

LNA IC for UHF Band (400 MHz to 800 MHz) Applications

FEATURES

- Low voltage operation +2.85 V typ.
- Low current consumption 3.0 mA typ. (High-Gain mode)  
0.1  $\mu$ A typ. (Low-Gain mode)
- High gain 14.5 dB typ. fRX = 620 MHz (High-Gain mode)
- Low noise figure 1.40 dB typ. fRX = 620 MHz (High-Gain mode)
- Low distortion -8.0 dBm typ. fRX = 620 MHz (High-Gain mode)  
(IIP3 +10 MHz offset)
- Small package 5 pin Plastic Small Surface Mount Package  
(SMINI Type)

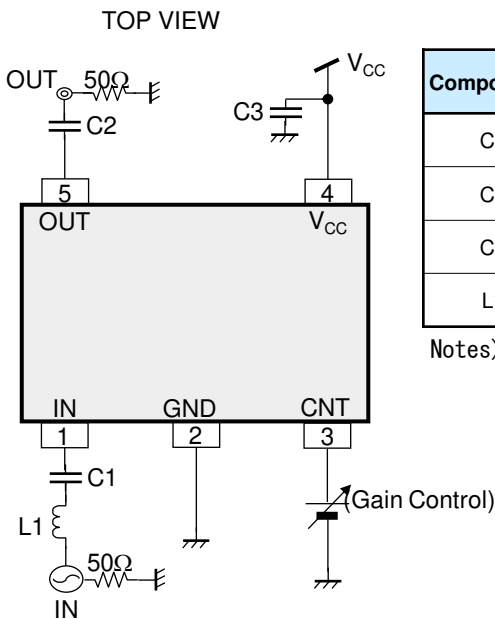
DESCRIPTION

AN26018A is LNA-IC for UHF Band (400 MHz to 800 MHz) Applications.  
Realizing high performance by using SiGe Bi-CMOS process ( $f_T = 90$  GHz,  $f_{max} = 140$  GHz).  
High/Low Gain-mode is changeable, controlled by integrated CMOS logic circuit.  
Achieving miniaturization by using small size package.

APPLICATIONS

- DTV (UHF)

SIMPLIFIED APPLICATION



| Components | Size | Value       | Part Number       | Vendor |
|------------|------|-------------|-------------------|--------|
| C1         | 0603 | 1 000 pF    | GRM033B11C102KD01 | Murata |
| C2         | 0603 | 1 000 pF    | GRM033B11C102KD01 | Murata |
| C3         | 0603 | 0.1 $\mu$ F | GRM033B30J104KE18 | Murata |
| L1         | 0603 | 6.8 nH      | LQP03T6N8H04      | Murata |

Notes) This application circuit is an example. The operation of mass production set is not guaranteed. You should perform enough evaluation and verification on the design of mass production set. You are fully responsible for the incorporation of the above application circuit and information in the design of your equipment.

## ABSOLUTE MAXIMUM RATINGS

| Parameter                      | Symbol                 | Rating                     | Unit | Note |
|--------------------------------|------------------------|----------------------------|------|------|
| Supply voltage                 | $V_{CC}$               | 3.6                        | V    | *1   |
| Supply current                 | $I_{CC}$               | 18                         | mA   | —    |
| Operating ambient temperature  | $T_{opr}$              | -20 to 70                  | °C   | *2   |
| Operating junction temperature | $T_j$                  | -40 to +125                | °C   | *2   |
| Storage temperature            | $T_{stg}$              | -40 to +125                | °C   | *2   |
| Input Voltage Range            | IN (Pin No.1)          | —                          | V    | *3   |
|                                | CNT (Pin No.3)         | -0.3 to ( $V_{CC} + 0.3$ ) | V    | *4   |
|                                | OUT (Pin No.5)         | -0.3 to ( $V_{CC} + 0.3$ ) | V    | *4   |
| ESD                            | HBM (Human Body Model) | 2                          | kV   | —    |
|                                | MM (Machine Model)     | 100                        | V    | —    |

Notes). This product may sustain permanent damage if subjected to conditions higher than the above stated absolute maximum rating. This rating is the maximum rating and device operating at this range is not guaranteeable as it is higher than our stated recommended operating range.

