DATA SHEET

SunplusIT

# SPIF301

## USB to Serial-ATA Controller

JUL. 14, 2008

Version 1.0

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# USB 2.0 TO SERIAL-ATA HOST BRIDGE CONTROLLER

## 1. GENERAL DESCRIPTION

### 1.1. Introduction

The SunplusIT SPIF301 is a high-quality single-chip solution for USB to Serial-ATA (SATA) host bridge controller. It features an USB high-speed device port and a SATA 1.5Gb/s host port which leads it to carry out elementary function to receive standard Mass Storage Device Class (MSDC) SCSI command from USB host and translate into ATA/ATAPI command to SATA device.

### 1.2. Features

#### 1.2.1. Overall Features

- Single 5V power source.
- Fabricated in CMOS process with 1.8V core and 3.3V I/Os.
- Available in LQFP48-pin package.
- Integrated Memory, USB PHY and SATA PHY have isolated BIST.
- Full scan for high production test coverage
- Supports Window 2000/XP/Vista, Linux, Mac 10 OS platform.

### 1.3. USB Features

- Compliant with USB 2.0 specification and passed USB certification.
- Supports USB high speed (480Mbps) and full speed transfer rate (12Mbps).
- Supports Mass Storage Device Class bulk only transfer.
- Supports the USB host controller for UHCI, OHCI, EHCI mode.

### 1.4. Serial-ATA Features

- Compliant with Serial-ATA 1.0a specification.
- Supports Serial-ATA generation 1 transfer rate of 1.5Gb/s
- Supports spread spectrum in receiver

### 1.5. Application Field

- USB External HDD
- Enclosures
- Mobil Rack
- Docking Station

## 2. REFERENCES

For more detailed information about the USB and SATA technology, please refer to the following industry specifications:

- Serial-ATA / High Speed Serialized ATA Attachment specification, Revision 1.0a.
- Universal Serial Bus Specification Revision 2.0.

