# SM-2700

# Technical Information Manual

**Version 0.2**

# Document Information

| | | |
|---|---|---|
| **Title** | SM-2700 | |
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# Notice

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# 1. Introduction

## 1.1. Scope

The purpose of this document is to explain the hardware technical information and specifications of the SM-2700, satellite module. This document will be helpful to third party designers and manufactuers.

## 1.2. Related documents

- SM-2700 User Terminal AT Command Set , Doc No. AP01-344-49
- GMR-1 05.05, and GMPRS-1 05.05 Radio Transmission and Reception. , Doc No. ETSI TS 101 376-5-5

## 1.3. Glossary

| Name | Definition |
|---|---|
| SAT | Satellite. |
| GPS | Global Positioning System |
| PA | Power Amplifier |
| GMR | GEO Mobile Radio |
| RF | Radio Frequency |
| UART | Universal Asynchronous Receive and Transmitt |
| RTC | Real Time Clock |
| GND | Ground |
| PCM | Pulse Code Modulation |
| I2C | Inter-IC Control |
| SIM | Subscriber Identity Module |
| GPIO | General Purpose Input Output |
| USB | Universal Serial Bus interface |
| PVT | Position, Velocity, Time |
| PCB | Printed Circuit Board |

## 1.4. Regulatory Certification

The SM-2700 is a regulatory approved daughter module transceiver that can be fitted within an enclosed host system. With appropriate external connections, the host system can be designed to meet full transceiver regulatory tests and sold as a Regulatory Certified product that meets CE.

| Regulatory Approvals | Radio Tests | EMC Tests | Electrical/Mechanical/Operational Safety Tests |
|---|---|---|---|
| CE | EN 301 681 | EN 301 489-1/-20 | EN 60950-1 |

## 1.5. Overview

The SM-2700 is combined to baseband, RF transceiver and power management unit. The SM-2700 is THURAYA Satellite RF Transceiver which is able to access satellite mobile services via the GMR-1 and GMPRS-1 air interface. Configured as one transmitter and one receiver, its operating frequency is L-band satellite frequency.

The following Figure1, 2 shows the outline of SM-2700 and external interfaces that SAT RF and GPS connector, 100 pins of board to board connector.