When subjected under the absolute maximum rating for a long time, the reliability of the product may be affected.

\*1: The values under the condition not exceeding the above absolute maximum ratings and the power dissipation.

\*2: Except for the power dissipation, operating ambient temperature, and storage temperature, all ratings are for  $T_a = 25^\circ\text{C}$ .

\*3: RF signal input pin. Do not apply DC current.

\*4: ( $V_{CC} + 0.3$ ) V must not be exceeded 3.6 V

## POWER DISSIPATION RATING

| PACKAGE    | $\theta_{JA}$ | PD ( $T_a=25^\circ\text{C}$ ) | PD ( $T_a=70^\circ\text{C}$ ) |
|------------|---------------|-------------------------------|-------------------------------|
| SSMINI-5DC | 833.3°C/W     | 0.12W                         | 0.06W                         |

Note). For the actual usage, please refer to the PD- $T_a$  characteristics diagram in the package specification, supply voltage, load and ambient temperature conditions to ensure that there is enough margin follow the power and the thermal design does not exceed the allowable value.

**CAUTION**

Although this has limited built-in ESD protection circuit, but permanent damage may occur on it. Therefore, proper ESD precautions are recommended to avoid electrostatic damage to the MOS gates

## RECOMMENDED OPERATING CONDITIONS

| Parameter            | Symbol   | Min. | Typ. | Max. | Unit | Note |
|----------------------|----------|------|------|------|------|------|
| Supply voltage range | $V_{CC}$ | 2.70 | 2.85 | 3.0  | V    | *1   |

Note) \*1 : The values under the condition not exceeding the above absolute maximum ratings and the power dissipation.

**ELECTRICAL CHARACTERISTICS**

Note)  $V_{cc} = 2.85\text{ V}$ ,  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$  unless otherwise specified.

| Parameter                            | Symbol           | Condition  | Limits |      |      | Unit | Note |
|--------------------------------------|------------------|--|--------|------|------|------|------|
|                                      |                  |  | Min    | Typ  | Max  |      |      |
| <b>DC electrical characteristics</b> |                  |  |        |      |      |      |      |
| Supply current HG                    | I <sub>ccH</sub> | V <sub>cc</sub> current at High-Gain mode<br>No input signal | —      | 3.0  | 4.0  | mA   | —    |
| Supply current LG                    | I <sub>ccL</sub> | V <sub>cc</sub> current at Low-Gain mode<br>No input signal  | —      | 0.1  | 9.5  | μA   | —    |
| Input voltage<br>(High-Gain mode)    | V <sub>IH</sub>  | —  | 1.40   | 2.85 | —    | V    | —    |
| Input voltage<br>(Low-Gain mode)     | V <sub>IL</sub>  | —  | —      | 0.0  | 0.55 | V    | —    |
| SW current (High)                    | I <sub>IH</sub>  | Current at CNT pin<br>V <sub>IH</sub> = V <sub>cc</sub>      | —      | 11   | 40   | μA   | —    |

**ELECTRICAL CHARACTERISTICS (continued)**

Note)  $V_{cc} = 2.85\text{V}$ ,  $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RX} = 620\text{ MHz}$ ,  $PRX = -30\text{ dBm}$ , CW unless otherwise specified.

| Parameter                                | Symbol          | Conditions   | Limits |      |      | Unit | Note |
|--|-----------------|--|--------|------|------|------|------|
|  |                 |  | Min    | Typ  | Max  |      |      |
| <b>LNA AC electrical characteristics</b> |                 |  |        |      |      |      |      |
| Power Gain HG                            | G <sub>HS</sub> | High-Gain mode<br>$f = f_{RX}$   | 12.5   | 14.5 | 16.5 | dB   | —    |
| Power Gain LG                            | G <sub>LS</sub> | Low-Gain mode<br>$f = f_{RX}$ , $PRX = -20\text{ dBm}$   | -2.0   | -1.5 | —    | dB   | —    |
| IIP3<br>+10 MHz offset                   | IIP31S          | $f_1 = f_{RX} + 10\text{ MHz}$<br>$f_2 = f_{RX} + 20\text{ MHz}$<br>Input 2 signals ( $f_1, f_2$ ) | -14.5  | -8.0 | —    | dBm  | —    |