### 3. BLOCK DIAGRAM

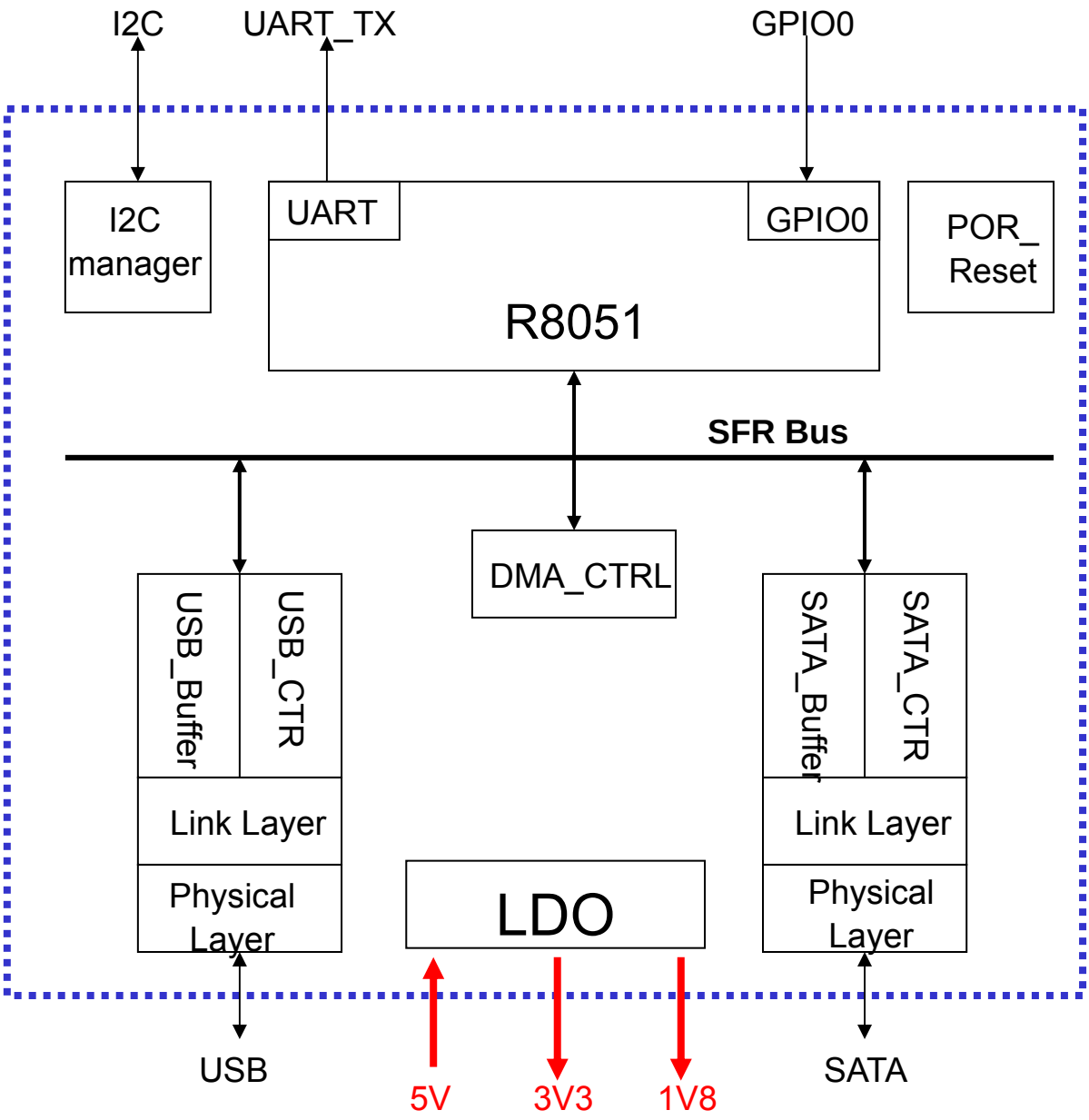



**Fig 3-1:** SPIF301 Functional Block Diagram

## 4. SIGNAL DESCRIPTIONS

### 4.1. Pin Diagram

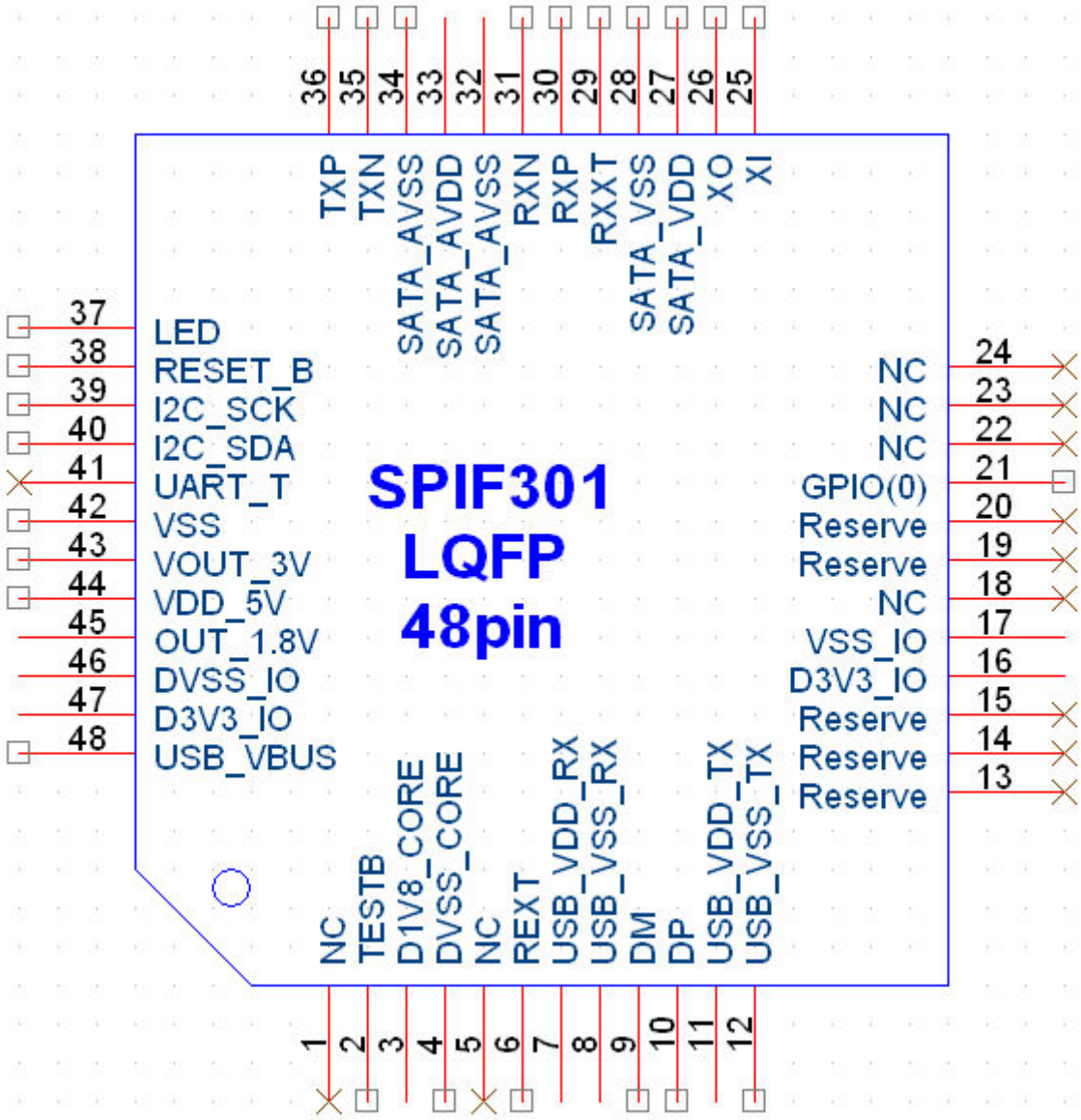



**Figure 4-1** SPIF301 Pin Diagram

### 4.2. Pin Descriptions

**Table 4-1:** Pin Types

| Pin Type | Pin Description |
|---|---|
| I/O | Bi-directional Pin |
| I | Input Pin |
| O | Output Pin |
| OD | Open Drain output Pin |
| A | Analog pin |
| USB | USB D+ D- |
| SATA | SATA TX+ TX- RX+ RX- |
| PWR_I | Power input |
| PWR_O | LDO power output |
| NC | NO connection |

### 4.3. SPIF301 Pin Listing

**Table 4-2:** SPIF301 Pin Listing

| Pin | Pin Name | Type | Internal resistor | Level | Pin Description |
|---|---|---|---|---|---|
| 1 | NC | --- | --- | --- | |
| 2 | TESTB | I | Pull High | 3.3V | Low active TEST Mode<br>1 (default): Normal mode 0: TEST Mode |
| 3 | D1V8_CORE | PWR_I | --- | +1.8V | Digital Core Power 1.8v |
| 4 | DVSS_CORE | GND | --- | 0V | Digital Core Ground |
| 5 | NC | --- | --- | --- | |
| 6 | REXT | A | --- | --- | USB external reference resistor input.<br>Connect 12K ohm pull low resistor |
| 7 | USB_VDD_RX | PWR_I | --- | +3.3V | USB Analog power 3.3V for PHY RX |
| 8 | USB_VSS_RX | GND | --- | 0 V | USB Analog ground for PHY RX |
| 9 | DM | USB | --- | --- | USB High Speed D- |
| 10 | DP | USB | --- | --- | USB High Speed D+ |
| 11 | USB_VDD_TX | PWR_I | --- | +3.3V | USB Analog power 3.3V for PHY TX |
| 12 | USB_VSS_TX | GND | --- | 0 V | USB Analog Ground for PHY TX |