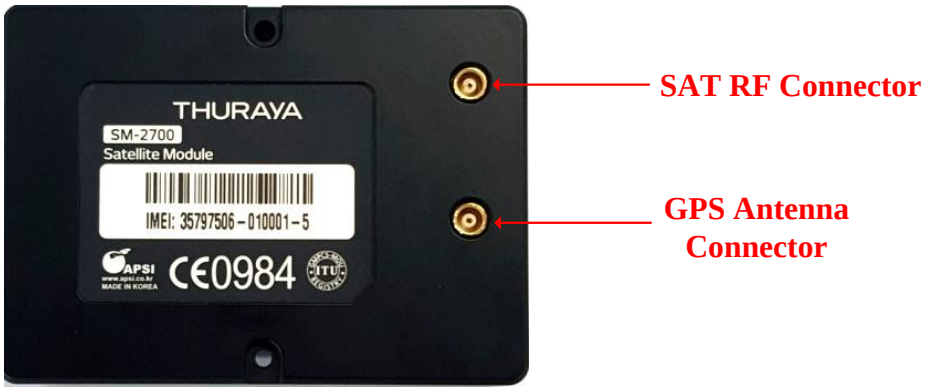



**Figure1 Top side**

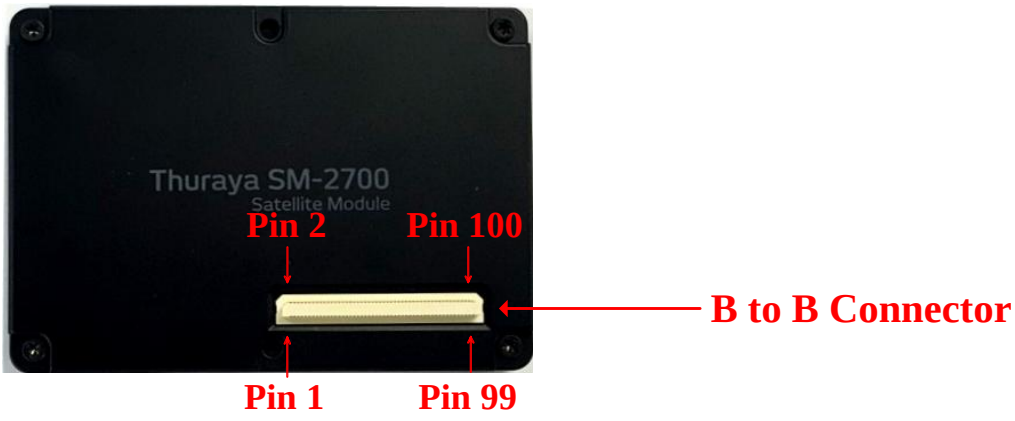



**Figure2 Bottom side**

# 1.6. Block diagram

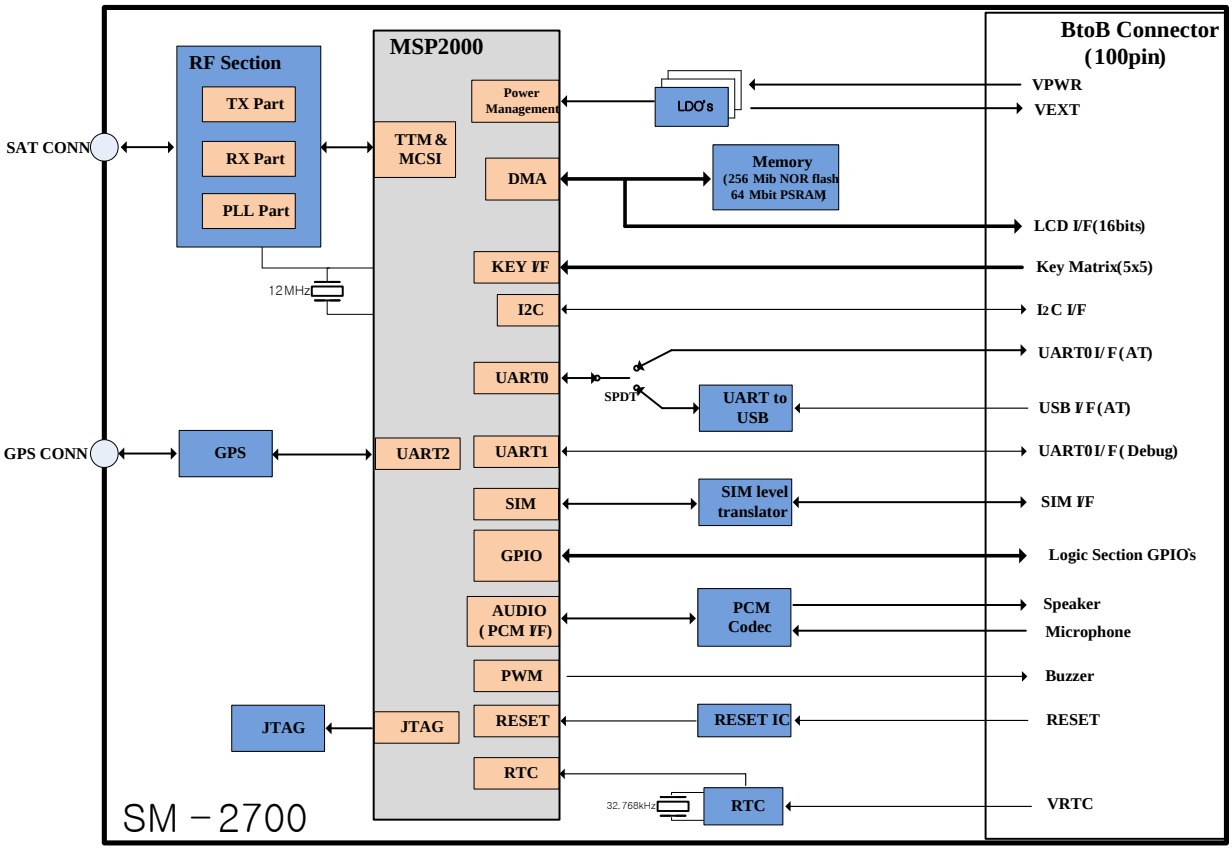



**Figure3 SM-2700 Block diagram**

The SM-2700 is a self-contained and compact product with 2 groups of interfaces:

a) The Baseband interface is provided on a Board-to-Board connector and contains power supply, control signals, accessory interfaces etc.

b) The RF interface is connected in a SAT section and a GPS Section.

# 2. Pin description

The SM-2700 has 100-pins B-to-B connector for interface with external device. Each pin, its designated function and interface is shown in Table 1 below.