**APPLICATION INFORMATION**

**REFERENCE VALUES FOR DESIGN**

Notes)  $V_{cc} = 2.85\text{ V}$

$T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$ ,  $f_{RX} = 470\text{ MHz}, 620\text{ MHz}, 770\text{ MHz}$ ,  $PRX = -30\text{ dBm}$ , CW unless otherwise specified.

| Parameter                                | Symbol | Conditions   | Reference values |      |      | Unit | Note   |
|--|--------|--|------------------|------|------|------|--------|
|  |        |  | Min              | Typ  | Max  |      |        |
| <b>LNA AC electrical characteristics</b> |        |  |                  |      |      |      |        |
| Power Gain HG                            | GH     | High-Gain mode<br>$f = f_{RX}$   | 12.0             | 14.5 | 17.0 | dB   | *1     |
| Power Gain LG                            | GL     | Low-Gain mode<br>$f = f_{RX}$ , $PRX = -20\text{ dBm}$   | -2.5             | -1.5 | —    | dB   | *1     |
| Noise Figure HG                          | NFH    | High-Gain mode<br>$f = f_{RX}$   | —                | 1.5  | 1.9  | dB   | *1, *2 |
| Noise Figure LG                          | NFL    | Low-Gain mode<br>$f = f_{RX}$  | —                | 1.5  | 2.5  | dB   | *1     |
| IIP3<br>+10 MHz offset HG                | IIP3H1 | High-Gain mode<br>$f_1 = f_{RX} + 10\text{ MHz}$<br>$f_2 = f_{RX} + 20\text{ MHz}$<br>Input 2 signals ( $f_1, f_2$ ) | -16.5            | -8.0 | —    | dBm  | *1     |
| IIP3<br>-10 MHz offset HG                | IIP3H2 | High-Gain mode<br>$f_1 = f_{RX} - 10\text{ MHz}$<br>$f_2 = f_{RX} - 20\text{ MHz}$<br>Input 2 signals ( $f_1, f_2$ ) | -17.0            | -8.5 | —    | dBm  | *1     |
| Input P1dB                               | IP1dBH | High-Gain mode<br>$f = f_{RX}$   | -11              | -5   | —    | dBm  | *1     |
| Reverse Isolation HG                     | ISOH   | High-Gain mode<br>$f = f_{RX}$   | —                | -24  | -18  | dB   | *1     |
| Reverse Isolation LG                     | ISOL   | Low-Gain mode<br>$f = f_{RX}$  | —                | -1.6 | -1.0 | dB   | *1     |
| Input Return Loss HG                     | S11H   | High-Gain mode<br>$f = f_{RX}$   | 5.0              | 9.5  | —    | dB   | *1     |
| Input Return Loss LG                     | S11L   | Low-Gain mode<br>$f = f_{RX}$  | 12               | 20   | —    | dB   | *1     |
| Output Return Loss HG                    | S22H   | High-Gain mode<br>$f = f_{RX}$   | 7                | 23   | —    | dB   | *1     |
| Output Return Loss LG                    | S22L   | Low-Gain mode<br>$f = f_{RX}$  | 10               | 12   | —    | dB   | *1     |
| K-Factor                                 | KH     | High-Gain mode<br>$f = 300\text{ kHz to }6\text{ GHz}$   | 1.0              | 1.5  | —    | —    | *1     |
| Switching Time                           | TSW    | High-Gain mode → Low-Gain mode<br>Low-Gain mode → High-Gain mode   | —                | 3.2  | 10.0 | us   | *1     |

Note) \*1 : Checked by design, not production tested.

\*2 : Connector & substrate loss (0.10 dB) included.

