

## **SPRC205A/SPRC206A**

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### **5-Function Remote Control Encoder/Decoder**

***Preliminary***

MAR. 14, 2005

Version 0.3

## **FIVE FUNCTIONS REMOTE CONTROL ENCODER/DECODER PAIRS**

### **1. GENERAL DESCRIPTION**

These two devices are especially designed is use as paired encoder/decoder in remote control (RC) applications.

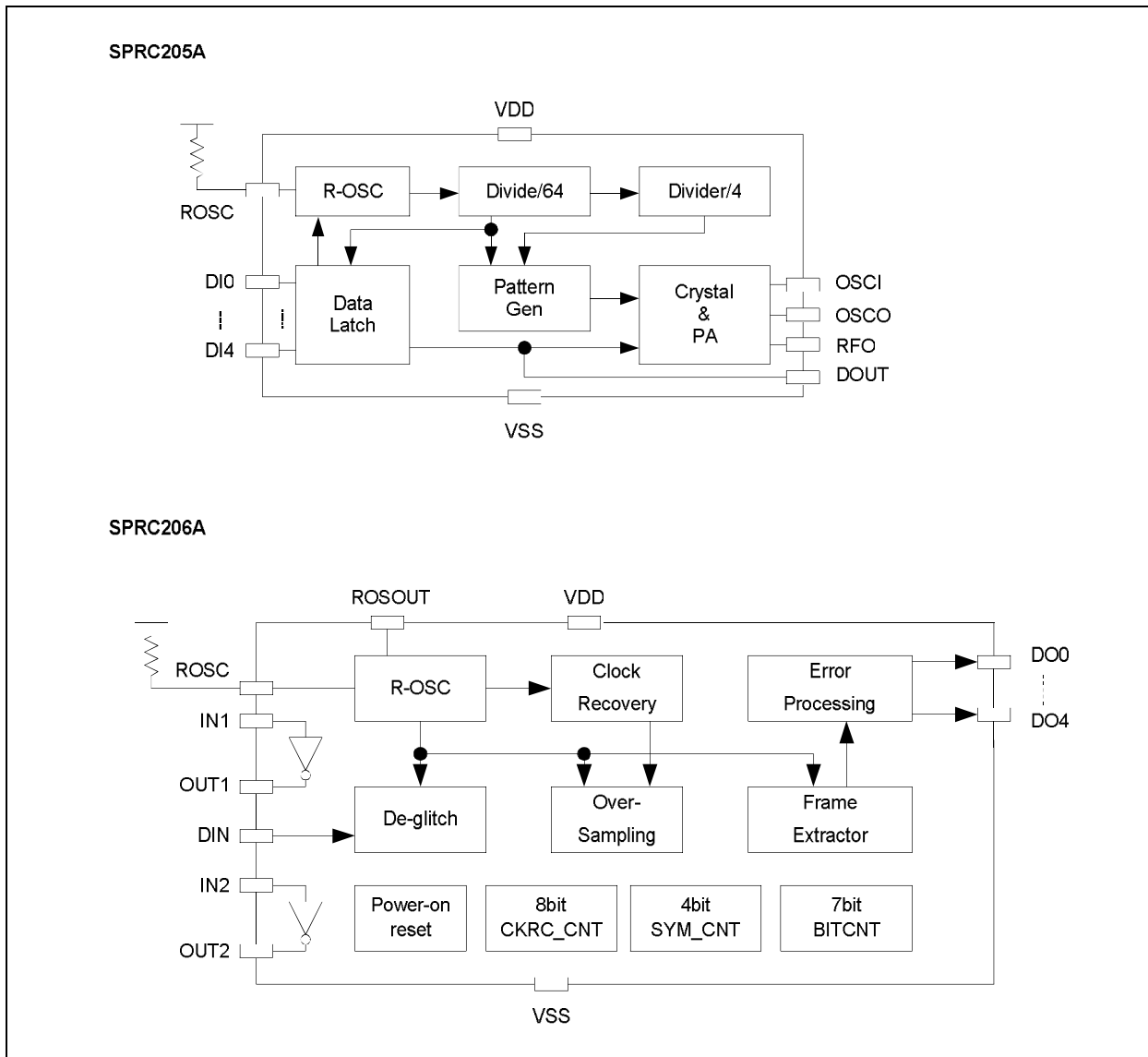
The SPRC205A, a RC encoder, is able to encode five lines of binary information into a serial bit-stream data. When any of the 5-line information is activated, built-in crystal oscillator and power amplifier will be enabled to deliver the encoded bit-stream data. After the 5-line information becomes inactive, the SPRC205A will transmit additional fifteen data frames to increase transmission reliability.

The SPRC206A is a remote control decoder, which decodes the serial bit-stream data received from the SPRC205A and interprets the 5-line information as 5-bit output data to control the corresponding external component. The SPRC206A will be activated only when two consecutive and equal frames are received.

With SUNPLUS state-of-the-art technology and strong support, SPRC205A and SPRC206A are the simplest and most suitable products for your RC products.

### **2. FEATURES**

- Operating voltage
  - 2.2V - 5.5V operation
- Built-in R-oscillator (a 5% resistor required)
- Low standby and operating current
  - $I_{STBY,SPRC205A} < 1.0\mu A$ , R-oscillator stops
  - $I_{OPERATE,SPRC205A} < 15mA$ , R-oscillator free run, crystal & PA on
  - $I_{OPERATE,SPRC206A} < 100\mu A$ , R-oscillator free run
- Built-in power on reset
- Built-in Crystal & PA in SPRC205A
- 5-function I/O pins
- $2^5 = 32$  encoding in SPRC205A
- Variable frame rates controlled by external resistor

**3. BLOCK DIAGRAM**


## 4. SIGNAL DESCRIPTIONS

### 4.1. PIN Description

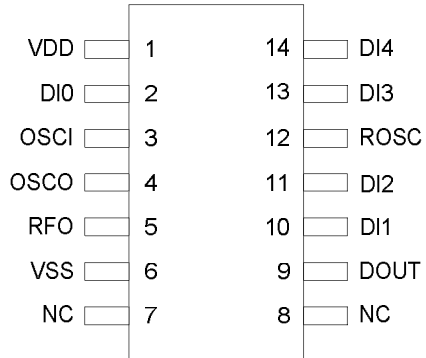
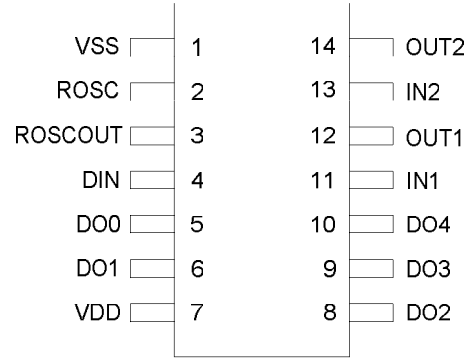
#### 4.1.1. SPRC205A

| Mnemonic | Type | PIN No. | Description  |
|----------|------|---------|--|
| DI0      | I    | 2       | 5-function parallel data input   |
| DI1      |      | 8       |  |
| DI2      |      | 9       |  |
| DI3      |      | 11      |  |
| DI4      |      | 12      |  |
| DOUT     | O    | 7       | Serial bit-stream data output; connected a capacitor of 10nF to VSS to reduce RF spurious. |
| OSCI     | I    | 3       | Crystal oscillator input pin   |
| OSCO     | O    | 4       | Crystal oscillator output pin  |
| RFO      | O    | 5       | Power Amplifier output pin. The waveform do not exceed 9Vpp.                               |
| ROSC     | I    | 10      | R-oscillator input, connected to VDD through a resistor.                                   |
| VDD      | P    | 1       | Power voltage input  |
| VSS      | P    | 6       | Power ground input   |