**Table1 B-to-B Connector Pin Assignment**

| Num | Pin Name | Description | Num | Pin Name | Description |
|---|---|---|---|---|---|
| 1 | LCD_ D0 | LCD DATA 0 | 2 | KEY_ROW 0 | KEYPAD Row 0 |
| 3 | LCD_ D1 | LCD DATA 1 | 4 | KEY_ROW 1 | KEYPAD Row 1 |
| 5 | LCD_ D2 | LCD DATA 2 | 6 | KEY_ROW 2 | KEYPAD Row 2 |
| 7 | LCD_ D3 | LCD DATA 3 | 8 | KEY_ROW 3 | KEYPAD Row 3 |
| 9 | LCD_D4 | LCD DATA 4 | 10 | KEY_ROW 4 | KEYPAD Row 4 |
| 11 | LCD_D5 | LCD DATA 5 | 12 | KEY_COL 0 | KEYPAD Col 0 |
| 13 | LCD_D6 | LCD DATA 6 | 14 | KEY_COL 1 | KEYPAD Col 1 |
| 15 | LCD_D7 | LCD DATA 7 | 16 | KEY_COL 2 | KEYPAD Col 2 |
| 17 | /LCD_CS | LCD Chip Select | 18 | KEY_COL 3 | KEYPAD Col 3 |
| 19 | /LCD_RD | LCD Read | 20 | KEY_COL 4 | KEYPAD Col 4 |
| 21 | /LCD_WR | LCD Write | 22 | UART0_TXD | UART_TX |
| 23 | LCD_RS | LCD Data/Instruction Select | 24 | UART0_RXD | UART RX |
| 25 | LCD_D14 | LCD DATA 14 | 26 | UART0_CTS | UART CTS |
| 27 | /LCD_RESET | LCD RESET | 28 | UART0_RTS | UART RTS |
| 29 | LCD_D15 | LCD DATA 15 | 30 | UART0_DTR | UART DTR |
| 31 | LCD_DIM | LCD Backlight Dimming Control | 32 | UART0_DSR | UART DSR |
| 33 | KEY_BL_EN | KEYPAD Backlight Enable | 34 | UART0_DCD | UART DCD |
| 35 | GND | Ground | 36 | UART0_RI | UART RI |
| 37 | I2C_SCL | Serial Clock | 38 | UART1_TXD | UART TX |
| 39 | I2C_SDA | Serial Data | 40 | UART1_RXD | UART RX |
| 41 | /I2C_INT | Accessory Detection and Interrupt | 42 | UART1_CTS | UART CTS |
| 43 | LCD_D8 | LCD DATA 8 | 44 | UART1_RTS | UART RTS |
| 45 | LCD_D9 | LCD DATA 9 | 46 | LCD_D12 | LCD DATA 12 |
| 47 | LCD_D10 | LCD DATA 10 | 48 | LCD_D13 | LCD DATA 13 |
| 49 | LCD_D11 | LCD DATA 11 | 50 | GND | Ground |
| 51 | /SAT_RESET | SAT Module Reset | 52 | USB_DP | USB D+ |
| 53 | HOST_WAKE_UP | Host Wakeup | 54 | USB_DM | USB D- |
| 55 | HOST_STATE | Host state | 56 | USB_VBUS | USB Power |
| 57 | SAT_PWR_ON | SAT Module ON | 58 | SIM_DATA | SIM DATA |
| 59 | SAT_PWR_OFF | SAT Module OFF | 60 | SIM_CLK | SIM CLOCK |
| 61 | SAT_STATE | SAT Module State | 62 | SIM_RST | SIM RESET |
| 63 | SAT_WAKE_UP | SAT Module Wakeup | 64 | SIM_VDD | SIM POWER |
| 65 | VRTC | RTC Backup Battery | 66 | VEXT | 3V Ourput Power |
| 67 | GND | Ground | 68 | GND | Ground |
| 69 | GND | Ground | 70 | GND | Ground |

| | | | | | |
|---|---|---|---|---|---|
| 71 | N.C | Not connection | 72 | SPK- | Speaker Out - |
| 73 | VPWR | Main Power | 74 | SPK+ | Speaker Out + |
| 75 | VPWR | Main Power | 76 | GND | Ground |
| 77 | VPWR | Main Power | 78 | MIC- | Mic In - |
| 79 | VPWR | Main Power | 80 | MIC+ | Mic In+ |
| 81 | VPWR | Main Power | 82 | GND | Ground |
| 83 | GND | Ground | 84 | BUZZER | BUZZER Control |
| 85 | GND | Ground | 86 | GND | Ground |
| 87 | GND | Ground | 88 | GND | Ground |
| 89 | GND | Ground | 90 | GND | Ground |
| 91 | GND | Ground | 92 | GND | Ground |
| 93 | 5V_TX | RF TX 5V Power | 94 | 5V_TX | RF TX 5V Power |
| 95 | 5V_TX | RF TX 5V Power | 96 | 5V_TX | RF TX 5V Power |
| 97 | 5V_TX | RF TX 5V Power | 98 | 5V_TX | RF TX 5V Power |
| 99 | 5V_TX | RF TX 5V Power | 100 | 5V_TX | RF TX 5V Power |