**APPLICATION INFORMATION (continued)**  
**REFERENCE VALUES FOR DESIGN (continued)**

Notes)  $V_{cc} = 2.7\text{ V to }3.0\text{ V}$

All characteristics are specified under  $T_a = -20^{\circ}\text{C to }70^{\circ}\text{C}$

| Parameter                            | Symbol | Conditions                                       | Reference values |      |      | Unit | Note |
|--------------------------------------|--------|--|------------------|------|------|------|------|
|                                      |        |  | Min              | Typ  | Max  |      |      |
| <b>DC electrical characteristics</b> |        |  |                  |      |      |      |      |
| Supply current HG                    | IccHT  | Vcc current at High-Gain mode<br>No input signal | —                | 3.0  | 4.5  | mA   | *1   |
| Supply current LG                    | IccLT  | Vcc current at Low-Gain mode<br>No input signal  | —                | 0.1  | 10   | μA   | *1   |
| Input voltage<br>(High-Gain mode)    | VIHT   | —  | 1.50             | 2.85 | —    | V    | *1   |
| Input voltage<br>(Low-Gain mode)     | VILT   | —  | —                | 0.0  | 0.40 | V    | *1   |
| SW current (High)                    | IIHT   | Current at CNT pin<br>$V_{IH} = V_{cc}$          | —                | 11   | 50   | μA   | *1   |

Note) \*1 : Checked by design, not production tested.

**APPLICATION INFORMATION (continued)**

**REFERENCE VALUES FOR DESIGN (continued)**

Notes)  $V_{cc} = 2.7\text{ V to }3.0\text{ V}$

All characteristics are specified under  $T_a = -20^\circ\text{C to }70^\circ\text{C}$ ,  $f_{RX} = 470\text{ MHz, }620\text{ MHz, }770\text{ MHz}$ ,  
 $PRX = -30\text{ dBm, CW}$

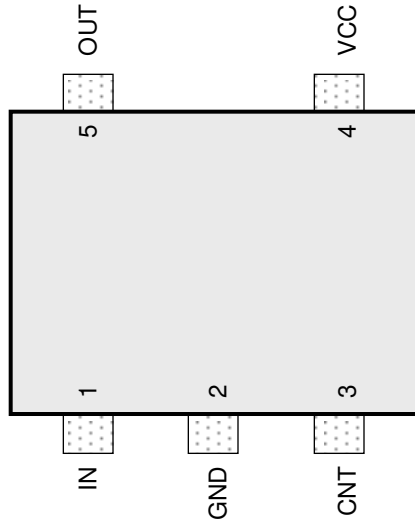
| Parameter                                | Symbol  | Conditions   | Reference values |      |      | Unit          | Note   |
|--|---------|--|------------------|------|------|---------------|--------|
|  |         |  | Min              | Typ  | Max  |               |        |
| <b>LNA AC electrical characteristics</b> |         |  |                  |      |      |               |        |
| Power Gain HG                            | GHT     | High-Gain mode<br>$f = f_{RX}$   | 11.5             | 14.5 | 17.5 | dB            | *1     |
| Power Gain LG                            | GLT     | Low-Gain mode<br>$f = f_{RX}$ , $PRX = -20\text{ dBm}$   | -2.7             | -1.5 | —    | dB            | *1     |
| Noise Figure HG                          | NFHT    | High-Gain mode<br>$f = f_{RX}$   | —                | 1.5  | 2.3  | dB            | *1, *2 |
| Noise Figure LG                          | NFLT    | Low-Gain mode<br>$f = f_{RX}$  | —                | 1.5  | 2.7  | dB            | *1     |
| IIP3<br>+10 MHz offset HG                | IIP3H1T | High-Gain mode<br>$f_1 = f_{RX} + 10\text{ MHz}$<br>$f_2 = f_{RX} + 20\text{ MHz}$<br>Input 2 signals ( $f_1, f_2$ ) | -17.0            | -8.0 | —    | dBm           | *1     |
| IIP3<br>-10 MHz offset HG                | IIP3H2T | High-Gain mode<br>$f_1 = f_{RX} - 10\text{ MHz}$<br>$f_2 = f_{RX} - 20\text{ MHz}$<br>Input 2 signals ( $f_1, f_2$ ) | -17.5            | -8.5 | —    | dBm           | *1     |
| Input P1dB HG                            | IP1dBHT | High-Gain mode<br>$f = f_{RX}$   | -13              | -5   | —    | dBm           | *1     |
| K-Factor                                 | KHT     | High-Gain mode<br>$f = 300\text{ kHz to }6\text{ GHz}$   | 1.0              | 1.5  | —    | —             | *1     |
| Switching Time                           | TSWT    | High-Gain mode → Low-Gain mode<br>Low-Gain mode → High-Gain mode   | —                | 3.2  | 10.0 | $\mu\text{s}$ | *1     |

Note) \*1 : Checked by design, not production tested.

