>                    |
| ID1                | 19.     | I      | D   | ID setting (MSB) for Channel shared , ID0=ID1 = 1⇒ enter <b>uC-mode</b>                   |
| TEST               | 20.     | I      | D   | TEST=1 reserved for chip testing, internal pull-low                                       |
| F1                 | 21.     | I/O    | D   | Decoder F1 output / power on trapping of OAGC (Set "0")                                   |
| F2                 | 22.     | I/O    | D   | Decoder F2 output / Power on trapping of HOPQ(Set "1") / CPU mode= \$ENB ("0" power down) |
| R                  | 23.     | I/O    | D   | Decoder Right-turn output / CPU mode=HOP_CLK  |
| L                  | 24.     | I/O    | D   | Decoder Left-turn output / CPU mode=OAGC2Q  |
| B                  | 25.     | I/O    | D   | Decoder Backward output / CPU mode=OAGC1Q   |
| F                  | 26.     | I/O    | D   | Decoder Forward output / CPU mode=OAGC0Q  |
| RXD                | 27.     | I/O    | D   | Receiver data output / power on trapping of LENB (set "1")                                |
| VSPLY              | 28.     | Power  | A   | Power input   |

**1.2.2 Power-On Trapping Function Description**

| <b>Power-Trapping Pin Name</b> | <b>Trapping State</b> | <b>Function Description</b> | <b>Recommend Usage</b>   |
|--------------------------------|-----------------------|-----------------------------|--------------------------|
| RXD                            | 1                     | Enable LNA                  | Enable LNA               |
|                                | 0                     | Disable LNA                 |                          |
| F1                             | 1                     | Enable OAGC                 | Disable OAGC             |
|                                | 0                     | Disable OAGC                |                          |
| F2                             | 1                     | Enable Frequency Hopping    | Enable Frequency Hopping |
|                                | 0                     | Disable Frequency Hopping   |                          |

# System Description

## 2.1 W55RFS27R3C System Block Diagram



## 2.2 W55RFS27R3C Functional Description

### ChannelShared Protocol Engine

W55RFS27R3C+W55RFS27T3B built-in *ChannelShared<sup>WB</sup>* protocol enables maximum 3 players in a frequency band. Switch channel is simply switch an input state, instead of change crystal such a high cost channel switching.

### Power Regulator

W55RFS27R3C build-in on-chip power regulator provides a stable operating performance under operating voltage from 2.2V ~ 5.5V, the very wide range of operating voltage is specially designed for mini R/C toy or R/C vehicle by 2-battery or 3-battery operation.

### RF Receiver

W55RFS27R3C RF receiver has been enhanced from "Super-Regeneration" architecture for R/C toy application. The high sensitivity and high noise immunity property is very suitable for getting higher RF receiving performance in very high noise level environment.

On-chip LNA provides isolation from receivers and is very useful for multi-player application

### Baseband Control Function Decoder

W55RFS27R3C build-in 6-function of general baseband control function for R/C toy "Forward"; "Backward"; "Left-turn"; "Right-turn", and 2 more reserved control functions of "F1"; "F2".

# Electronic Characteristics

## 3.1 W55RFS27R3C Absolute Maximum Ratings

| Parameter                                 | Rating       | Unit |
|---|--------------|------|
| Supply Voltage to Ground Potential        | - 0.3 to 6.5 | V    |
| Applied Input/Output Voltage              | - 0.3 to 6.5 | V    |
| Power Dissipation (T <sub>a</sub> = 70°C) | 150          | mW   |
| Ambient Operating Temperature             | 0 to 70      | °C   |
| Storage Temperature                       | -40 to 85    | °C   |

*Note:* Exposure to conditions beyond those listed under Absolute Maximum Ratings may adversely affect the life and reliability of the device.