**Table2 Pin functional and electrical description**

| PIN No. | PIN NAME | I/O | DESCRIPTION | Note | Electrical Spec. |
|---|---|---|---|---|---|
| **Power** | | | | | |
| 73, 75, 77, 79, 81 | VPWR | I | VPWR(5pin) is used as main power of the SM-2700 and allowed input power is +3.5~4.2V. Supply max current: 500 ㎃ | | $V_{Imax}$ = +4.2V<br>$V_{Imin}$ = +3.5V<br>$V_{Ityp}$ = +3.8V |
| 93 ~ 100 | 5V_TX | I | 5V_TX(8pin) is used as input power of RF power amplifier and allowed input power is +5.0V.<br>This power has to be low ripple noise and enable to supply 2.0A (at 5V) of peak voltage well when TX transmit burst. | | $V_{Ityp}$ = +5.0V |
| 65 | VRTC | I | VRTC is supply power to interior RTC block when VPWR is not supplied to SM-2700. | | $V_{INmax}$ = +3.3V<br>$V_{INmin}$ = +2.0V<br>$V_{INtyp}$ = +3V<br>$I_{dd}$ = 2mA(max) |
| 66 | VEXT | O | VEXT provides an internally generated DC power 3.0V which may be used on the host application board. Prohibit approving external load of above 200 ㎃ | | $V_{Omax}$ = +3.1V<br>$V_{Omin}$ = +2.9V<br>$V_{Otyp}$ = +3.0V<br>$I_{OLmax}$ = 200 ㎃ |
| 35,50,67 ~70,76, 82~83, 85~92 | GND | | Ground | | |
| **I2C I/F** | | | | | |
| 37 | I2C_SCL | O | I2C serial clock output. | Internal 1.2K Pull up | $V_{typ}$ = 3.3V |

| | | | | | |
|---|---|---|---|---|---|
| 39 | I2C_SDA | I/O | I2C serial bi-directional data. | Internal 1.2K Pull up | $V_{typ}$ = 3.3V |
| **LCD I/F** | | | | | |
| 1,3,5,7,9,11,13,15,25,29,43,45~49 | LCD_D[0:15] | I/O | 16bit bi-directional data bus for LCD data | | |
| 17 | /LCD_CS | O | LCD chip select output pin. Data/Iinstruction is enabled when LCD_CS is low level. | | |
| 19 | /LCD_RD | O | Servers as a read strobe signal and read data at the low level. | | |
| 21 | /LCD_WR | O | Servers as a write strobe signal and write data at the low level. | | |
| 23 | LCD_RS | O | Data/Instruction select output pin H:LCD_D[0:15] are display data L: LCD_D[0:15] are instruction data | | |
| 27 | /LCD_RESET | O | LCD reset output pin. When /LCD_RESET is low level, initialization is executed. | | |
| 31 | LCD_DIM | O | White LCD to backlight of LCD module dimming control pin. | | |
| **KEY I/F** | | | | | |
| 2,4,6,8,10 | KEY_ROW[0:4] | I | Row line input pin of keypad matrix. | | |
| 12,14,16,18,20 | KEY_COL[0:4] | O | Column line input pin of keypad matrix. | | |
| 33 | KEY_BL_EN | O | Keypad backlight enable output pin. | Active high | $V_{typ}$ = 3.3V |
| **UART0 (AT command) I/F** | | | | | |
| 22 | UART0_TXD | O | UART0 serial data output. | | $V_{typ}$ = 3.3V |
| 24 | UART0_RXD | I | UART0 serial data input. | | $V_{typ}$ = 3.3V |
| 26 | UART0_CTS | I | UART0 clear to send input. | | $V_{typ}$ = 3.3V |
| 28 | UART0_RTS | O | UART0 request to send output. | | $V_{typ}$ = 3.3V |
| 30 | UART0_DTR | O | UART0 data transmit ready output. | | $V_{typ}$ = 3.3V |
| 32 | UART0_DSR | I | UART0 data set ready input. | | $V_{typ}$ = 3.3V |
| 34 | UART0_DCD | O | UART0 data carrier detect output. | | $V_{typ}$ = 3.3V |
| 36 | UART0_RI | O | UART0 ring indicator output. | | $V_{typ}$ = 3.3V |
| **UART1 (Debug) I/F** | | | | | |
| 38 | UART0_TXD | O | UART1 serial data output. | | $V_{typ}$ = 3.3V |
| 40 | UART0_RXD | I | UART1 serial data input. | | $V_{typ}$ = 3.3V |