\*2 : Connector & substrate loss (0.10 dB) included.

PIN CONFIGURATION

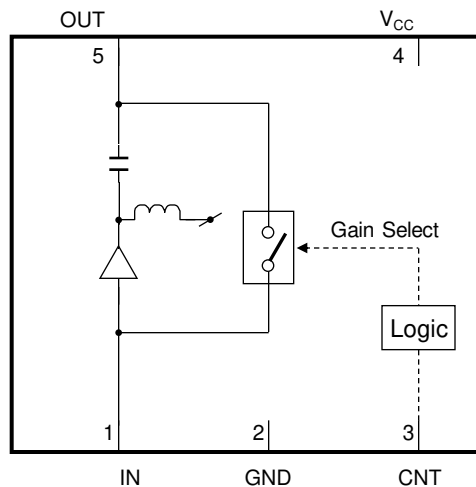
Top View



PIN FUNCTIONS

| Pin No. | Pin name | Type         | Description  |
|---------|----------|--------------|--|
| 1       | IN       | Input        | RF Input   |
| 2       | GND      | Ground       | GND  |
| 3       | CNT      | Input        | High-Gain / Low-Gain switch<br>L: Low-Gain Mode<br>H: High-Gain Mode |
| 4       | VCC      | Power Supply | V <sub>CC</sub>  |
| 5       | OUT      | Output       | RF Output  |

