# User Manual

## 1. SIM900E Description

### 1.1. Summarize

SIM900E designed by SIMCom is a quad-band module which supports GSM/GPRS. The baseband circuit is based on STE and RF circuit is based on RFMD. It works at quad bands------GSM 850MHz, EGSM 900MHz, DCS 1800MHz and PCS 1900MHz. CPU clock is based on 26MHz crystal. The main IC includes PNX4851, RF7176 and Flash, etc.

### 1.2. Feature

- Quad-band 900/1800/850/1900MHz
- GPRS multi-slot class 10/8
- GPRS mobile station class B
- Compliant to GSM phase 2/2+
  - Class 4 (2W) at GSM 850 and EGSM 900
  - Class 1 (1W) at DCS 1800 and PCS 1900
- Dimensions: 19.8*19.8*2.7mm
- Weight: 2.4 g
- Control via AT commands (GSM 07.07 ,07.05 and SIMCom enhanced AT Commands)
- Supply voltage range 3.2V ~ 4.8V
- Low power consumption
- Operation temperature: -30°C ~ +80°C
- 69 SMT pads include
  - Interface to external SIM 3V/1.8V
  - Analog audio interface
  - RTC backup
  - Serial interface
  - LCD interface
  - Antenna pad
  - GPIO
  - ADC

## 1.3. Pin Name and IO Characters

| Pin No. | Pin Name | I/O | | Pin No. | Pin Name | I/O |
|---|---|---|---|---|---|---|
| 1 | GND | | | 35 | VDD_EXT | O |
| 2 | SPK_P | O | | 36 | PWRKEY | I |
| 3 | SPK_N | O | | 37 | ADC | I |
| 4 | GND | | | 38 | GPIO12 | IO |
| 5 | MIC_N | I | | 39 | SDA | IO |
| 6 | MIC_P | I | | 40 | SCL | IO |
| 7 | GND | | | 41 | DBG_RXD | I |
| 8 | NETLIGHT | O | | 42 | DBG_TXD | O |
| 9 | GND | | | 43 | VRTC | IO |
| 10 | SIM_CLK | O | | 44 | SIM_PRESENCE | I |
| 11 | SIM_DATA | IO | | 45 | GPIO8/KBC2 | IO |
| 12 | SIM_RST | I | | 46 | GPIO1/KBR4 | IO |
| 13 | SIM_VDD | O | | 47 | GPIO9/KBC1 | IO |
| 14 | STATUS | O | | 48 | GPIO6/KBC4 | IO |
| 15 | NRESET | I | | 49 | GPIO7/KBC3 | IO |
| 16 | RXD | I | | 50 | GPIO5/KBR0 | IO |
| 17 | TXD | O | | 51 | GPIO4/KBR1 | IO |
| 18 | GND | | | 52 | GPIO2/KBR3 | IO |
| 19 | RTS | I | | 53 | GPIO3/KBR2 | IO |
| 20 | CTS | O | | 54 | GPIO10 | IO |
| 21 | DTR | I | | 55 | PWM2 | O |
| 22 | RI | O | | 56 | PWM1 | O |
| 23 | DCD | O | | 57 | DISP _CLK | O |
| 24 | GPIO11 | IO | | 58 | DISP _CS | O |
| 25 | GND | | | 59 | DISP_DATA | O |
| 26 | GND | | | 60 | DISP _D/C | IO |
| 27 | GND | | | 61 | GND | |
| 28 | RF_ANT | IO | | 62 | GND | |
| 29 | GND | | | 63 | GND | |
| 30 | VBAT | I | | 64 | GND | |
| 31 | VBAT | I | | 65 | GND | |
| 32 | VBAT | I | | 66 | GND | |
| 33 | GND | | | 67 | GND | |
| 34 | GND | | | 68 | GND | |
| 69 | GND | | | | | |