### 3.2 W55RFS27R3C DC Characteristics

(VDD-VSS = 3 V, Ta = 25°C; unless otherwise specified)

| Parameter                        | Sym.             | Conditions  | Min.                | Typ. | Max.                | Unit |
|----------------------------------|------------------|---|---------------------|------|---------------------|------|
| <b>Power Supply</b>              |                  |   |                     |      |                     |      |
| Operating Voltage                | V <sub>DD</sub>  |   | 2.2                 | -    | 5.5                 | V    |
| Operating Current                | I <sub>OP</sub>  | V <sub>DD</sub> =5.5V                             | -                   | -    | 4                   | mA   |
| Stand-by Current                 | I <sub>SBY</sub> | V <sub>DD</sub> =5.5V , ENB= 0 ( <i>uC-mode</i> ) | -                   | -    | 2                   | μA   |
| <b>Digital Input/Output Pin</b>  |                  |   |                     |      |                     |      |
| Input High Voltage               | V <sub>IH</sub>  |   | 0.8*V <sub>DD</sub> | -    | V <sub>DD</sub>     | V    |
| Input Low Voltage                | V <sub>IL</sub>  |   | V <sub>SS</sub>     | -    | 0.1*V <sub>DD</sub> | V    |
| F,B,L,R,F1,F2 Output High Source | I <sub>OH</sub>  | V <sub>OH</sub> =0.7 * V <sub>DD</sub>            | -                   | 6    | -                   | mA   |
| F,B,L,R,F1,F2 Output Low Sink    | I <sub>OL</sub>  | V <sub>OL</sub> =0.3 * V <sub>DD</sub>            | -                   | 6    | -                   | mA   |
| RXD Output High Source Current   | I <sub>OH</sub>  | V <sub>OH</sub> =0.7 * V <sub>DD</sub>            | -                   | 2    | -                   | mA   |
| RXD Output Low Sink Current      | I <sub>OL</sub>  | V <sub>OL</sub> =0.3 * V <sub>DD</sub>            | -                   | 2    | -                   | mA   |
| <b>Oscillator</b>                |                  |   |                     |      |                     |      |
| Operation Frequency              | F <sub>OSC</sub> |   | 27                  | -    | 49.8                | MHz  |
| Quench frequency                 | F <sub>QCH</sub> |   | 170                 | 200  | 250                 | KHz  |
| <b>Baseband Decoder Section</b>  |                  |   |                     |      |                     |      |
| Modulation Duty Cycle            | M <sub>DYT</sub> |   | 30                  | 50   | 70                  | %    |
| Received Data Rate               | R <sub>DTT</sub> | 50% Duty-cycle Manchester Code                    | -                   | 2.5  | -                   | Kbps |

### 3.3 W55RFS27R3C Ordering Information

W55RFS27R3C provides two types of package in shipment: Dice form and wafer form

| Part Number    | Package    | Remarks |
|----------------|------------|---------|
| W55RFS27R3C(H) | Dice form  |         |
| W55RFS27R3C(W) | Wafer form |         |

### 3.4 W55RFS27R3C Package Information

#### 3.4.1 W55RFS27R3C Bonding Pad List

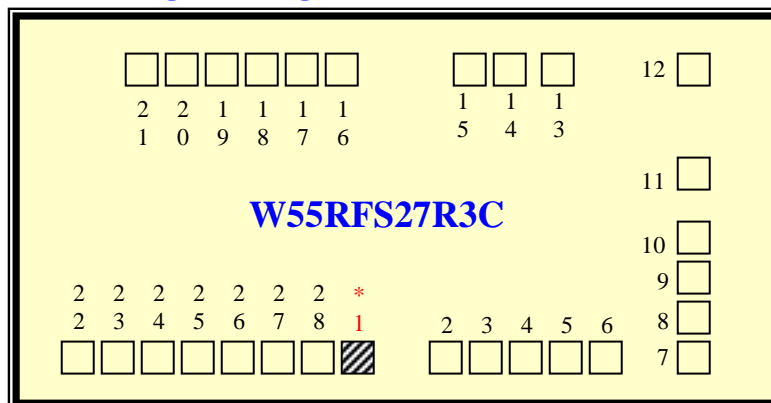
Window : (xl = -1228.000, yl = -625.000), (xh = 1228.000, yh = 625.000)