#### 4.1.2. SPRC206A

| Mnemonic | Type | PIN No. | Description  |
|----------|------|---------|--|
| DO0      | I    | 5       | 5-function parallel data output                          |
| DO1      |      | 6       |  |
| DO2      |      | 8       |  |
| DO3      |      | 9       |  |
| DO4      |      | 10      |  |
| DIN      | I    | 4       | Serial bit-stream data input                             |
| ROSC     | I    | 2       | R-oscillator input, connected to VDD through a resistor. |
| ROSCOUT  | O    | 3       | R-oscillator clock output                                |
| IN1      | I    | 11      | Inverter input pins                                      |
| IN2      | I    | 12      |  |
| OUT1     | O    | 13      | Inverter output pins                                     |
| OUT2     | O    | 14      |  |
| VDD      | P    | 7       | Power voltage input                                      |
| VSS      | P    | 1       | Power ground input                                       |

Legend: I = Input, O = Output, P = Power

**4.2. PIN Configuration**
**4.2.1. SPRC205A - PDIP 14**

**4.2.2. SPRC206A - PDIP 14**


## 5. FUNCTIONAL DESCRIPTIONS

### 5.1. Frame Format

| Preamble |   |   |   |   |   | PO  | E   | D0  | D1  | D2  | D3  | D4  |
|----------|---|---|---|---|---|-----|-----|-----|-----|-----|-----|-----|
| P        | P | P | P | P | P | A/I | A/I | A/I | A/I | A/I | A/I | A/I |

Preamble field: 6 preamble fields

PO field: Even parity check field

E field: Frame polarity indication field; frames are transmitted in positive/negative sequence.

Data field: 5 data fields

P pattern: encoded as 101

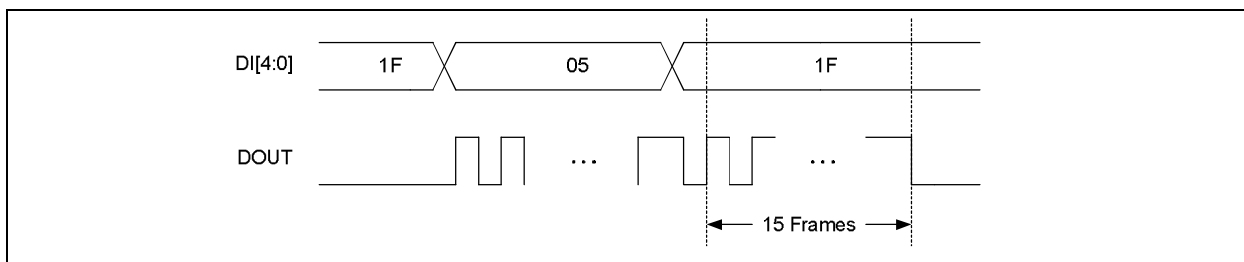
A pattern: encoded as 100

I pattern: encoded as 110

### 5.2. Operation

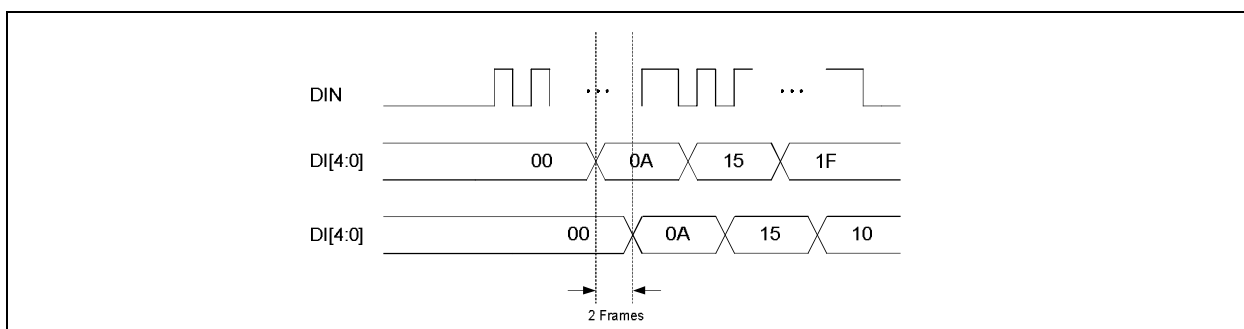
The SPRC205A encodes 5-function information into  $2^5$  series of bit-stream data and transmits the encoded data stream via RFO when any of the 5-function I/Os is activated. The cycle will repeat until all 5-function I/Os become inactive. After these 5-function I/Os

become inactive, SPRC205A will transmit another 15 all-zero frames to inform SPRC206A returning to disabled state. The transmitting timing is shown as follows:

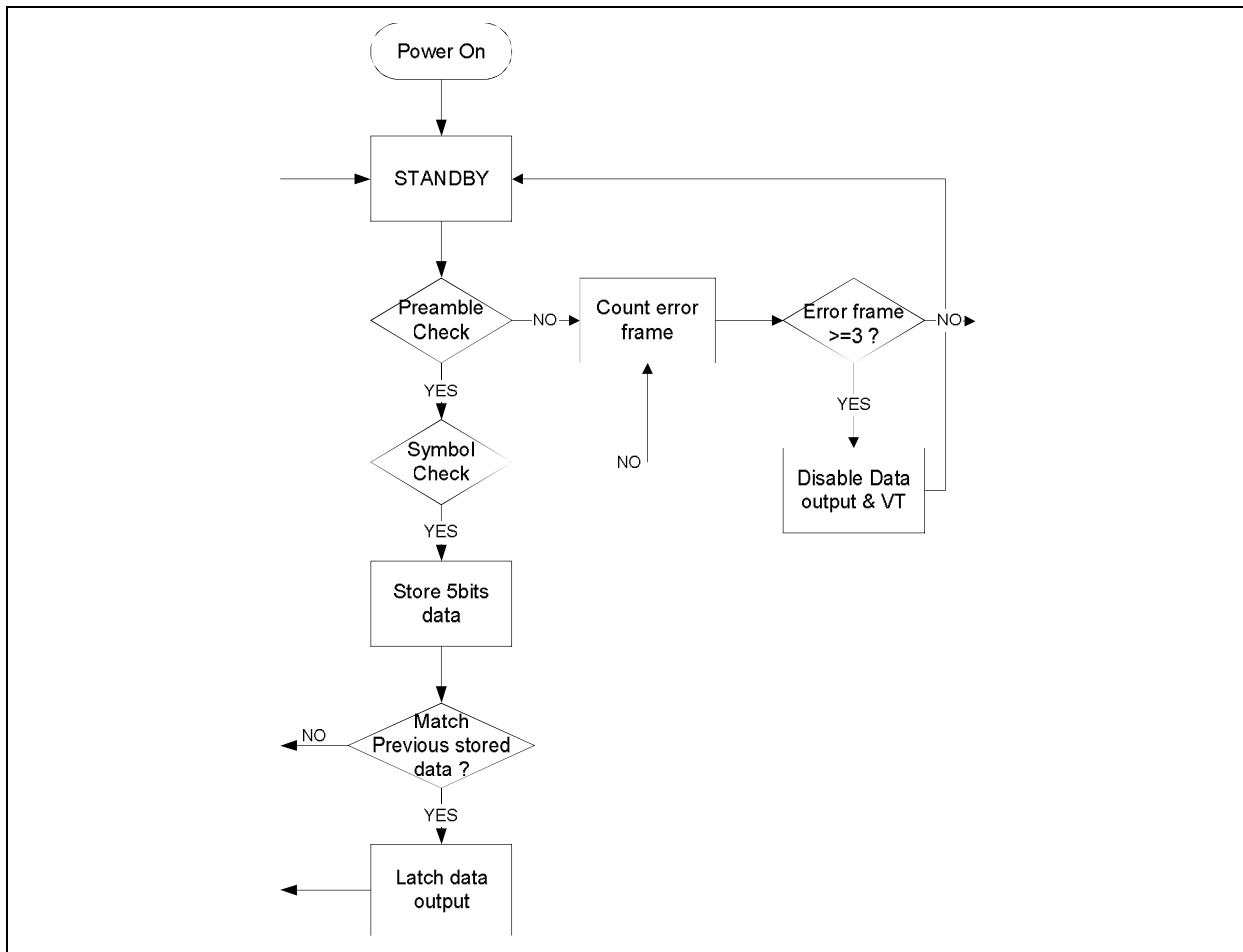


The SPRC206A is able to receive serial bit-stream data transmitted from SPRC205A and decode the data fields as 5-bits data output. Any signal on DIN pin will activate SPRC206A to decode the incoming data. When SPRC206A receives two consecutive,

correct and equal frames, DO[4:0] is able to control the external component. The DO[1,0] and DO[3:2] are exclusive to each other; that is, DO[1:0] and DO[3:2] cannot be activated at the same time. The receiving timing is shown below:



### 5.3. Decoder Flow Chart



After power on, it is reset at STANDBY state. When the signal on DIN is received by SPRC206A, it will check the incoming data frame structure. If preamble or data field errors occur, it will back to STANDBY state to check the next frame. If the receiving frame structure passes the preamble and symbol checks, the 5-bit data is stored and then compared to the previous stored 5-bits data. If the present data matches the previous data, DO[4:0] is active and it is back to STANDBY and ready to check the next frame.

### 5.4. R-oscillator

Both SPRC205A and SPRC206A have built in R-oscillator. Users need only one resistor (or a capacitor if needed) to implement the clock input and to change the frame rate by replacing different resistor.

$$\text{Frame rate} = F_{\text{OSC}} / 64 / 33$$

In addition, the SPRC206A built-in a Clock Recovery block to automatically adjust the ratio of data rate to clock rate. The only limitation is using a 5% accuracy resistor is required in SPRC205A and SPRC206A.

### 5.5. Super Regeneration Amplifier

The SPRC206A features two inverter inputs and outputs as pins. The two inverters can be used for amplifier of the Super-Regeneration RF receiver data output. Users can change the two inverters' gain by adjusting external resistor and capacitor.

## 6. ELECTRICAL SPECIFICATIONS

### 6.1. Absolute Maximum Ratings

| Characteristics       | Symbol    | Ratings               |
|-----------------------|-----------|-----------------------|
| DC Supply Voltage     | $V_+$     | < 7.0V                |
| Input Voltage Range   | $V_{IN}$  | -0.5V to $V_+ + 0.5V$ |
| Operating Temperature | $T_A$     | -20°C to +60°C        |
| Storage Temperature   | $T_{STO}$ | -50°C to +150°C       |

**Note:** Stresses beyond those given in the Absolute Maximum Rating table may cause operational errors or damage to the device. For normal operational conditions see AC/DC Electrical Characteristics.

### 6.2. DC Characteristics of SPRC205A (VDD = 3.0V, $T_A = 25^\circ\text{C}$ )

| Characteristics            | Symbol              | Limit |      |      | Unit            | Test Condition   |
|----------------------------|---------------------|-------|------|------|-----------------|--|
|                            |                     | Min.  | Typ. | Max. |                 |  |
| Operating Voltage          | VDD                 | 2.2   | -    | 5.5  | V               | R-OSC resistor = 200K $\Omega$                             |
| RFO Maximum Waveform       | VRFO                | -     | -    | 9    | V <sub>pp</sub> | VDD = 4.5V, Inductor load.                                 |
| Operating Current          | $I_{OP}$            | -     | -    | 15   | mA              | R-OSC resistor = 200K $\Omega$<br>Crystal & PA on (6.0dBm) |
| Standby Current            | $I_{STBY,SPRC205A}$ | -     | -    | 1.0  | $\mu\text{A}$   | R-OSC disable  |
| Input High level           | $V_{IH}$            | 2.0   | -    | -    | V               | VDD = 3.0V   |
| Input Low level            | $V_{IL}$            | -     | -    | 0.8  | V               | VDD = 3.0V   |
| Output High Current        | $I_{OH}$            | -     | -6.0 | -    | mA              | VDD = 3.0V, $V_{OH} = 2.4V$                                |
| Output Sink Current        | $I_{OL}$            | -     | 6.0  | -    | mA              | VDD = 3.0V, $V_{OL} = 0.4V$                                |
| DI[4:0] pull high resistor | $R_{DI}$            | -     | 200  | -    | K $\Omega$      | VDD = 3.0V   |
| OSC Frequency              | $F_{OSC}$           | -     | 128  | -    | KHz             | $R_{osc} = 200K\Omega$ @ VDD from 2.0V - 5.5V              |