| | | | | | |
|---|---|---|---|---|---|
| 42 | UART0_CTS | I | UART1 clear to send input. | | $V_{typ}$ = 3.3V |
| 44 | UART0_RTS | O | UART1 request to send output. | | $V_{typ}$ = 3.3V |
| **Logic section GPIO`s** | | | | | |
| 41 | / I2C_INT | I | External I2C device detect and interrupt input. If unused, this pin must be left unconnected. | Internal 10K Pull up / Active Low | Vtyp = 3.3V |
| 51 | / SAT_RESET | I | Input pin to initialize the SM-2700. Reset signal is internally controlled on start-up to achieve always a proper power-on reset sequence, so there's no need to control this pin on start-up at external circuit. | Active Low | Vtyp = 3.3V |
| 53 | HOST_WAKE_UP | O | In HOST device sleep condition, Output pin to wake HOST up before sending data to SM-2700. | Active High | Vtyp = 3.3V |
| 59 | SAT_PWR_OFF | I | Input pin that to power off the SM-2700. | Active High | Vtyp = 3.3V |
| 57 | SAT_PWR_ON | I | Input pin that to power on the SM-2700. | Active High | Vtyp = 3.3V |
| 55 | HOST_STATE | I | Informs the status of the HOST to SM-2700. | Active High | Vtyp = 3.3V |
| 61 | SAT_STATE | O | Informs the status of the SM-2700 to HOST. | Active High | Vtyp = 3.3V |
| 63 | SAT_WAKE_UP | I | In SM-2700 sleep condition, Output pin to wake SM-2700 up before sending data to HOST. | Active High | Vtyp = 3.3V |
| **USB I/F** | | | | | |
| 56 | USB_VBUS | I | USB device detection input. | | Vtyp = 5V |
| 52 | USB_DP | I/O | USB data plus | | |
| 54 | USB_DM | I/O | USB data minus | | |
| **Audio** | | | | | |
| 74 | SPK+ | O | Positive speaker output. | | |
| 72 | SPK- | O | Negative speaker output. | | |
| 80 | MIC+ | I | Positive mic input. | | |
| 78 | MIC- | I | Negative mic input. | | |
| 84 | BUZZER | O | This pin is used to control a buzzer which is output of PWM signal. | | Vtyp = 3.3V |
| **SIM I/F** | | | | | |
| 40 | SIM_CLK | O | SIM card serial clock. | | 1.8V / 3.0V |
| 42 | SIM_DATA | I/O | SIM card serial data. | | 1.8V / 3.0V |
| 44 | SIM_RST | O | SIM card reset. | | 1.8V / 3.0V |
| 46 | SIM_VDD | O | Supply voltage for SIM card. | | 1.8V / 3.0V |

# 3. Specifications

## 3.1. Power management

The main power supply of SM-2700 is composed as dual voltage sources of VPWR and 5V_TX.
5V_TX provides power of internal RF power amplifier. And it is divided because it can be affect to the other circuit such as audio by outbreak of TDMA ripple noise, which is caused by peak current during TX burst.
VRTC is the Real Time Clock(RTC) supply of SM-2700 and The VEXT of SM-2700 provides an internally generated supply rail output for digital interfaces.
Required power supply specification is described in follow.

### 3.1.1. VPWR

The SM-2700 must be supplied through the VPWR pins by a DC power supply.
VPWR is main power source supplied at entire circuit except PA power in SM-2700.
Interior all power supply are derived from this power source.
The voltage range is from 3.5V to 4.2V.

| Pin Name | $V_{MIN}$ | $V_{Typ}$ | $V_{MAX}$ | Comments |
|---|---|---|---|---|
| VPWR | 3.5 V | 3.8 V | 4.2 V | Maximum current : 500mA |

The internal ASIC in the SM-2700 is detect voltage level of these pins.
If these pins are below 3.5V, the SM-2700 is power off. When you design the power supply applications, it must be connected with the power source be able to provide sufficient current to rated 500㎃.
User can read the voltage level of these pins as using AT command.

### 3.1.2. 5V_TX

5V_TX is main power source for internal PA (power amplifier) in SM-2700.
In some case, the ripple in a transmit burst may cause voltage drops when current consumption rises to typical peaks of 2.0A (5V), so the power supply must be able to provide sufficient current up to 2.0A.
These pins shouldn't be drops below 5.0V. If the voltage of these pins is below 5.0V, module will not processing the call.
The best way to reducing voltage drops is using the low impedance power source including power supply lines and ESR value of the bypass capacitors.
We recommend that you use linear regulators what has low ripple noise and good transient response as source power.
5V_TX input capacitor depends on the impedance of the source supply and input power ripple.
To satisfy this high RMS current demand, two 47 ㎌ (16V) are required.

Power consumption timing diagrams is in figure 4 at talk time.