Windows size : Width = 2456.000, length = 1250.000

| PAD NO             | PAD NAME | PIN NO (DIP28) | X         | Y        |
|--------------------|----------|----------------|-----------|----------|
| 1                  | * GND    | * 1            | -33.015   | 540.000  |
| 2                  | CMFB     | 2              | -385.965  | 540.000  |
| 3                  | RBIAS    | 3              | -492.965  | 540.000  |
| 4                  | RSAW     | 4              | -599.965  | 540.000  |
| 5                  | VDDA:    | 5              | -709.365  | 540.000  |
| 6                  | VDDA:    | 5              | -821.165  | 540.000  |
| 7                  | GND_LNA  | 6              | -1143.000 | 532.375  |
| 8                  | VDD_LNA  | 7              | -1143.000 | 420.975  |
| 9                  | SDINGD   | 8              | -1143.000 | 308.495  |
| 10                 | LNAING   | 9              | -1143.000 | 174.685  |
| 11                 | LNAINS   | 10             | -1143.000 | -46.460  |
| 12                 | LNAOUT   | 11             | -1143.000 | -525.320 |
| 13                 | OSCin    | 12             | -815.090  | -540.000 |
| 14                 | OSCut    | 13             | -685.215  | -540.000 |
| 15                 | GNDA     | 14             | -575.165  | -540.000 |
| 16                 | resetn   | 15             | -148.690  | -540.000 |
| 17                 | MODE     | 16             | -41.690   | -540.000 |
| 18                 | ID0      | 17             | 65.310    | -540.000 |
| 19                 | ID1      | 18             | 172.310   | -540.000 |
| 20                 | TEST     | 19             | 279.310   | -540.000 |
| 21                 | F1       | 20             | 389.910   | -540.000 |
| -----21 (GND)----- |          |                |           |          |
| 22                 | F2       | 22             | 770.310   | 540.000  |
| 23                 | R        | 23             | 655.860   | 540.000  |
| 24                 | L        | 24             | 541.410   | 540.000  |
| 25                 | B        | 25             | 426.960   | 540.000  |
| 26                 | F        | 26             | 312.510   | 540.000  |
| 27                 | RXD      | 27             | 196.535   | 540.000  |
| 28                 | VSPLY    | 28             | 78.385    | 540.000  |

(\*: Bonding Sequence start from GND(Pin1))