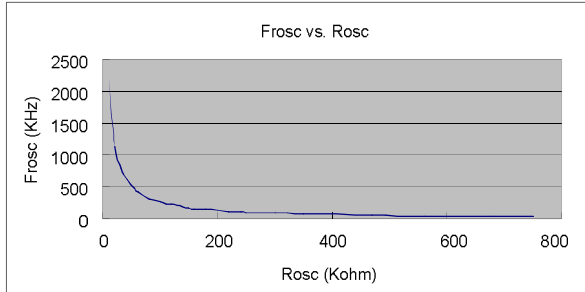
### 6.3. DC Characteristics of SPRC206A (VDD = 3.0V, $T_A = 25^\circ\text{C}$ )

| Characteristics             | Symbol        | Limit |      |      | Unit          | Test Condition                                |
|-----------------------------|---------------|-------|------|------|---------------|---|
|                             |               | Min.  | Typ. | Max. |               |   |
| Operating Voltage           | VDD           | 2.0   | -    | 5.5  | V             | R-OSC resistor = 200K $\Omega$                |
| Operating Current           | $I_{OP}$      | -     | -    | 100  | $\mu\text{A}$ | R-OSC resistor = 200K $\Omega$                |
| Input High level            | $V_{IH}$      | 2.0   | -    | -    | V             | VDD = 3.0V                                    |
| Input Low level             | $V_{IL}$      | -     | -    | 0.8  | V             | VDD = 3.0V                                    |
| Output High Current (DO)    | $I_{OH}$      | -     | -6.0 | -    | mA            | VDD = 3.0V, $V_{OH} = 2.4V$                   |
| Output Sink Current (DO)    | $I_{OL}$      | -     | 6.0  | -    | mA            | VDD = 3.0V, $V_{OL} = 0.4V$                   |
| DIN pull low resistor       | $R_{DIN}$     | -     | 200  | -    | K $\Omega$    | VDD = 3.0V                                    |
| OSC Frequency               | $F_{OSC}$     | -     | 128  | -    | KHz           | $R_{osc} = 200K\Omega$ @ VDD from 2.0V - 5.5V |
| Maximum tolerance data rate | $F_{TOR,MAX}$ | 2.4   | -    | -    | KHz           | $F_{osc} = 128KHz$                            |
| Minimum tolerance data rate | $F_{TOR,MIN}$ | -     | -    | 1.6  | KHz           | $F_{osc} = 128KHz$                            |
| Maximum rejection data rate | $F_{REJ,MAX}$ | 2.8   | -    | -    | KHz           | $F_{osc} = 128KHz$                            |
| Minimum rejection data rate | $F_{REJ,MIN}$ | -     | -    | 1.3  | KHz           | $F_{osc} = 128KHz$                            |

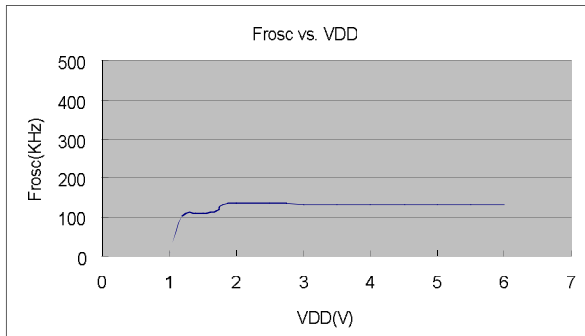


#### 6.4. The Relationships of the $R_{OSC}$ and the $F_{OSC}$

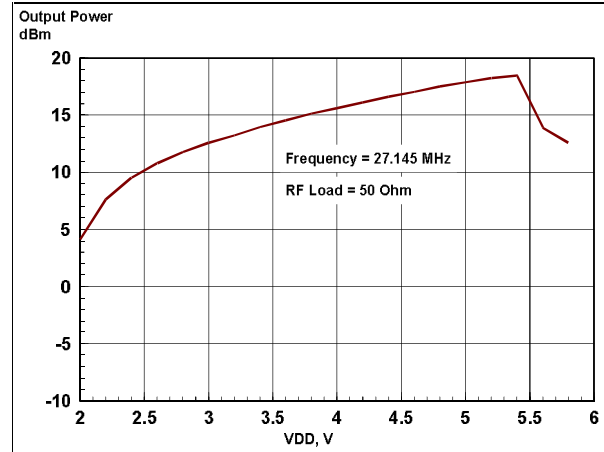
6.4.1.  $V_{DD} = 3.0V$ ,  $T_A = 25^\circ C$