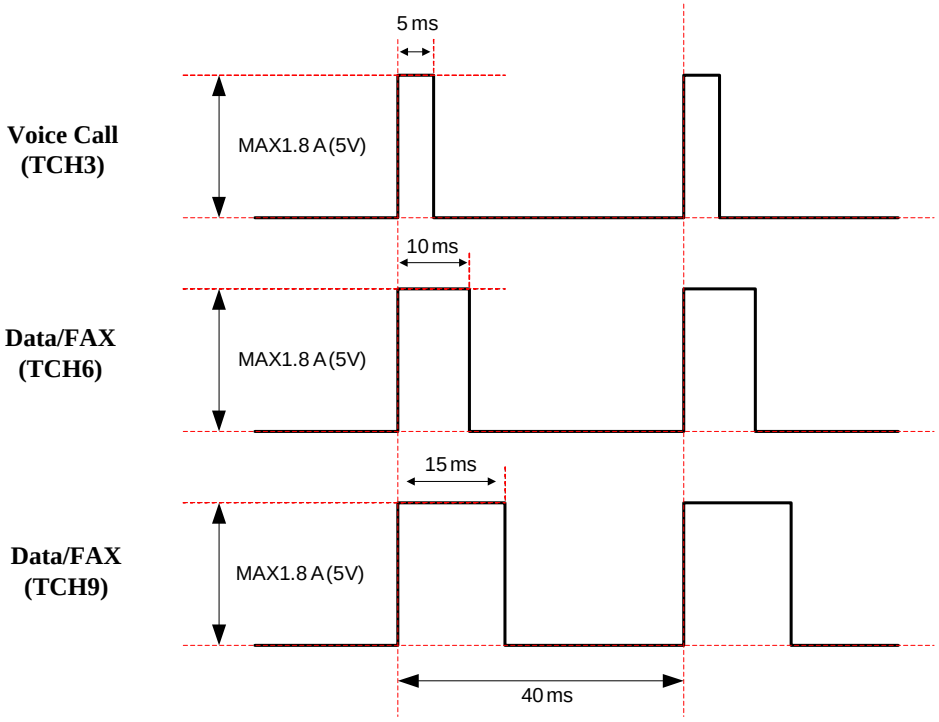



**Figure 4 5V_TX timing diagrams on each talk mode**

User should select power device by regarding the following items as suitting to the character of each power when designs power supply.

1. Ripple noise should be ignorable
2. Transient response should be good quality
3. Whether output current enable to support enough current to each PIN
4. Whether accuracy is guaranteed
5. Whether PCB space suit to the condition required
6. Whether proper cost is required

## 3.1.3. Power supply solutions of various application

There are some alternative devices for the SM-2700 power supply solutions. The most common are described in below.

- Linear voltage regulators (Section 3.1.3.1)
- Switched DC/DC converter (Section 3.1.3.2)
- 1-cell Li-Ion battery (Section 3.1.3.3)
- Power Supply design Examples(Section 3.1.3.4)

### 3.1.3.1. Linear voltage regulators

Linear regulators has good quality of ripple noise and output accuracy, so power supply with linear regulators is easy to design, and the total cost for the components can be low, but when the difference between the input voltage and the output voltage is a high, its efficiency is so bad .
Ideally if the desired output voltage is 5V and the input voltage is 15V, ideal 10V goes away as heat, so efficiency is only 30%. Therefore linear voltage regulator is necessary to effective cooling element in case of big power dissipations.
We recommend using linear voltage regulators when the difference between the input voltage and the output voltage is below 1V.
LDO Input is applicable to single power which has voltage of 5V. Connect VPWR after putting voltage down as 3.8V by using LDO.
Attension to the following contents that LDO should be selected that enable to supply current of 500mA at VPWR well.

### 3.1.3.2. Switched DC/DC converter

A switched DC/DC converter is very often used when there are requirements for high efficiency.
There are instead a lot of other things to consider when design with switched DC/DC converter.

- Need to many parts of inductor, diode, big size capacitor etcs.
- PCB artwork must be very well because around a switched DC/DC converter there are magnetic fields, which can create disturbances to other electronic circuits.
- Circuit is designed that it is suppressed the ripple noise created by switching of MOSFET.

### 3.1.3.3. Battery

1-cell Li-Ion battery is general power equipment which is mostly used at the handheld goods.

When using a Li-Ion battery, the battery must be able to deliver all necessary power range to SM-2700. The pack incorporates a protection circuit capable of detecting overvoltage (protection against overcharging), undervoltage (protection against deep discharging) and overcurrent. Overcurrent detecting range should be setted as supply sufficient current

The internal resistance of the battery and the protection circuits should be as low as possible because internal resistance is very proportioned the voltage drop. It is recommended not to exceed 100mΩ, even under extreme conditions at low temperature. The battery pack must be approved to satisfy the requirements of CE.

### 3.1.3.4. Power Supply Design Examples

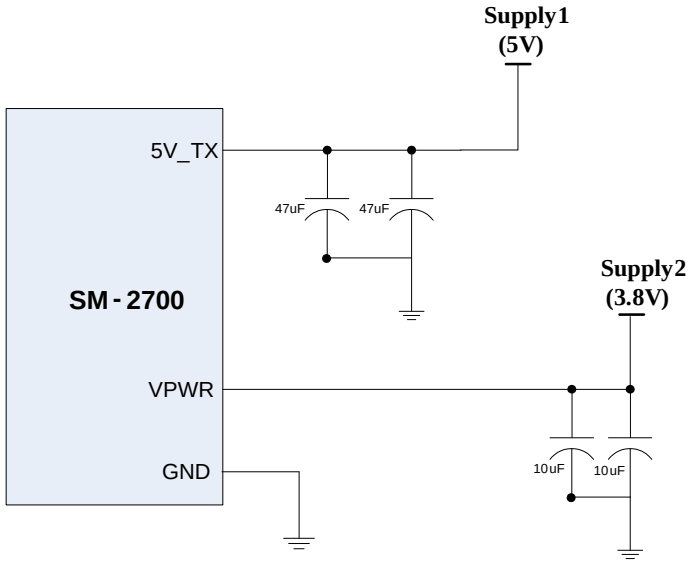



**Figure5 Dual power source reference circuit**

The example above is applicable to the power which has double voltage such as 5V and 3.8V. By this way, user enables to design in the simplest way and to get the best character.