## 1.4. Pictures


**Figure 1: Top view of SIM900E**

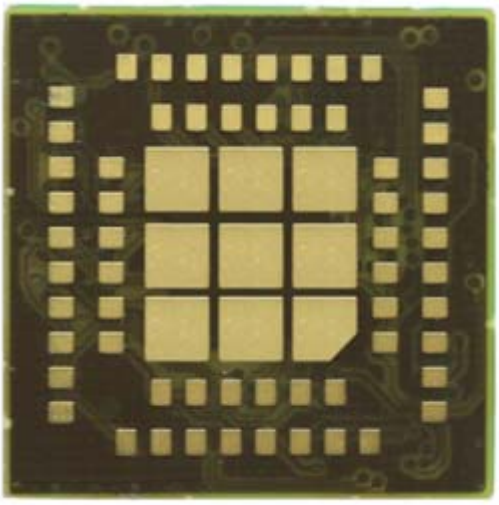

**Figure 2: Bottom view of SIM900E**

## 1.5. Dimension

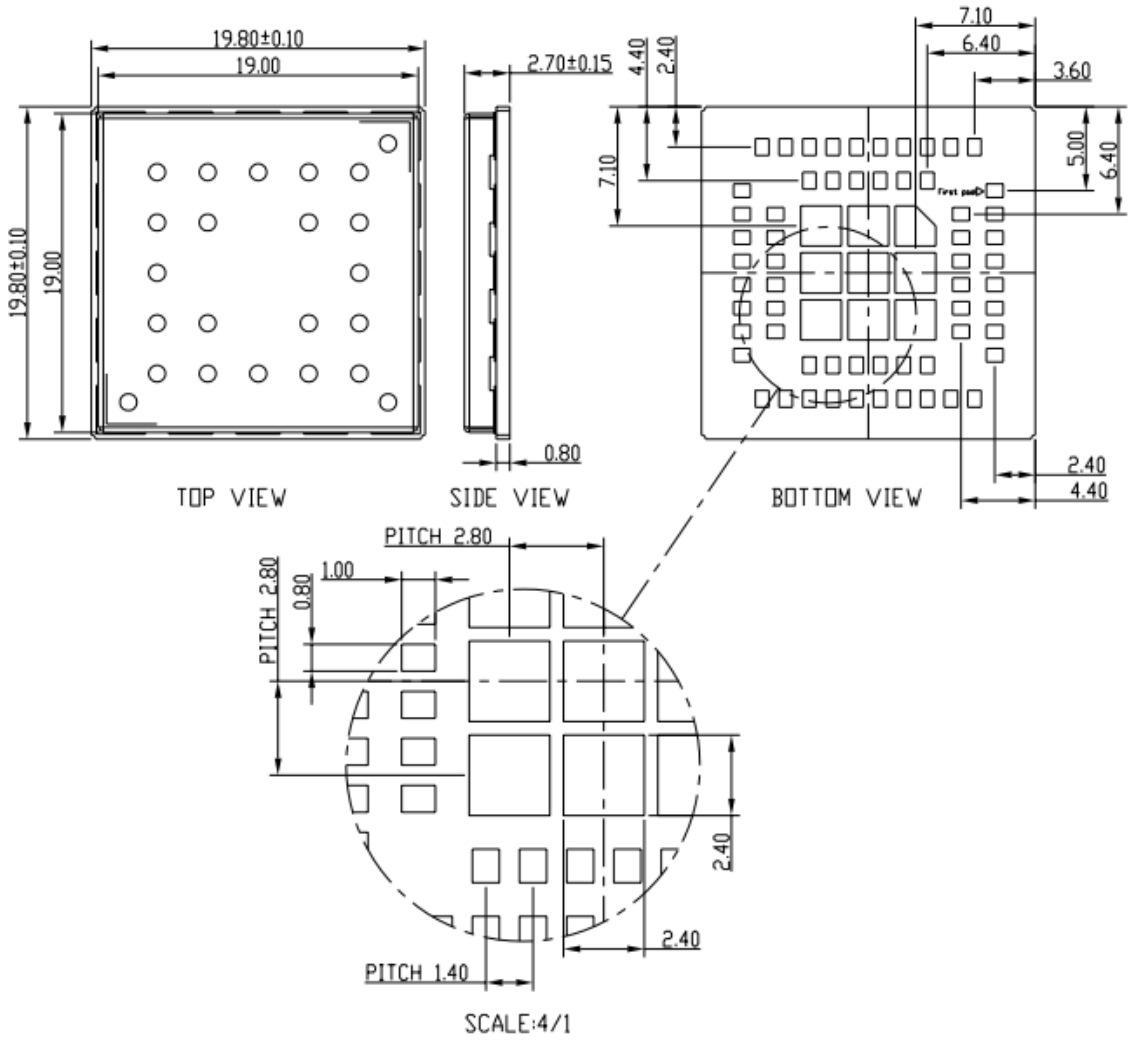


**Figure 3: Dimention**

# 2. Detail Block Diagram

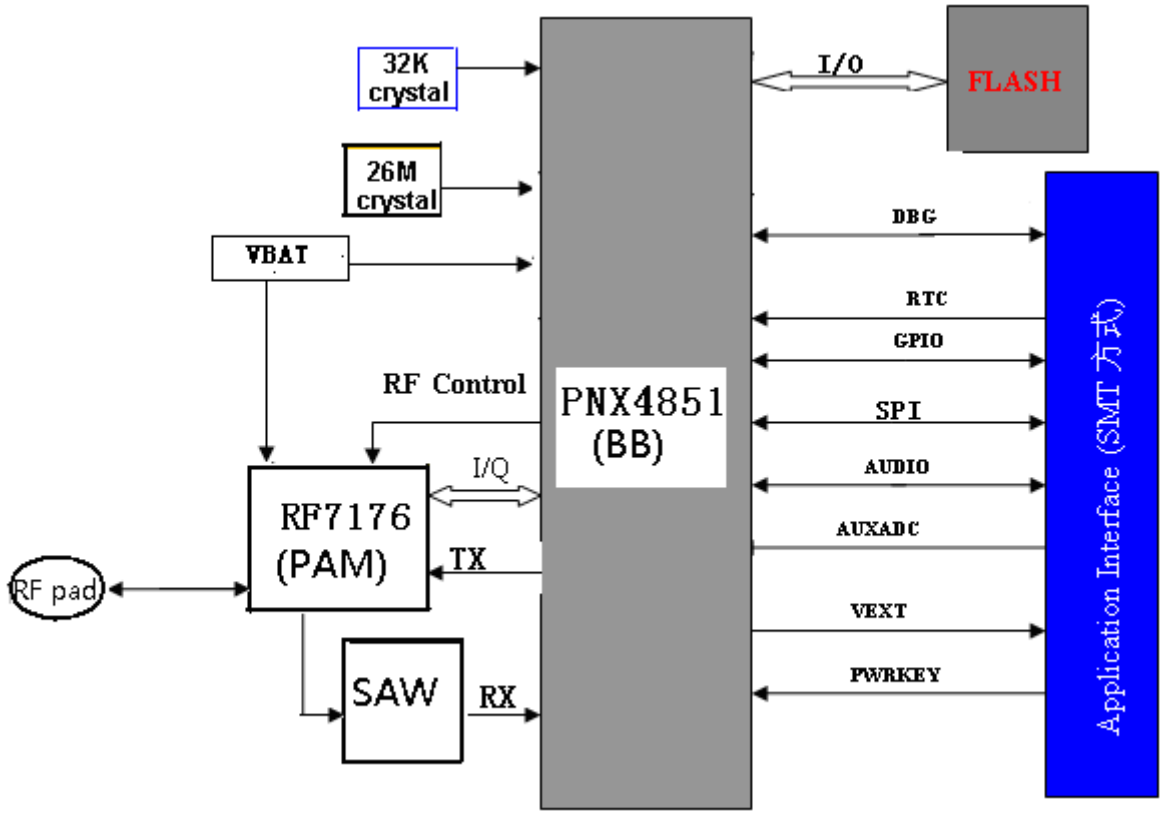


**Figure 4: Block diagram of SIM900E**

# 3. Electrical and Reliability Characteristics

## 3.1. Absolute Maximum Ratings

The absolute maximum ratings stated in following table are stress ratings under non-operating conditions. Stresses beyond any of these limits will cause permanent damage to SIM900E .

**Table 1: Absolute maximum ratings**

| Symbol | Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| VBAT | Power supply voltage | - | - | 5.5 | V |
| $V_I$* | Input voltage | -0.3 | - | 3.1 | V |
| $I_I$* | Input current | - | - | 10 | mA |
| $I_O$* | Output current | - | - | 10 | mA |

*These parameters are for digital interface pins, such as keypad, GPIO, $I^2C$, UART, LCD and DEBUG.

## 3.2. Digital Interface Characteristics

**Table 2: Digital interface characteristics**

| Symbol | Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| $I_{IH}$ | High-level input current | -10 | - | 10 | uA |
| $I_{IL}$ | Low-level input current | -10 | - | 10 | uA |
| $V_{IH}$ | High-level input voltage | 2.4 | - | - | V |
| $V_{IL}$ | Low-level input voltage | - | - | 0.4 | V |
| $V_{OH}$ | High-level output voltage | 2.7 | - | - | V |
| $V_{OL}$ | Low-level output voltage | - | - | 0.1 | V |

* These parameters are for digital interface pins, such as keypad, GPIO, $I^2C$, UART, LCDand DEBUG.