| 13 | Reserve | --- | --- | --- | |
| 14 | Reserve | --- | --- | --- | |
| 15 | Reserve | --- | --- | --- | |
| 16 | D3V3_IO | PWR_I | --- | +3.3V | Digital 3.3V Power for IO |
| 17 | VSS_IO | GND | --- | 0 V | Digital Ground for IO |
| 18 | NC | --- | --- | --- | |
| 19 | Reserve | --- | --- | --- | |
| 20 | Reserve | --- | --- | --- | |
| 21 | GPIO(0) | I | Pull Low | +3.3V | General purpose I/O 0 |
| | | O | --- | +3.3V | |
| 22 | NC | --- | --- | --- | |
| 23 | NC | --- | --- | --- | |
| 24 | NC | --- | --- | --- | |
| 25 | XI | A | --- | --- | SATA Crystal Oscillator Input / External Clock Input |
| 26 | XO | A | --- | --- | SATA Crystal Oscillator Output |
| 27 | SATA_VDD | PWR_I | --- | +1.8V | SATA 1.8V Digital Power |
| 28 | SATA_VSS | GND | --- | 0 V | SATA Digital Ground |
| 29 | RXXT | A | --- | --- | SATA external reference resistor Input<br>Connect 1K(1%) ohm pull low resistor |
| 30 | RXP | SATA | --- | --- | SATA Differential Receive + |
| 31 | RXN | SATA | --- | --- | SATA Differential Receive – |
| 32 | SATA_AVSS | GND | --- | 0 V | SATA Analog Ground |
| 33 | SATA_AVDD | PWR_I | --- | +1.8V | SATA 1.8V Analog Power |
| 34 | SATA_AVSS | GND | --- | 0 V | SATA Analog Ground |
| 35 | TXN | SATA | --- | --- | SATA Differential Transmit – |
| 36 | TXP | SATA | --- | --- | SATA Differential Transmit + |
| 37 | LED | OD | --- | +3.3V | HDD active LED (low active) |
| 38 | RESET_B | I | Pull High | +3.3V | Low Active Reset |