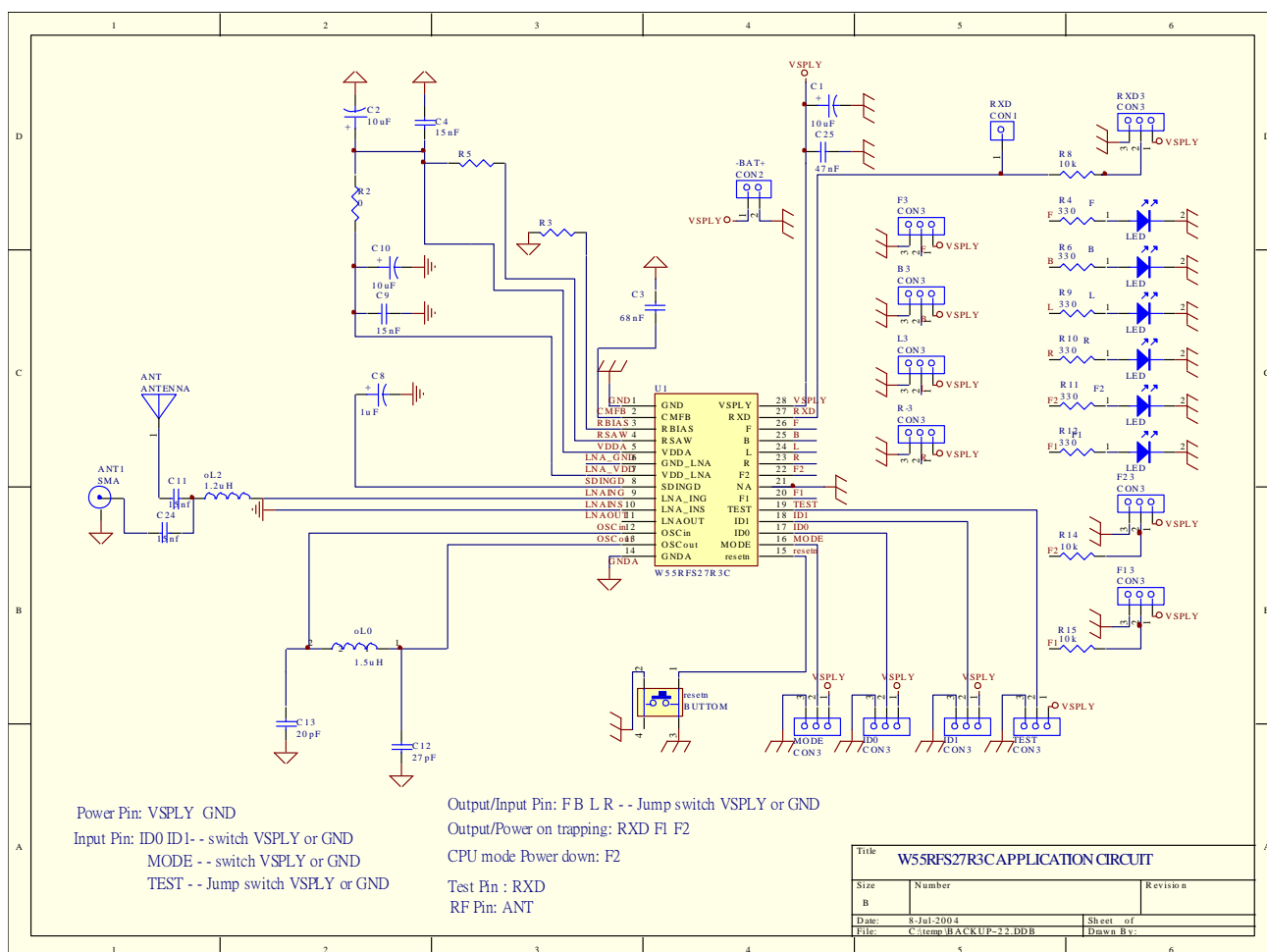
#### 3.4.2 W55RFS27R3C Bonding Pad Diagram



# Design Information

## 4.1 W55RFS27R3C Reference Design

### 4.1.1 W55RFS27R3C Application Circuit



**W55RFS27R3C Application Schematic BOM:**

| Item | Qty | Reference   | Part            |
|------|-----|-------------|-----------------|
| 1.   | 1   | 0           | R2              |
| 2.   | 1   | 1.2uH       | oL2             |
| 3.   | 1   | 1.5uH       | oL0             |
| 4.   | 1   | 1uF         | C8              |
| 5.   | 2   | 10k         | R8 R14          |
| 6.   | 1   | 10k         | R15             |
| 7.   | 3   | 10uF        | C1 C2 C10       |
| 8.   | 4   | 15nF        | C4 C9 C11 C24   |
| 9.   | 1   | 20pF        | C13             |
| 10.  | 1   | 27pF        | C12             |
| 11.  | 1   | 47nF        | C25             |
| 12.  | 1   | 68nF        | C3              |
| 13.  | 5   | 330         | R4 R6 R9 10 R11 |
| 14.  | 1   | 330         | R12             |
| 15.  | 1   | ANTENNA     | ANT             |
| 16.  | 1   | W55RFS27R3C | U1              |

**4.2 W55RFS27R3C Data Sheet Document History**

| Revision | Date      | Description            |
|----------|-----------|------------------------|
| A0       | Jul. 2004 | Preliminary version A0 |
| A1.0     | Feb. 2010 | Logo Changed           |

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