## 3.3. SIM Card Interface Characteristics

**Table 3: SIM card interface characteristics**

| Symbol | Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| $I_{IH}$ | High-level input current | -10 | - | 10 | uA |
| $I_{IL}$ | Low-level input current | -10 | - | 10 | uA |
| $V_{IH}$ | High-level input voltage | 1.4 | - | - | V |
| | | 2.4 | - | - | V |
| $V_{IL}$ | Low-level input voltage | - | - | 0.4 | V |
| | | | | 2.4 | V |
| $V_{OH}$ | High-level output voltage | 1.7 | - | - | V |
| | | 2.7 | - | - | V |
| $V_{OL}$ | Low-level output voltage | - | - | 0.1 | V |
| | | - | - | 0.1 | V |

## 3.4. SIM_VDD Characteristics

**Table 4: SIM_VDD characteristics**

| Symbol | Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| $V_O$ | Output voltage | 2.75 | 2.9 | 3.00 | V |
| | | 1.65 | 1.80 | 1.95 | |
| $I_O$ | Output current | - | - | 10 | mA |

## 3.5. VRTC Characteristics

**Table 5: VRTC characteristics**

| Symbol | Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| $V_{RTC-IN}$ | VRTC input voltage | 2.00 | 3.00 | 3.15 | V |
| $I_{RTC-IN}$ | VRTC input current | - | 2 | - | uA |
| $V_{RTC-OUT}$ | VRTC output voltage | - | 3.00 | - | V |
| $I_{RTC-OUT}$ | VRTC output current | - | 10 | - | uA |

## 3.6. Current Consumption (VBAT = 3.8V)

**Table 6: Current consumption**

| Symbol | Parameter | Conditions | | | Value | Unit |
|---|---|---|---|---|---|---|
| $I_{VRTC}$ | VRTC current | VBAT disconnects. Backup battery is 3 V | | | 2 | uA |
| $I_{VBAT}$ | VBAT current | Power down mode | | | 30 | uA |
| | | Sleep mode | BS-PA-MFRMS=9 | | 1.0 | mA |
| | | | BS-PA-MFRMS=5 | | 1.2 | |
| | | | BS-PA-MFRMS=2 | | 1.5 | |
| | | Idle mode | GSM 850 | | 22 | mA |
| | | | EGSM 900 | | | |
| | | | DCS 1800 | | | |
| | | | PCS 1900 | | | |
| | | Voice call | GSM 850 EGSM 900 | PCL=5 | 240 | mA |
| | | | | PCL=12 | 108 | |
| | | | | PCL=19 | 81 | |
| | | | DCS 1800 PCS 1900 | PCL=0 | 176 | |
| | | | | PCL=7 | 94 | |
| | | | | PCL=15 | 76 | |
| | | Data mode GPRS(1Rx,1Tx) | GSM 850 EGSM 900 | PCL=5 | 240 | mA |
| | | | | PCL=12 | 110 | |
| | | | | PCL=19 | 83 | |
| | | | DCS 1800 PCS 1900 | PCL=0 | 170 | mA |
| | | | | PCL=7 | 95 | |
| | | | | PCL=15 | 80 | |
| | | Data mode GPRS(4Rx,1Tx) | GSM 850 EGSM 900 | PCL=5 | 223 | mA |
| | | | | PCL=12 | 150 | |
| | | | | PCL=19 | 120 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | DCS 1800<br>PCS 1900 | PCL=0 | 166 | mA |
| | | | | PCL=7 | 130 | |
| | | | | PCL=15 | 115 | |
| | | Data mode<br>GPRS(3Rx,2Tx) | GSM 850<br>EGSM 900 | PCL=5 | 410 | mA |
| | | | | PCL=12 | 185 | |
| | | | | PCL=19 | 130 | |
| | | | DCS 1800<br>PCS 1900 | PCL=0 | 300 | mA |
| | | | | PCL=7 | 155 | |
| | | | | PCL=15 | 122 | |
| $I_{VBAT-peak}$ | Peak current | During Tx burst | | | 2 | A |

## 3.7. Electro-Static Discharge

SIM900E is an ESD sensitive component, so more attention should be paid to the procedure of handling and packaging. The ESD test results are shown in the following table.