| Pin | Pin Name | Type | Internal resistor | Level | Pin Description |
|---|---|---|---|---|---|
| 39 | I2C_SCL | OD | Pull High | +3.3V | I2C Clock |
| 40 | I2C_SDA | I | Pull High | +3.3V | I2C Data |
| | | OD | Pull High | +3.3V | |
| 41 | UART_TX | O | --- | +3.3V | UART TX |
| 42 | VSS | GND | --- | 0 V | LDO Ground |
| 43 | VOUT_3V | PWR_O | --- | +3.3V | LDO 3.3 voltage output |
| 44 | VDD_5V | PWR_I | --- | +5V | LDO 5 voltage input |
| 45 | VOUT_1.8V | PWR_O | --- | +1.8V | LDO 1.8 voltage output (For IC internal use only) |
| 46 | DVSS_IO | PWR_I | --- | 0 V | Digital Ground for IO |
| 47 | D3V3_IO | GND | --- | +3.3V | Digital 3.3V Power for IO |
| 48 | USB_VBUS | I | --- | +3.3V | USB VBUS detect pin |

Note1: Internal pull high resistor is 45Kohm in typical, internal pull low resistor is 55Kohm in typical

## 5. ELECTRICAL SPECIFICATIONS

### 5.1. Power Requirement

**Table 5-1:** Total Power Dissipation (Typical , $T_A$ =25℃)

| Symbol | Parameter | Condition | Limits | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| $I_{IO}$ | Absolute digital I/O pad power supply | 3.3V | 1.0 | 4.5 | 6.0 | mA |
| $I_{CORE}$ | Absolute digital core power supply | 1.8V | 8 | 18 | 25 | mA |
| $I_{AUSB}$ | Absolute analog power supply for USB PHY | 3.3V | 0 | 25 | 30 | mA |
| $I_{ASATA}$ | Absolute analog power supply for SATA PHY | 1.8V | 64 | 68 | 80 | mA |

### 5.2. LDO DC Characteristics

**Table 5-2:** LDO DC Characteristics (Typical , $T_A$ =25℃)

| Symbol | Parameter | Condition | Limits | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| VDD_5V | Input voltage | | 4.5 | 5 | 5.5 | V |
| VOUT_33V | 3.3V output voltage | @VDD_5 = 5V | 2.97 | 3.3 | 3.63 | V |
| VOUT_1.8V | 1.8V output voltage | @VDD_5 = 5V | 1.71 | 1.8 | 1.91 | V |
| I(VOUT_3.3V) | 3.3V Output current | @VDD_5 = 5V, VOUT_3.3V = 3.3V | | | 50 | mA |
| I(VOUT_1.8V) | 1.8V output current | @VDD_5 = 5V VOUT_1.8V = 1.8V | | | 150 | mA |
| I(VDD_5V) | 5V input current | @I(VOUT_3.3V) = 50mA; I(VOUT_1.8V) = 150mA | 250 | | | mA |

### 5.3. Absolute Maximum Ratings

**Table 5-3:** Absolute Maximum Ratings (Typical , $T_A$ =25℃)

| Symbol | Parameter | Limits | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| $V_{IO}$ | Absolute digital I/O pad power supply voltage | 2.97 | 3.3 | 3.63 | V |
| $V_{CORE}$ | Absolute digital power supply | 1.71 | 1.8 | 1.91 | V |
| $V_{AUSB}$ | Absolute analog power supply voltage for USB PHY | 2.97 | 3.3 | 3.63 | V |
| $V_{ASATA}$ | Absolute analog power supply voltage for SATA PHY | 1.71 | 1.8 | 1.91 | V |
| $T_{STR}$ | Absolute storage temperature | -20 | 25 | 105 | ℃ |