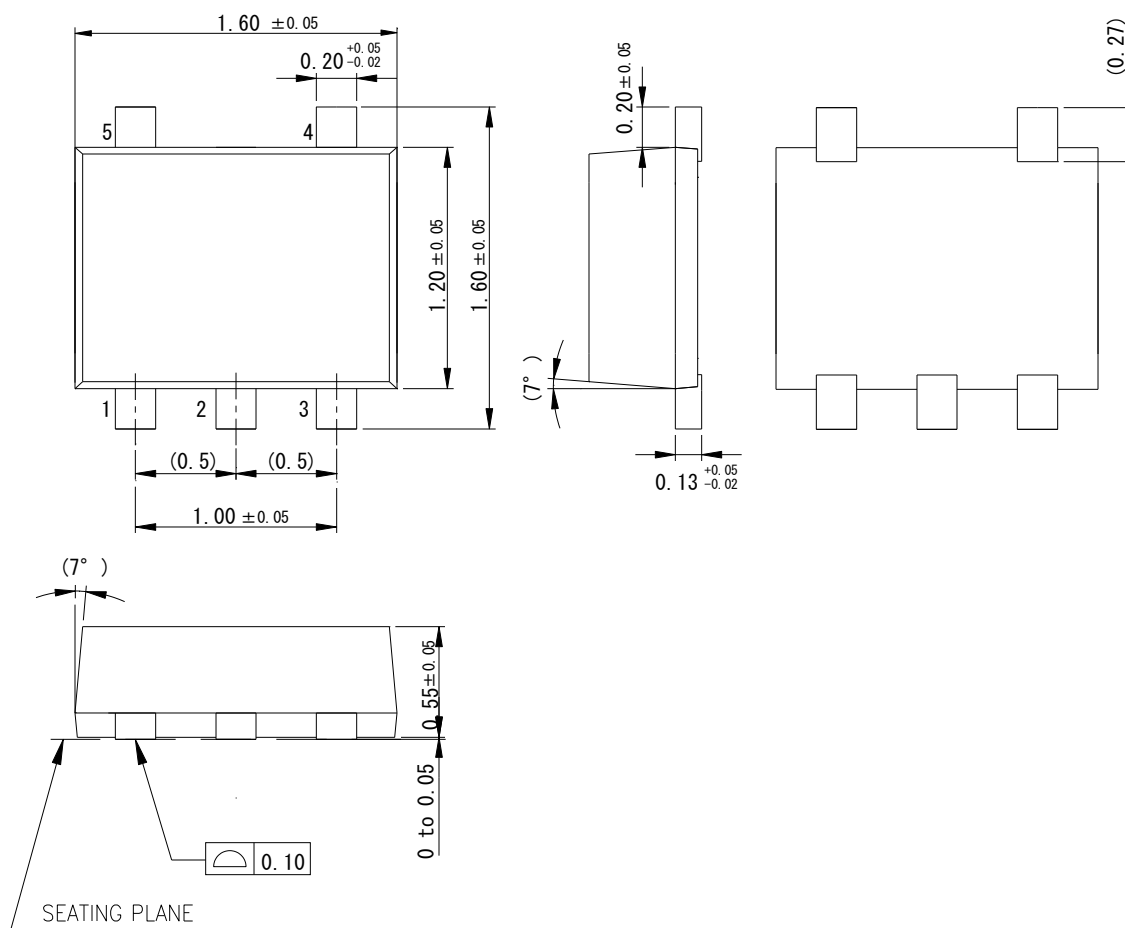
FUNCTIONAL BLOCK DIAGRAM



PACKAGE INFORMATION ( Reference Data )

Package Code:SSMINI-5DC

Unit:mm



|                    |                               |
|--------------------|-------------------------------|
| Body Material      | : Br / Sb Free<br>Epoxy Resin |
| Lead Material      | : Cu Alloy                    |
| Lead Finish Method | : SnBi Plating                |



## IMPORTANT NOTICE

1. The products and product specifications described in this book are subject to change without notice for modification and/or improvement. At the final stage of your design, purchasing, or use of the products, therefore, ask for the most up-to-date Product Standards in advance to make sure that the latest specifications satisfy your requirements.
2. When using the LSI for new models, verify the safety including the long-term reliability for each product.
3. When the application system is designed by using this LSI, be sure to confirm notes in this book.  
Be sure to read the notes to descriptions and the usage notes in the book.
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6. This LSI is intended to be used for general electronic equipment [cellular phones].  
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Any applications other than the standard applications intended.
  - (1) Space appliance (such as artificial satellite, and rocket)
  - (2) Traffic control equipment (such as for automobile, airplane, train, and ship)
  - (3) Medical equipment for life support
  - (4) Submarine transponder
  - (5) Control equipment for power plant
  - (6) Disaster prevention and security device
  - (7) Weapon
  - (8) Others : Applications of which reliability equivalent to (1) to (7) is requiredIt is to be understood that our company shall not be held responsible for any damage incurred as a result of or in connection with your using the LSI described in this book for any special application, unless our company agrees to your using the LSI in this book for any special application.
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**USAGE NOTES**

1. When designing your equipment, comply with the range of absolute maximum rating and the guaranteed operating conditions (operating power supply voltage and operating environment etc.). Especially, please be careful not to exceed the range of absolute maximum rating on the transient state, such as power-on, power-off and mode-switching. Otherwise, we will not be liable for any defect which may arise later in your equipment.

Even when the products are used within the guaranteed values, take into the consideration of incidence of break down and failure mode, possible to occur to semiconductor products. Measures on the systems such as redundant design, arresting the spread of fire or preventing glitch are recommended in order to prevent physical injury, fire, social damages, for example, by using the products.

2. Comply with the instructions for use in order to prevent breakdown and characteristics change due to external factors (ESD, EOS, thermal stress and mechanical stress) at the time of handling, mounting or at customer's process. When using products for which damp-proof packing is required, satisfy the conditions, such as shelf life and the elapsed time since first opening the packages.
3. Pay attention to the direction of LSI. When mounting it in the wrong direction onto the PCB (printed-circuit-board), it might smoke or ignite.
4. Pay attention in the PCB (printed-circuit-board) pattern layout in order to prevent damage due to short circuit between pins. In addition, refer to the Pin Description for the pin configuration.
5. Perform a visual inspection on the PCB before applying power, otherwise damage might happen due to problems such as a solder-bridge between the pins of the semiconductor device. Also, perform a full technical verification on the assembly quality, because the same damage possibly can happen due to conductive substances, such as solder ball, that adhere to the LSI during transportation.
6. Take notice in the use of this product that it might break or occasionally smoke when an abnormal state occurs such as output pin-VCC short (Power supply fault), output pin-GND short (Ground fault), or output-to-output-pin short (load short) .

And, safety measures such as an installation of fuses are recommended because the extent of the above-mentioned damage and smoke emission will depend on the current capability of the power supply.