**Table 7: The ESD characteristics (Temperature: 25℃, Humidity: 45 %)**

| Pin | Contact discharge | Air discharge |
|---|---|---|
| VBAT | ±5KV | ±10KV |
| GND | ±4KV | ±10KV |
| RXD, TXD | ±3KV | ±6KV |
| Antenna port | ±5KV | ±10KV |
| SPK_P/ SPK_N<br>MIC_P/ MIC_N | ±2KV | ±6KV |
| PWRKEY | ±1KV | ±6KV |

## 3.8. Recommended Operating Conditions

**Table 8: Recommended operating conditions**

| Symbol | Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| VBAT | Power supply voltage | 3.6 | 4.0 | 4.2 | V |
| $T_{OPER}$ | Operating temperature | -40 | +25 | +85 | ℃ |
| $T_{STG}$ | Storage temperature | -45 | | +90 | ℃ |

# 4. Radio Characteristics

## 4.1. Module RF Output Power

The following table shows the module conducted output power, it is followed by the 3GPP TS 05.05 technical specification requirement.

**Table 9: SIM900E GSM850 and EGSM900 conducted RF output power**

| GSM850 and EGSM900 | | | |
|---|---|---|---|
| PCL | Nominal output power (dBm) | Tolerance (dB) for conditions | |
| | | Normal | Extreme |
| 5 | 33 | ±3 | ±4 |
| 6 | 31 | ±3 | ±4 |
| 7 | 29 | ±3 | ±4 |
| 8 | 27 | ±3 | ±4 |
| 9 | 25 | ±3 | ±4 |
| 10 | 23 | ±3 | ±4 |
| 11 | 21 | ±3 | ±4 |
| 12 | 19 | ±3 | ±4 |
| 13 | 17 | ±3 | ±4 |
| 14 | 15 | ±3 | ±4 |
| 15 | 13 | ±3 | ±4 |
| 16 | 11 | ±5 | ±6 |
| 17 | 9 | ±5 | ±6 |
| 18 | 7 | ±5 | ±6 |
| 19-31 | 5 | ±5 | ±6 |

**Table 10: SIM900E DCS1800 and PCS1900 conducted RF output power**

| DCS1800 and PCS1900 | | | |
|---|---|---|---|
| PCL | Nominal output power (dBm) | Tolerance (dB) for conditions | |
| | | Normal | Extreme |
| 0 | 30 | ±3 | ±4 |
| 1 | 28 | ±3 | ±4 |
| 2 | 26 | ±3 | ±4 |
| 3 | 24 | ±3 | ±4 |
| 4 | 22 | ±3 | ±4 |
| 5 | 20 | ±3 | ±4 |
| 6 | 18 | ±3 | ±4 |

| | | | |
|---|---|---|---|
| 7 | 16 | ±3 | ±4 |
| 8 | 14 | ±3 | ±4 |
| 9 | 12 | ±4 | ±5 |
| 10 | 10 | ±4 | ±5 |
| 11 | 8 | ±4 | ±5 |
| 12 | 6 | ±4 | ±5 |
| 13 | 4 | ±4 | ±5 |
| 14 | 2 | ±5 | ±6 |
| 15-28 | 0 | ±5 | ±6 |

For the module's output power, the followings should be noted:

At GSM850 and EGSM900 band, the module is a class 4 device, so the module's output power should not exceed 33dBm, and at the maximum power level, the output power tolerance should not exceed +/-2dB under normal condition and +/-2.5dB under extreme condition.

At DCS1800 and PCS1900 band, the module is a class 1 device, so the module's output power should not exceed 30dBm, and at the maximum power level, the output power tolerance should not exceed +/-2dB under normal condition and +/-2.5dB under extreme condition.

## 4.2. Module RF Receive Sensitivity

The following table shows the module's conducted receive sensitivity, it is tested under static condition.

**Table 11: SIM900E conducted RF receive sensitivity**

| Frequency | Receive sensitivity（Typical） | Receive sensitivity(Max) |
|---|---|---|
| GSM850 | -109dBm | -107dBm |
| EGSM900 | -109dBm | -107dBm |
| DCS1800 | -109dBm | -107dBm |
| PCS1900 | -109dBm | -107dBm |

## 4.3. Module Operating Frequencies

The following table shows the module's operating frequency range; it is followed by the 3GPP TS 05.05 technical specification requirement.