### 5.4. Recommended/Typical Operating Conditions

**Table 5-4:** Recommended/Typical Operating Conditions

| Symbol | Parameter | Limits | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| $V_{CORE}$ | Operating digital power supply voltage | 1.71 | 1.8 | 1.91 | V |
| $V_{IO}$ | Operating digital I/O pad supply voltage | 2.97 | 3.3 | 3.63 | V |
| $V_{AUSB}$ | Operating analog power supply voltage for USB PHY | 2.97 | 3.3 | 3.63 | V |
| $V_{ASATA}$ | Operating analog power supply voltage for SATA PHY | 1.71 | 1.8 | 1.91 | V |
| $T_{STR}$ | Operating temperature | 0 | 25 | 70 | ℃ |

### 5.5. IO DC Characteristics

**Table 5-5: IO** DC Characteristics

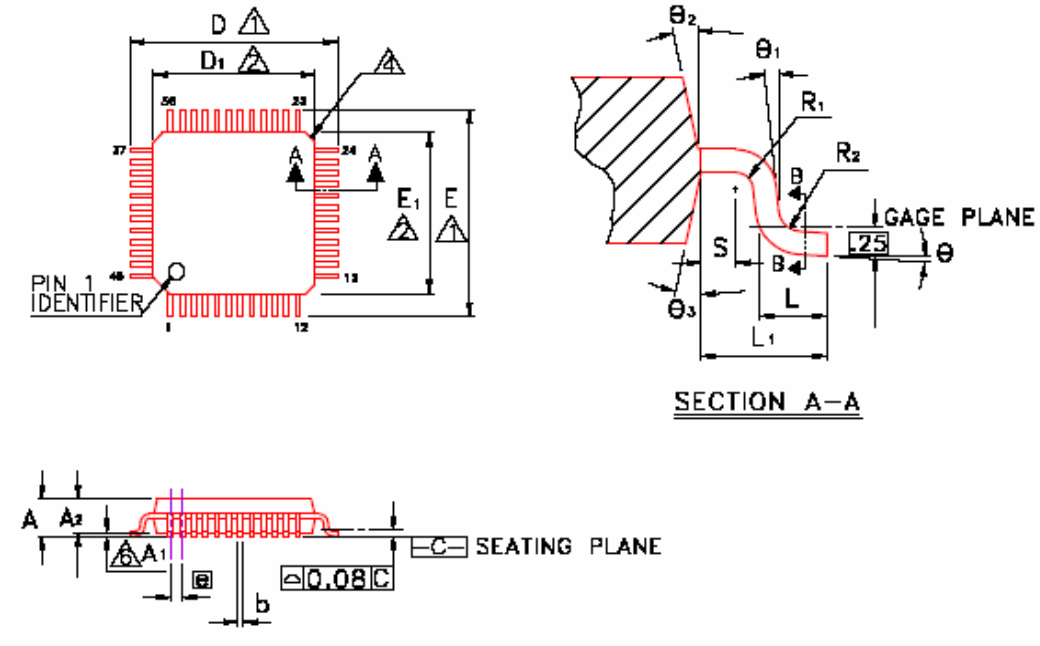
(Testing condition: $V_{CORE}$ =1.8V $V_{AUSB}$, = 3.3V, $V_{ASATA}$ = 1.8V $T_a$ =25$^0$C, unless otherwise noted)

| Symbol | Parameter | Condition | Limits | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| $V_{IL}$ | Input low voltage | CMOS | -0.3 | - | 0.8 | V |
| $V_{IH}$ | Input high voltage | CMOS | 2.0 | - | Vio+0.3 | V |
| $V_{TH}$ | Threshold point | CMOS | 1.45 | 1.59 | 1.77 | V |
| $V_T^+$ | Schmitt trig. Low to High threshold point | CMOS | 1.9 | | | V |
| $V_T^-$ | Schmitt trig. high to low threshold point | CMOS | | | 1.3 | V |
| $I_I$ | Input leakage current | CMOS | | | ±10 | µA |
| $I_{OZ}$ | Tri-state output leakage current | CMOS | | | ±10 | µA |
| $R_{PU}$ | Pull-up resistor | CMOS | | 45 | | KΩ |
| $R_{PD}$ | Pull-down resistor | CMOS | | 55 | | KΩ |
| $V_{OL}$ | Output low voltage | CMOS, @ $I_{OL}$ =2mA | - | - | 0.4 | V |
| $V_{OH}$ | Output high voltage | CMOS @ $I_{OH}$ =5mA | 2.4 | - | - | V |
| $I_{OL}$ | Low level output current | @ $V_{OL}$ =0.4v | 2 | | | mA |
| $I_{OH}$ | High level output current | @ $V_{OH}$ =2.4v | 5 | | | mA |