#### 6.5. The Relationships of the $V_{DD}$ and the $F_{OSC}$

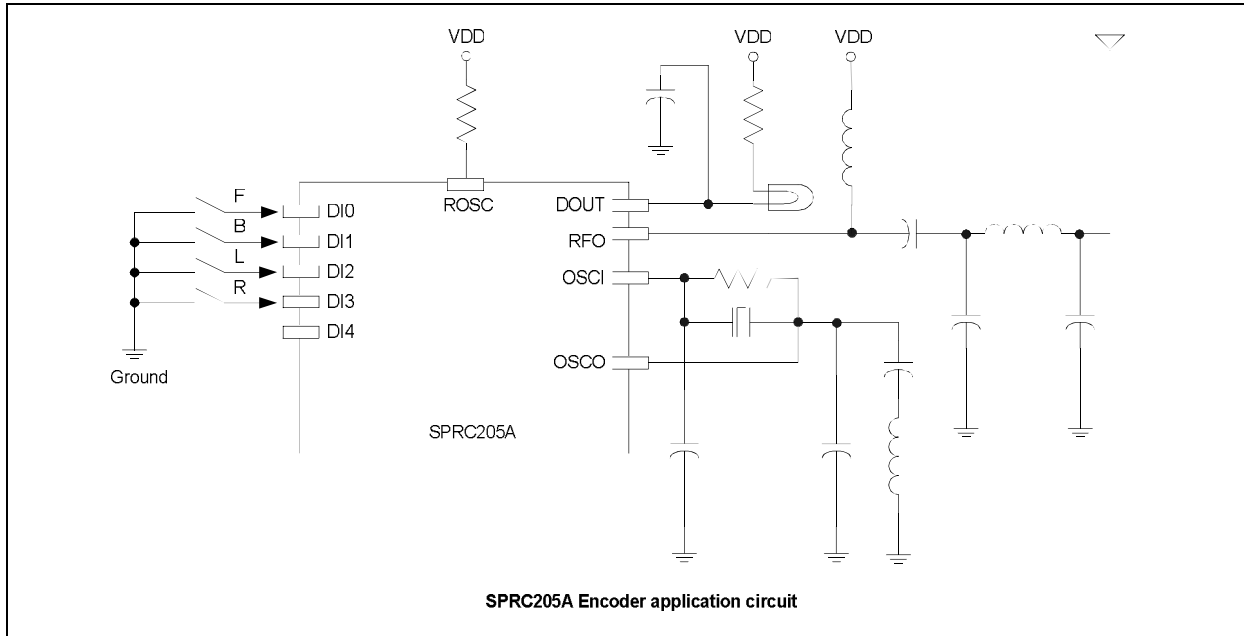


#### 6.6. The Relationships of the $V_{DD}$ and the Output Power

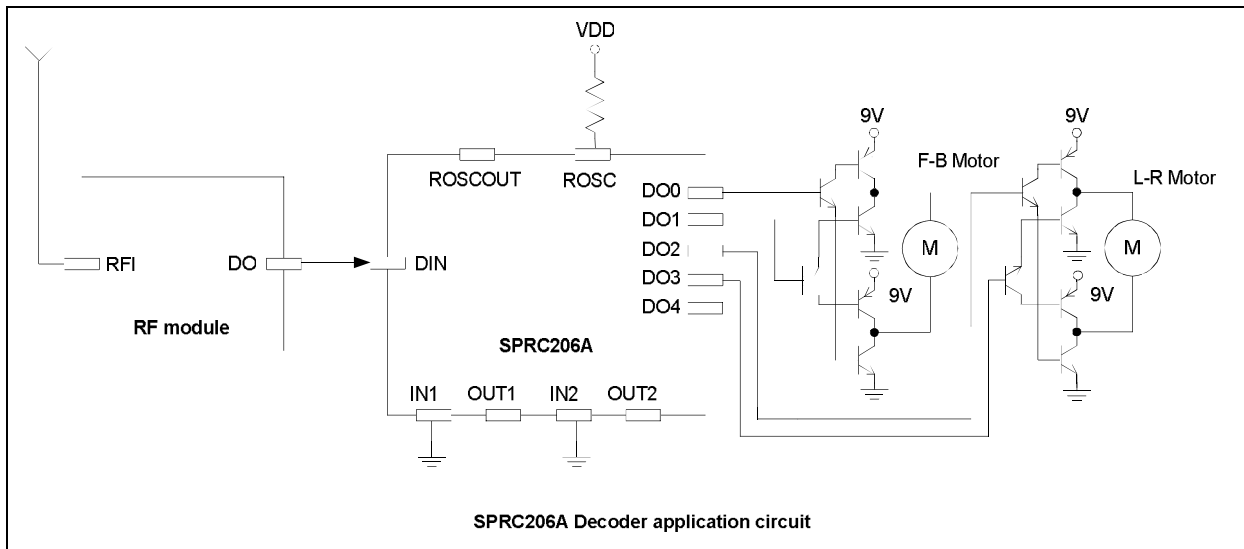


## 7. APPLICATION CIRCUITS

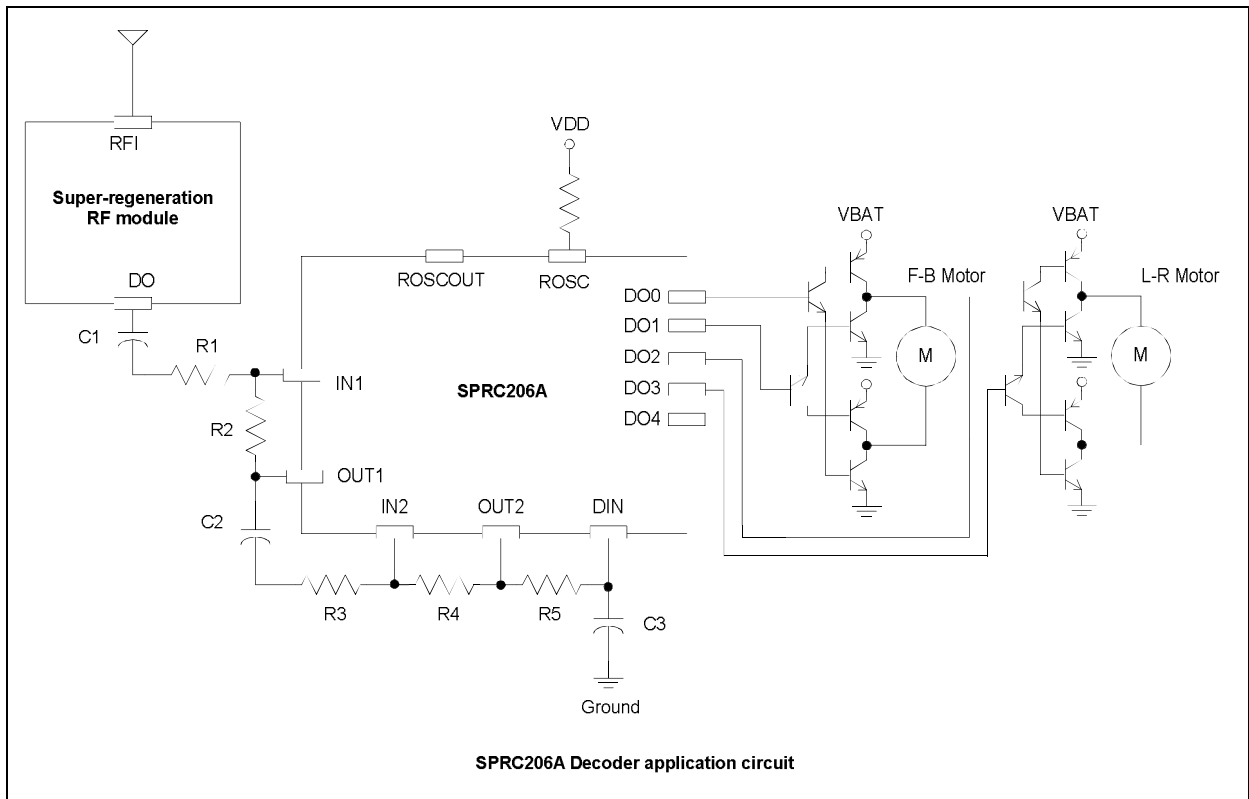
### 7.1. SPRC205A Application Circuit



### 7.2. SPRC206A Application Circuit



### 7.3. SPRC206A Application Circuit (with Super Regeneration RF)

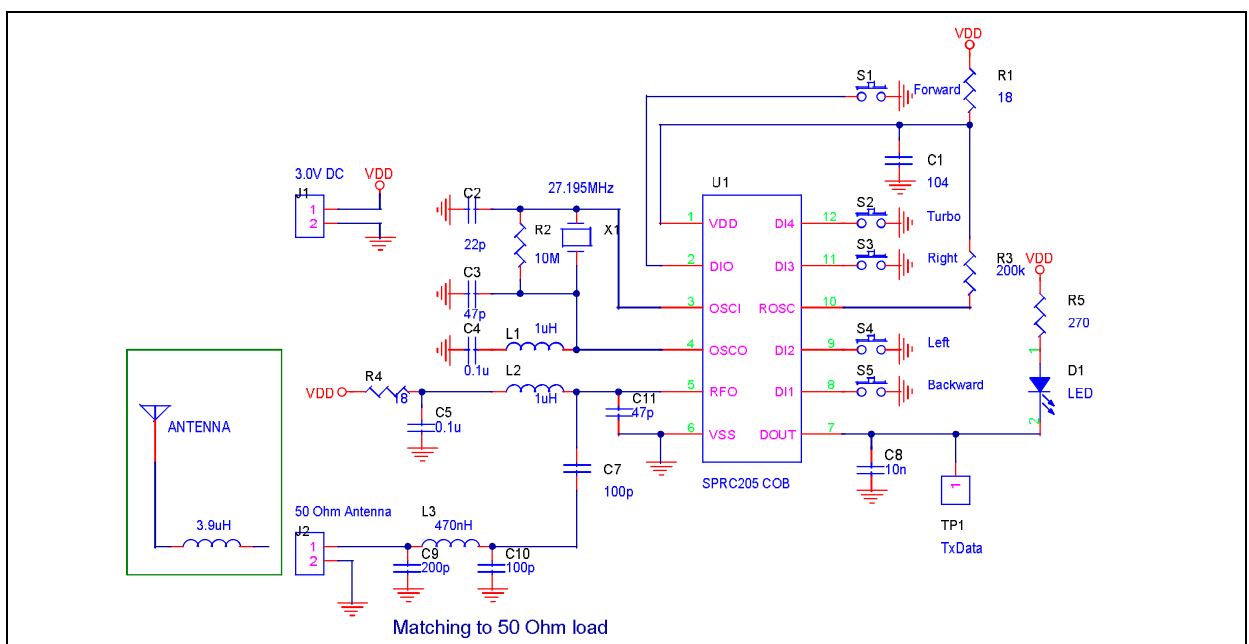


### 7.4. Reference Design

For general application, "DI0" is defined as "Forward". "DI1" is "Backward", "DI2" as 'Left', "DI3" as "Right", and "DI4" for "Turbo" or other functions.

### 7.5. 27MHz Transmitter

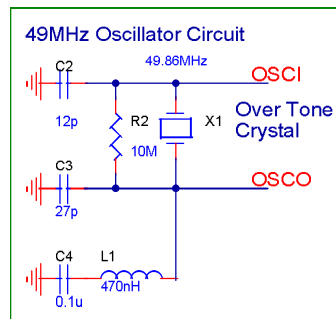