**Table 12: SIM900E operating frequencies**

| Frequency | Receive | Transmit |
|---|---|---|
| GSM850 | 869 ~ 894MHz | 824 ~ 849 MHz |
| EGSM900 | 925 ~ 960MHz | 880 ~ 915MHz |

| | | |
|---|---|---|
| DCS1800 | 1805 ~ 1880MHz | 1710 ~ 1785MHz |
| PCS1900 | 1930 ~ 1990MHz | 1850 ~ 1910MHz |

# 5. RF Circuit Routing Constraints

## 5.1. General recommendations

To route the RF antenna signals, the following recommendations must be observed for PCB layout: The RF signals must be routed using traces with a 50 characteristic impedance. Basicaly, the characteristic impedance depends on the dielectric constant (εr) of the material used, trace width (W), trace thickness (T), and height (H) between the trace and the reference ground plane. In order to respect this constraint, SIMCom recommends that a MicroStrip structure be used and trace width be computed with a simulation tool (such as CITS25, shown in the figure below)

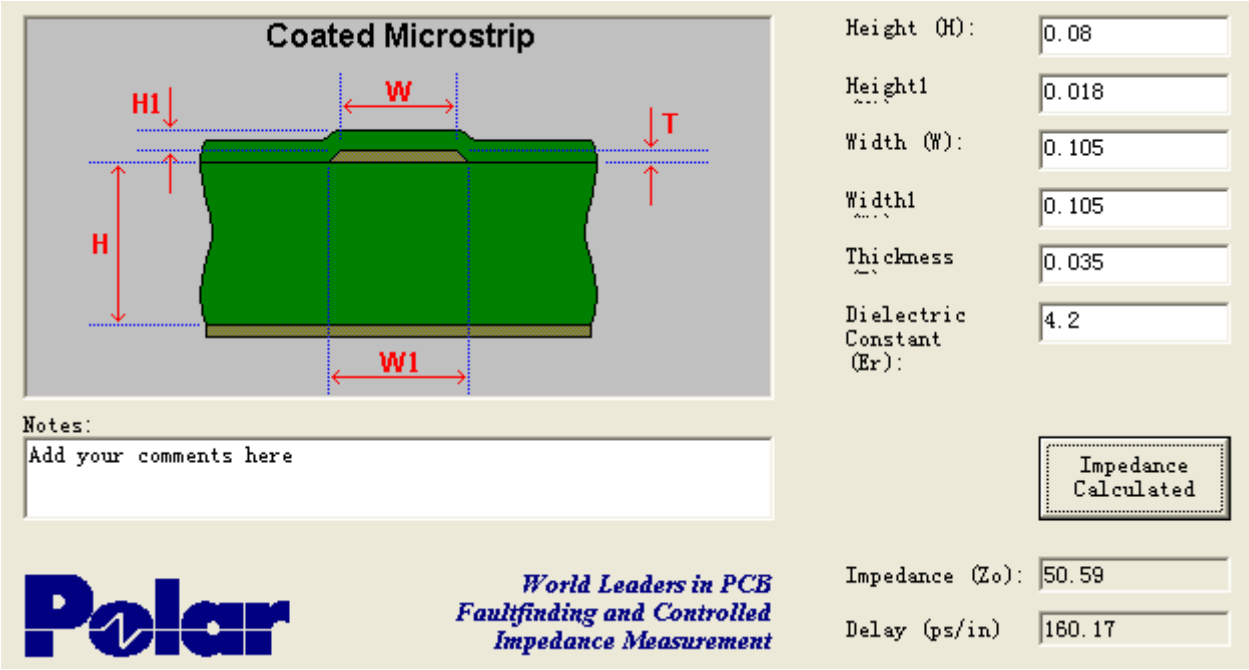


**Figure 5: CITS25 screenshot for MicroStrip design power mode diagram**

The trace width should be wide enough to maintain reasonable insertion loss and manufacturing reliability. Cutting out inner layers of ground under the trace will increase the effective substrate height; therefore, increasing the width of the RF trace.