## 6. PACKAGE/PAD LOCATIONS

### 6.1. Package Information

#### 6.1.1. 48 pin LQFP



| Symbol | Dimension in mm | | | Dimension in inch | | |
|---|---|---|---|---|---|---|
| | Min | Nom | Max | Min | Nom | Max |
| A | — | — | 1.60 | — | — | 0.063 |
| $A_1$ | 0.05 | — | 0.15 | 0.002 | — | 0.006 |
| $A_2$ | 1.35 | 1.40 | 1.45 | 0.053 | 0.055 | 0.057 |
| b | 0.17 | 0.22 | 0.27 | 0.007 | 0.009 | 0.011 |
| $b_1$ | 0.17 | 0.20 | 0.23 | 0.007 | 0.008 | 0.009 |
| c | 0.09 | — | 0.20 | 0.004 | — | 0.008 |
| $c_1$ | 0.09 | — | 0.16 | 0.004 | — | 0.006 |
| D | 9.00 BSC | | | 0.354 BSC | | |
| $D_1$ | 7.00 BSC | | | 0.276 BSC | | |
| E | 9.00 BSC | | | 0.354 BSC | | |
| $E_1$ | 7.00 BSC | | | 0.276 BSC | | |
| e | 0.50 BSC | | | 0.020 BSC | | |
| L | 0.45 | 0.60 | 0.75 | 0.018 | 0.024 | 0.030 |
| $L_1$ | 1.00 REF | | | 0.039 REF | | |
| $R_1$ | 0.08 | — | — | 0.003 | — | — |
| $R_2$ | 0.08 | — | 0.20 | 0.003 | — | 0.008 |
| S | 0.20 | — | — | 0.008 | — | — |
| θ | 0° | 3.5° | 7° | 0° | 3.5° | 7° |
| $θ_1$ | 0° | — | — | 0° | — | — |
| $θ_2$ | 12°TYP | | | 12°TYP | | |
| $θ_3$ | 12°TYP | | | 12°TYP | | |

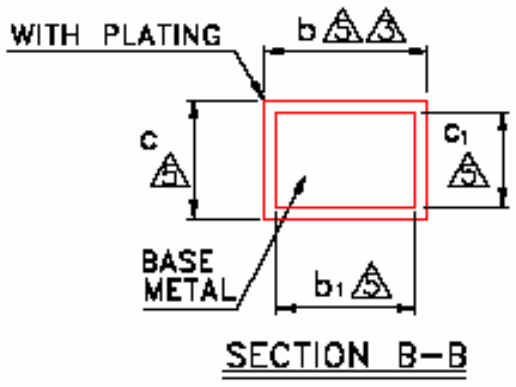
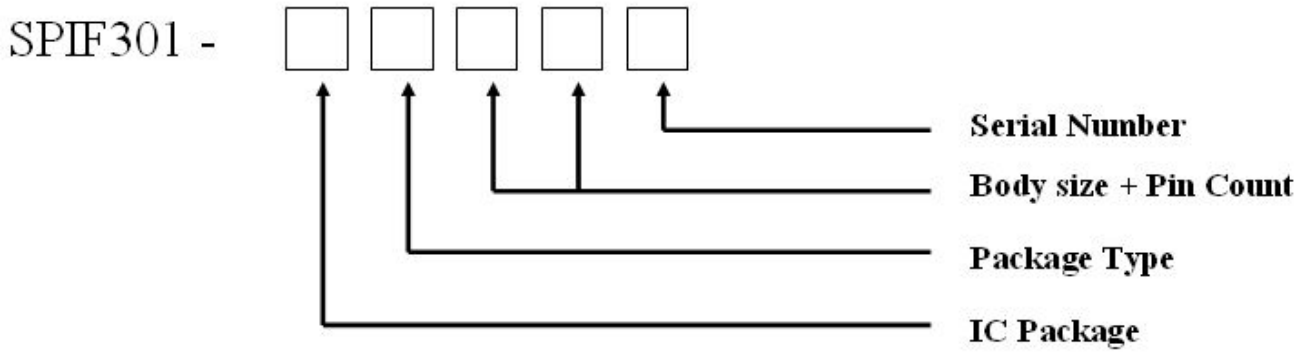