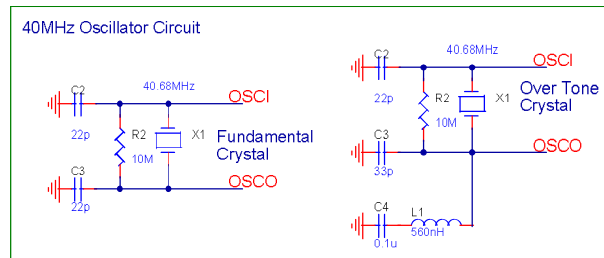
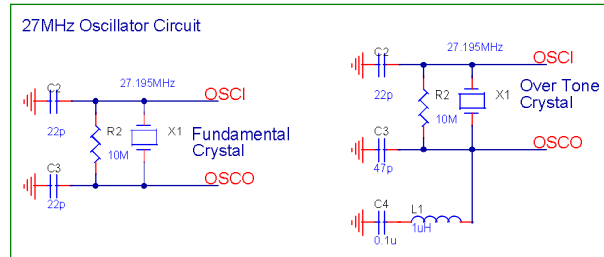
The standby current is estimated less than 1.0 $\mu$ A if no button pressed. When a button is pressed, the SPRC205A wakes up and transmits the encoded RF signal.



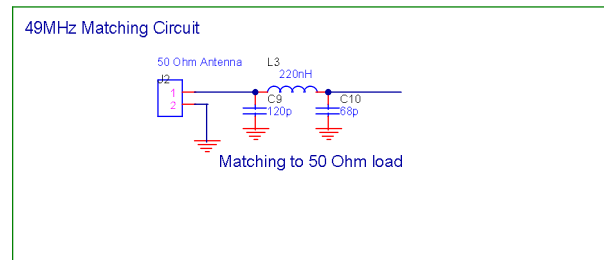
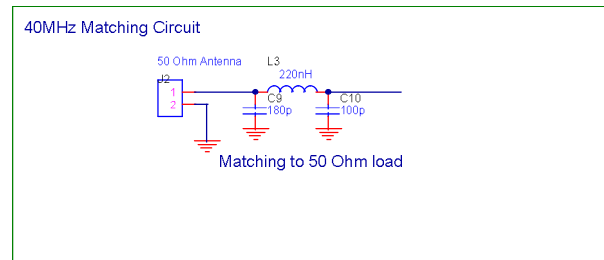
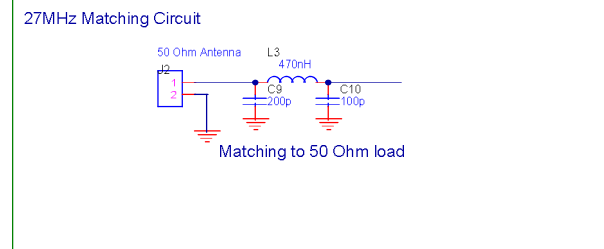
### 7.6. Crystal Oscillator Example

For over tone type crystal, a LC tank circuit is necessary to prevent base tone oscillating.

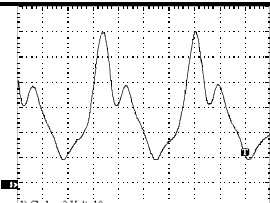
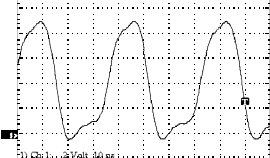
$$F_x > \frac{1}{2\pi\sqrt{LC}}, F_x = \text{crystal frequency}, L = L1, C = C3$$