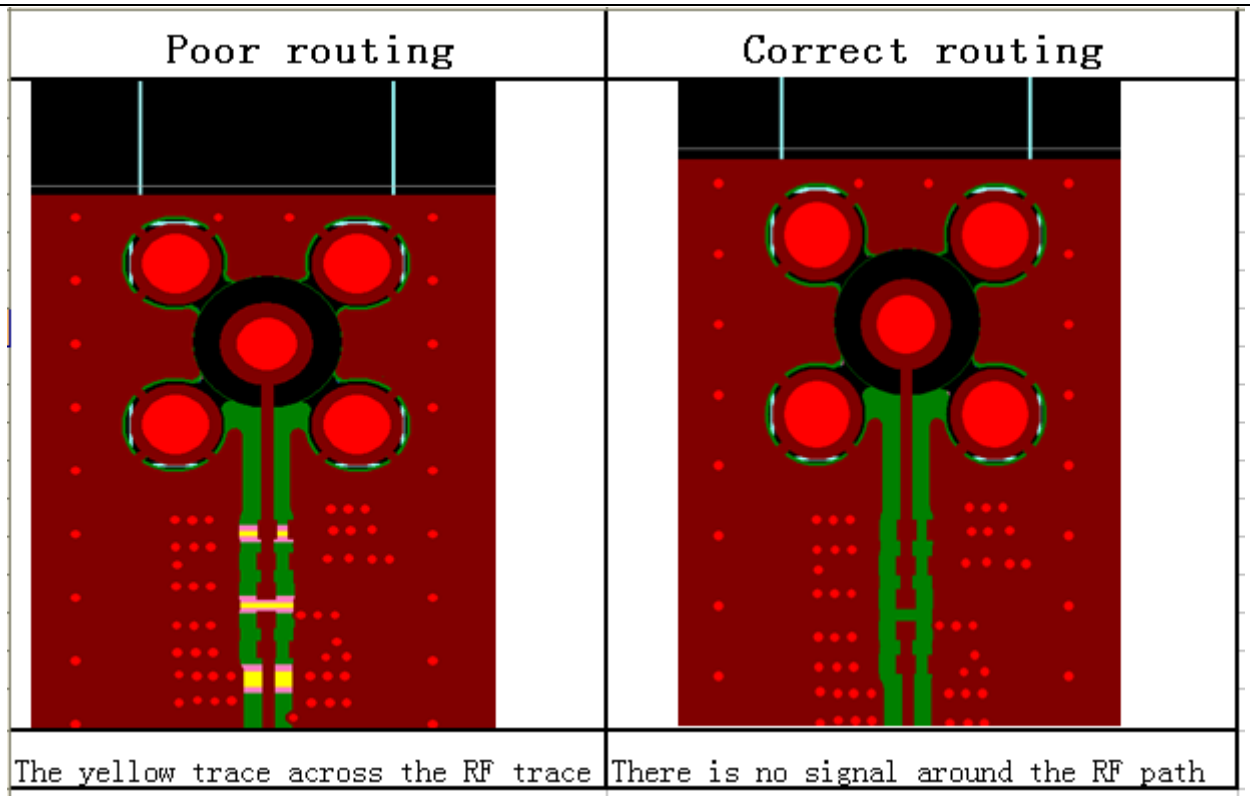


**Figure 6: RF routing examples**

- Fill the area around the RF traces with ground and ground vias to connect inner ground layers for isolation.
- Cut out ground under RF signal pads to reduce stray capacitance losses.
- Avoid routing RF traces with sharp corners. A smooth radius is recommended.
- The ground reference plane should be a solid continuous plane under the trace.
- The coplanar clearance (G, below) from the trace to the ground should be at least the trace width (W) and at least twice the height (H). This reduces the parasitic capacitance, which potentially alters the trace impedance and increases the losses. Note the figure below shows several internal ground layers cutout, which may not be necessary for every application.