Fig 6-1: SPIF301 in LQFP-48 package

### 6.2. Ordering Information




**IC package:**

H = Green Package

**Package Type:**

L = LQFP

**Body Size + Pin count:**

23 = 48 pins (7 x 7 x 1.4 mm)

**Serial Number:** [= 1 ~ 9 ]

**Example:**

| Product Number | Package Type |
|---|---|
| SPIF301 - HL23X | Green Package form - LQFP 48 |

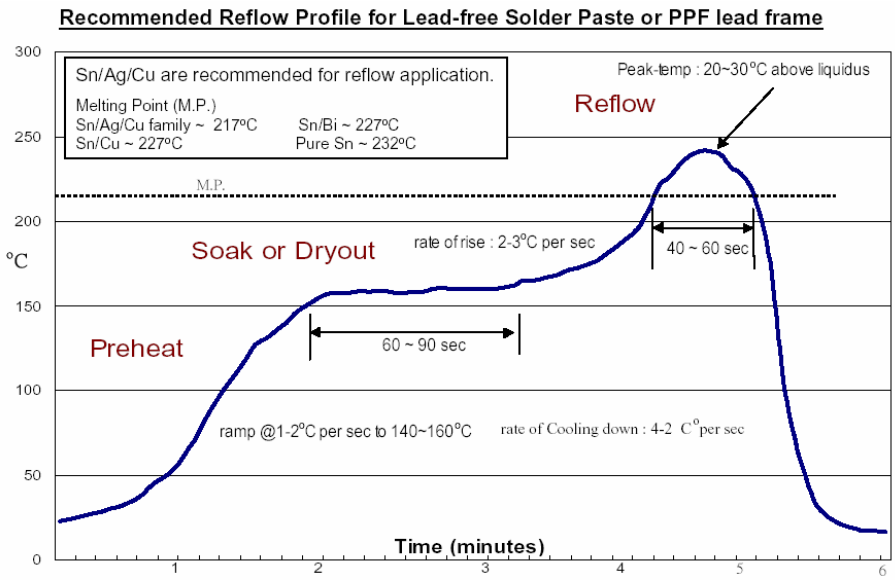
### 6.3. Storage Condition and Period for Package

| Package | Moisture sensitivity level | Max. Reflow temperature | Floor life storage condition | Dry pack |
|---|---|---|---|---|
| LQFP48 | LEVEL 3 | 255 +5/-0℃ | 168Hrs @ ≦30℃/ 60% R.H. | Yes |

**Note1:** Please refer to the IPC/JEDEC standard J-STD-020A and the EIA JEDEC stand JESD22-A112, or the "CAUTION Note" on dry pack bag.

### 6.4. Recommended SMT Temperature Profile

This "Recommended" temperature profile is a rough guideline for SMT process reference. Most of SUNPLUSIT lead frame based product choice Matte Tin and Sn/Bi for plating recipe. For PPF(Pre-Plated Frame) product with 63/37 solder paste, we recommend 240℃~245℃ for peak temperature.


Recommended Reflow Profile for Lead-free Solder Paste or PPF lead frame
Sn/Ag/Cu are recommended for reflow application.
Melting Point (M.P.)
Sn/Ag/Cu family ~ 217°C
Sn/Cu ~ 227°C
Sn/Bi ~ 227°C
Pure Sn ~ 232°C
Peak-temp : 20~30°C above liquidus
Reflow
M.P.
Soak or Dryout
rate of rise : 2-3°C per sec
40 ~ 60 sec
Preheat
60 ~ 90 sec
ramp @1-2°C per sec to 140~160°C
rate of Cooling down : 4-2 C°per sec
°C
Time (minutes)
300
250
200
150
100
50
0
1
2
3
4
5
6

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## 8. REVISION HISTORY

| Date | Revision # | Description | Page |
|---|---|---|---|
| 2008/07/14 | 1.0 | SPIF301 data sheet initial version | 16 |