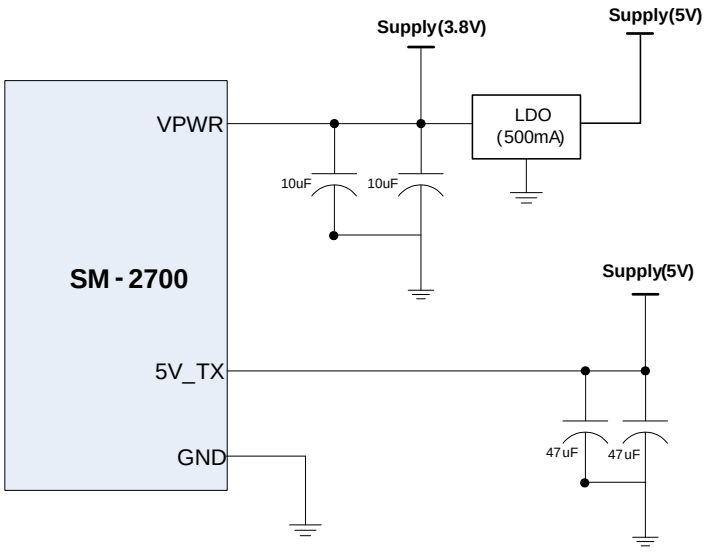



**Figure6 Single 5V power source reference circuit**

The example above is applicable to single power which has voltage of 5V. Connect main power and 5V_TX directly, and connect VPWR after putting voltage down as 3.8V by using LDO.

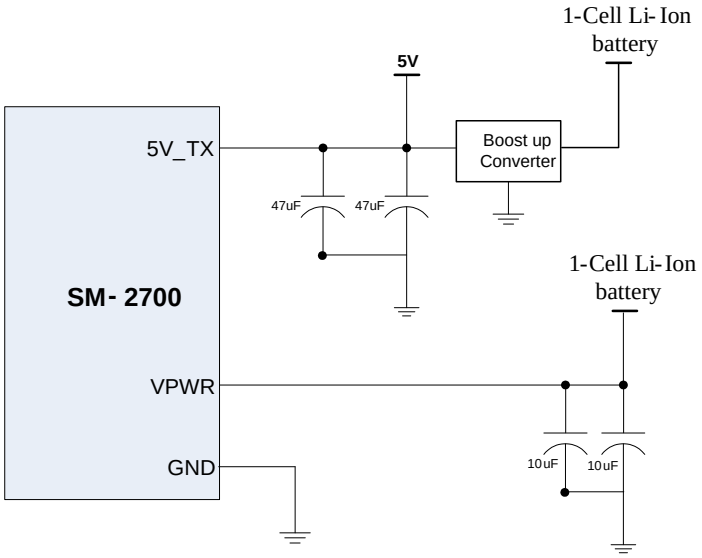



**Figure7 1-Cell Li-Ion battery power source reference circuit**

Main source power is directly connected wich VPWR. Procedure should be able to supply enough current to the entire system. Main source power is directly connected wich VPWR and boost-up converter is used to allow the voltage which is proper to 5V_TX. Procedure should be able to supply enough current to the entire system, and boost-up converter should be constituted by the parts which enables to supply enough current to 5V_TX.

## 3.1.4. VRTC

RTC (Real Time Clock) power of SM-2700 is supplied by VRTC pin of board-to-board connector. VRTC is used as the power souce of internal RTC block.

| **Pin Name** | **$V_{MIN}$** | **$V_{Typ}$** | **$V_{MAX}$** | **Comments** |
|---|---|---|---|---|
| VRTC | 2.0 V | 3.0 V | 3.3 V | Maximum current : 2mA |

External backup battery should be connected at VRTC pin because there's no supply of internal power in VRTC pin. When RTC backup battery is not used, it should be connected with VEXT. If this pin isn't connected with any power source, a RTC Block of SM-2700 doesn't operate.
Here are various examples of external backup battery interface.
If used to super-capacitor or rechargeable battery, There must be connected with external power management circuit because there is not battery charging circuit in inside of SM-2700.
R, C, LDO and Diode should be used suitable value to specifications of rechargeable.