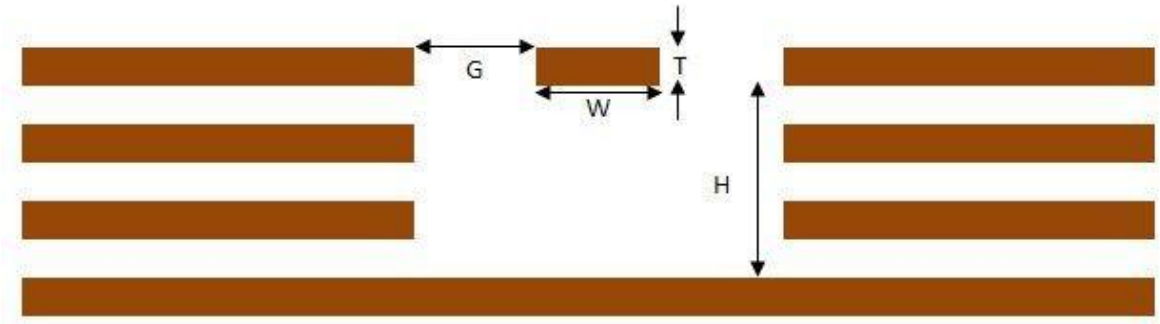


**Figure 7: Coplanar clearance example**

# 6. Regulatory Information

**Important notice**

Because of the nature of wireless communications, transmission and reception of data can never be guaranteed. Data may be delayed, corrupted (i.e., have errors) or be total y lost.

Although significant delays or losses of data are rare when wireless devices such as the SIMCom modem are used in a normal manner with a well-constructed network, the SIMCom modem should not be used in situations where failure to transmit or receive data could result in damage of any kind to the user or any other party, including but not limited to personal injury, death, or loss of property. SIMCom and its affiliates accept no responsibility for damages of any kind resulting from delays or errors in data transmitted or received using SIMCom modem, or for failure of the SIMCom modem to transmit or receive such data.

**Safety caution**

| Marks | Requirements |
|---|---|
|  | When in a hospital or other health care facility, observe the restrictions about the use of mobiles. Switch the cellular terminal or mobile off, medical equipment may be sensitive to not operate normally for RF energy interference. |
|  | Switch off the cellular terminal or mobile before boarding an aircraft. Make sure it is switched off. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communication systems. Forget to think much of these instructions may lead to the flight safety or offend against local legal action, or both. |
|  | Do not operate the cellular terminal or mobile in the presence of flammable gases or fumes. Switch off the cellular terminal when you are near petrol stations, fuel depots, chemical plants or where blasting operations are in progress. Operation of any electrical equipment in potentially explosive atmospheres can constitute a safety hazard. |
|  | Your cellular terminal or mobile receives and transmits radio frequency energy while switched on. RF interference can occur if it is used close to TV sets, radios, computers or other electric equipment. |
|  | Road safety comes first! Do not use a hand-held cellular terminal or mobile when driving a vehicle, unless it is securely mounted in a holder for hands free operation. Before making a call with a hand-held terminal or mobile, park the vehicle. |
|  | GSM cellular terminals or mobiles operate over radio frequency signals and cellular networks and cannot be guaranteed to connect in all conditions, for example no mobile fee or a invalid SIM card. While you are in this condition and need emergent help, please remember using emergency calls. In order to make or receive calls, the cellular terminal or mobile must be switched on and in a service area with adequate cellular signal strength.<br>Some networks do not allow for emergency call if certain network services or phone features are in use (e.g. lock functions, fixed dialing etc.). You may have to deactivate those features before you can make an emergency call.<br>Also, some networks require that a valid SIM card be properly inserted in the cellular terminal or mobile. |

**Important Compliance Information for USA OEM Integrators**

The SIM900E modem is granted with a modular approval for mobile applications. Integrators may use the SIM900E modem in their final products without additional FCC (Industry Canada) certification if they meet the following conditions. Otherwise, additional FCC approvals must be obtained.

1. At least 20cm separation distance between the antenna and the user's body must be maintained at all times.
2. To comply with FCC/IC regulations limiting both maximum RF output power and human exposure to RF

radiation, the maximum antenna gain including cable loss in a mobile-only exposure condition must not exceed 4.5dBi for GSM850 band and 2.5dBi for GSM PCS band.

3. SIM900E modem and the antenna must not be co-located or operating in conjunction with any other transmitter or antenna within a host device.

4. A label must be affixed to the outside of the end product into which the SIM900E modem is incorporated, with a statement similar to the following:

   a. For SIM900E: This device contains FCC ID: UDV-SIM900E

A user manual with the end product must clearly indicate the operating requirements and conditions that must be observed to ensure compliance with current FCC RF exposure guidelines. The end product with an embedded SIM900E modem may also need to pass the FCC Part 15 unintentional emission testing requirements and be properly authorized.

Note: If this module is intended for use in a portable device, you are responsible for separate approval to satisfy the SAR requirements of FCC Part 2.1093