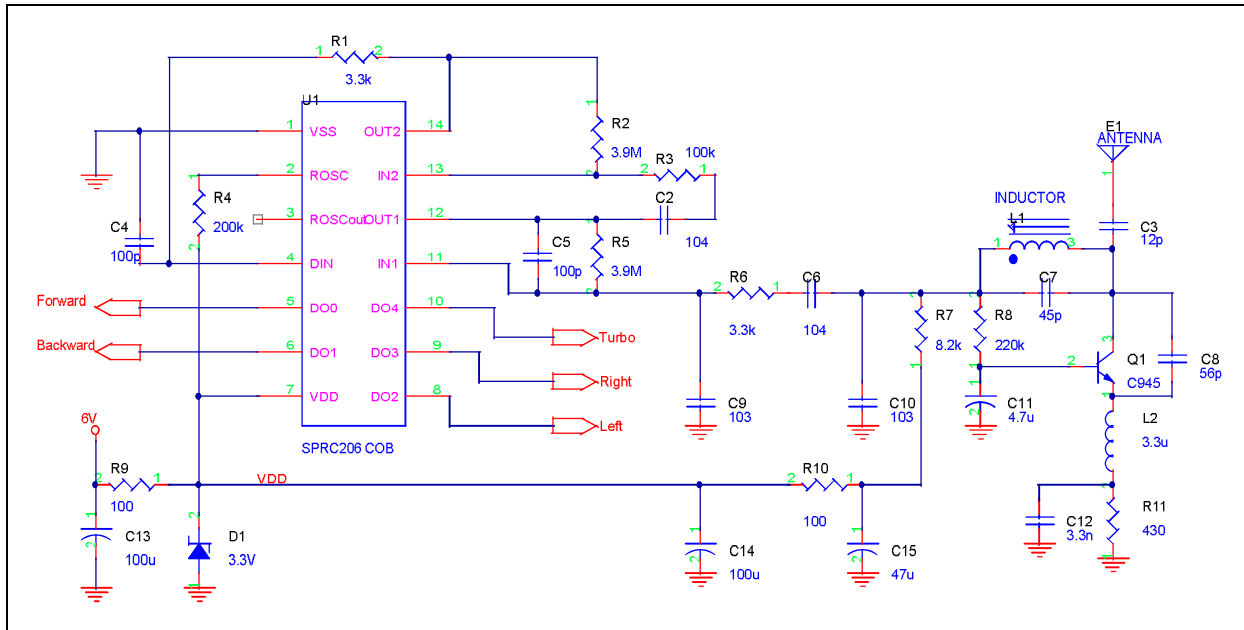
### 7.7. RF Output Matching Example





| Test condition  | RFO waveform  |
|---|---|
| <p>VDD=5.5V, R4=0, R1=0 Ohm</p> <p>If the peak voltage of RFO exceeds 9V, RFO breaks down.<br/>It gets lower fundamental and higher harmonic.</p> |  <p style="text-align: right;">2v/, 10ns/</p> |
| <p>VDD=5.5V, R4=100 Ohm, R1=330 Ohm</p> <p>Use R4 to limit the RFO waveform.</p>  |  <p style="text-align: right;">2v/, 10ns/</p> |

### 7.9. 27MHz Super Regenerative Receiver



## 8. PACKAGE/PAD LOCATIONS

### 8.1. PAD Assignment and Locations

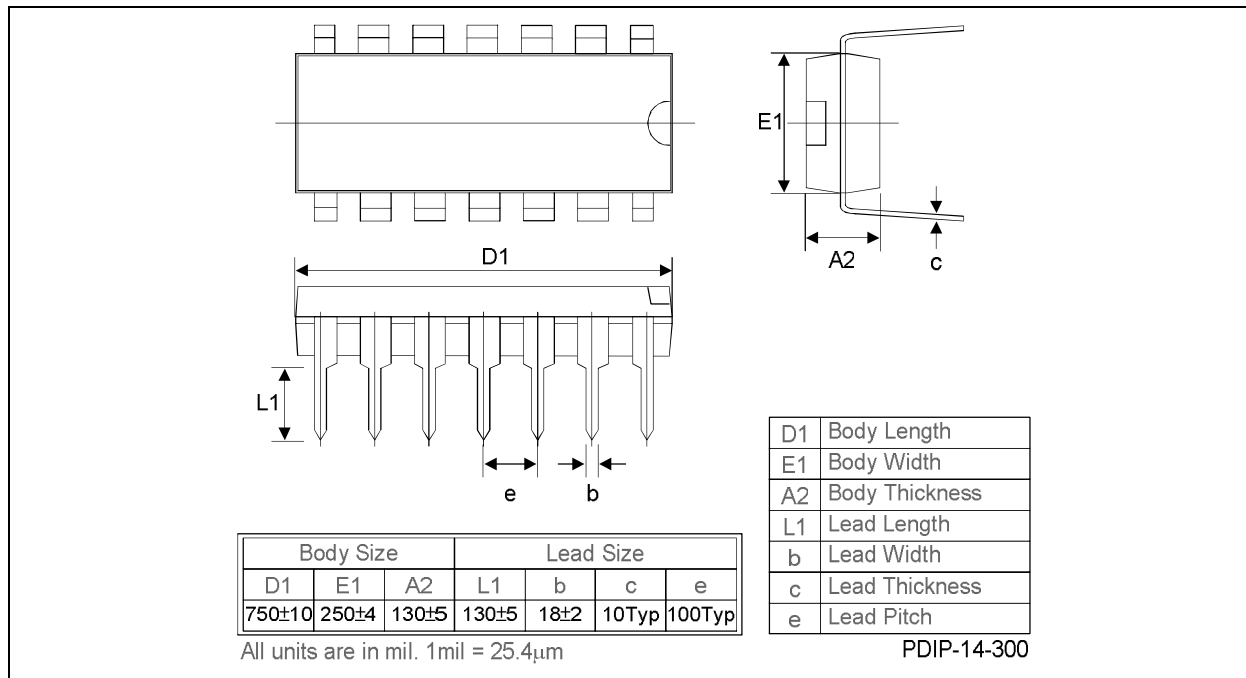
Please contact Sunplus sales representatives for more information.

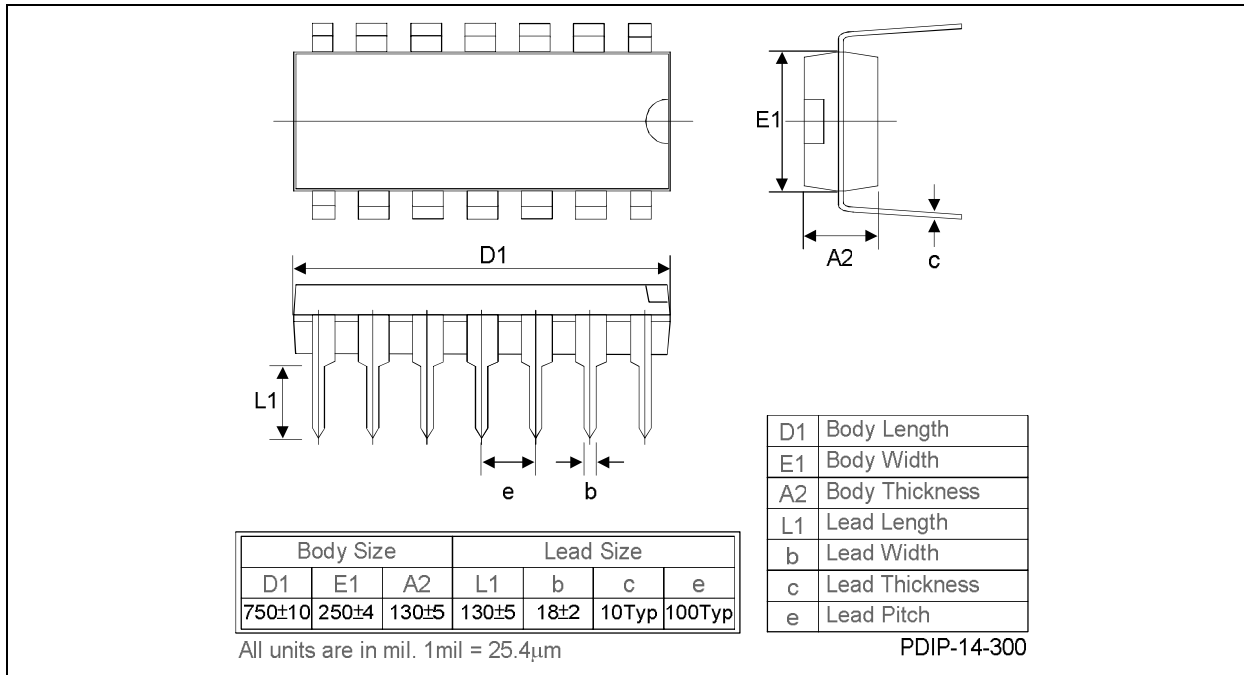
### 8.2. Ordering Information

| Product Number  | Package Type           |
|-----------------|------------------------|
| SPRC205A - C    | Chip form              |
| SPRC206A - C    | Chip form              |
| SPRC205A - PD02 | Package form - PDIP 14 |
| SPRC206A - PD02 | Package form - PDIP 14 |

### 8.3. Package Information

#### 8.3.1. SPRC205A - PDIP 14



**8.3.2. SPRC206A - PDIP 14**




#### 8.4. Storage Condition and Period for Package

| Package | Moisture sensitivity level | Max. Reflow temperature | Floor life storage condition | Dry pack |
|---------|----------------------------|-------------------------|------------------------------|----------|
| PDIP    | LEVEL 3 (Reference)        | 220 +5/-0°C (Reference) | N/A                          | No       |

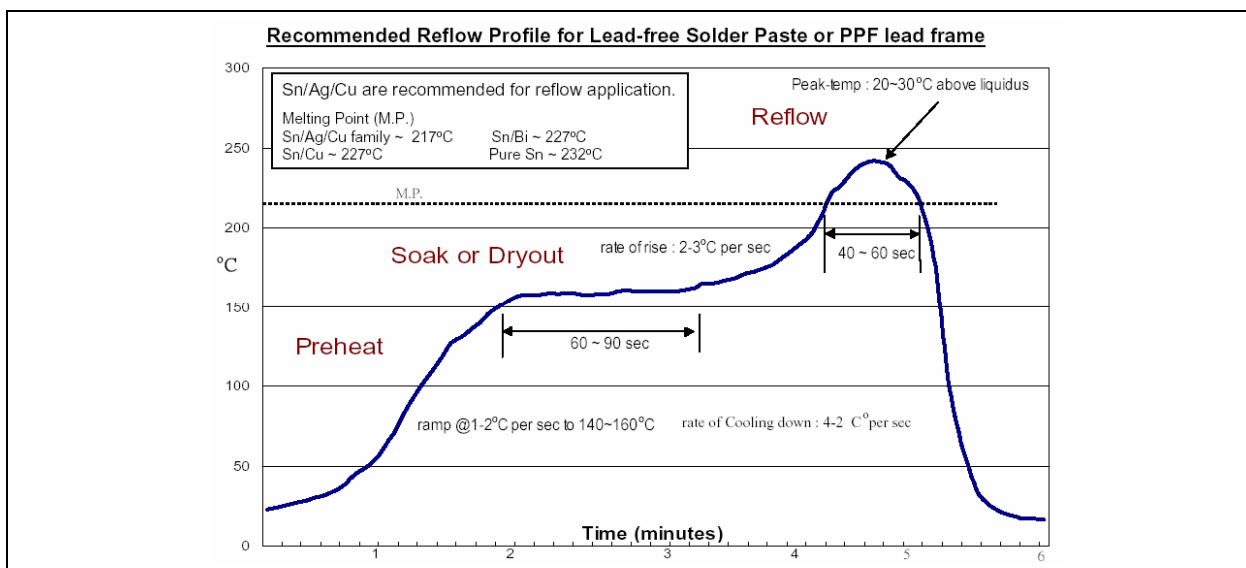
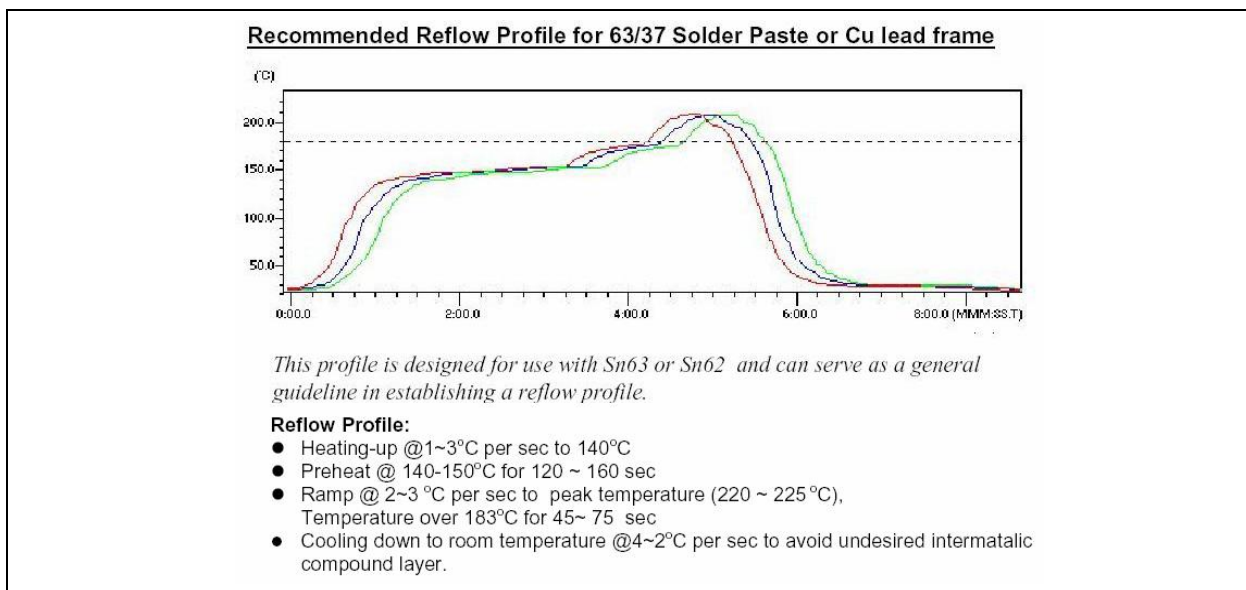
**Note1:** Please refer to IPC/JEDEC standard J-STD-020A and EIA JEDEC stand JFSD22-A112

**Note2:** or refer to the "CAUTION Note" on dry pack bag.

#### 8.5. Recommended SMT Temperature Profile

This "Recommended" temperature profile is a rough guideline for SMT process reference. Most of SUNPLUS leadframe base product choice Matte Tin and Sn/Bi for plating recipe. For

PPF(Pre-Plated Frame) product with 63/37 solder paste, we recommend 240°C~245°C for peak temperature.



## 9. DISCLAIMER

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**10. REVISION HISTORY**

| <b>Date</b>   | <b>Revision #</b> | <b>Description</b>   | <b>Page</b> |
|---------------|-------------------|--|-------------|
| MAR. 14, 2005 | 0.3               | 1. Modify Frame rate: from Fosc/64/54 to Fosc/64/33 in section 5.4<br>2. Add package storage in sections 8.4 and 8.5 | 8<br>18     |
| DEC. 03, 2003 | 0.2               | 1. Add RFO limit, Bandwidth, Harmonic characteristic.<br>2. Remove " <u>8. PACKAGE/PAD LOCATIONS</u> "               |             |
| SEP. 18, 2002 | 0.1               | Original   | 19          |