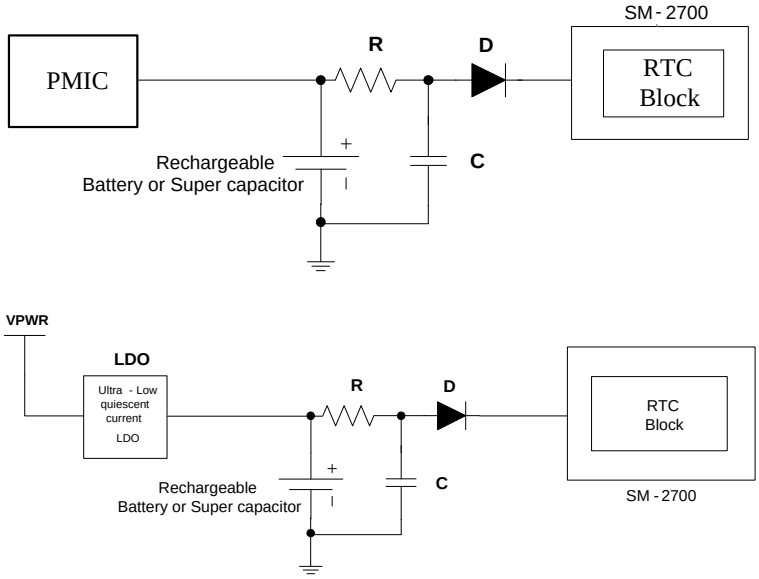



**Figure8 External RTC battery charging circuit examples**

## 3.1.5. VEXT

VEXT provides an internally generated DC power 3.0V which may be used on the host application board. Prohibit approving external load of above 200 mA

| Pin Name | $V_{MIN}$ | $V_{Typ}$ | $V_{MAX}$ | Comments |
|---|---|---|---|---|
| VEXT | 2.9 V | 3.0 V | 3.1V | Maximum current : 200mA |

## 3.2. Absolute Maximum Ratings

Stressing the device above one or more of the ratings listed in the Absolute Maximum Rating section may cause permanent damage. These are stess ratings only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification are not implied. Exposure the absolute maxmum rating conditions for extended periodes may affect device reliability.

| **Absolute Maximum Ratings** | |
|---|---|
| **Parameter** | **RATING** |
| VPWR | ~ 4.5V |
| 5V_TX | ~5.0V |
| VEXT | ~ 3.1V |
| VRTC | ~ 3.3V |
| All other Analog I/O voltage pins to GND | ~ 3.6V |
| Digital I/O voltage to GND | ~ 3.6V |
| Operating temperature range | -20℃ to +70℃ |
| Storage temperature range | -40℃ to +85℃ |

## 3.3. DC Electrical Specification

| **Parameter** | **Description** | **Min** | **Nominal** | **Max** | **Unit** |
|---|---|---|---|---|---|
| VPWR | Main Power | 3.5 | 3.8 | 4.2 | V |
| 5V_TX | RF Power amplifier | - | 5.0 | - | V |
| VRTC | Backup power | 2.0 | 3.0 | 3.3 | V |
| VEXT | Power to supply external 3V | 2.9 | 3.0 | 3.1 | V |
| $V_{IH}$ | High Level Input Voltage | 2.0 | 3.3 | 3.6 | V |
| $V_{IL}$ | Low Level Input Voltage | - | - | 0.8 | V |
| $V_{OH}$ | High Level Output Voltage | 2.4 | 3.3 | | V |
| $V_{OL}$ | Low Level Output Voltage | - | - | 0.4 | V |
| $I_{OL}$ / $I_{OH}$ | Rated Output Current | TBD | - | - | mA |

# 4. Control signals

## 4.1. Logic Section Control Signals

There are 7-pins for control the SM-2700. It is pins for SAT_PWR_ON, SAT_PWR_OFF, /SAT_RESET, SAT_WAKE_UP, HOST_WAKE_UP, SAT_STATE, HOST_STATE.
The status of SM-2700 and HOST is shown in Figure 9 according to each of the control signals timing.

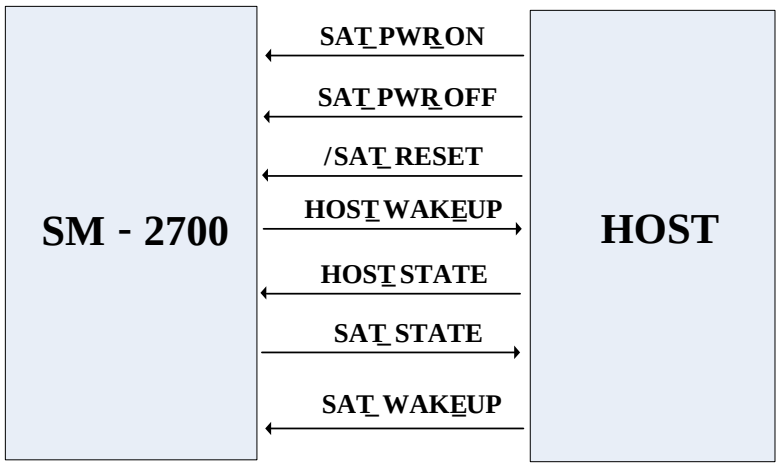



**Figure9 Connection diagram of Logic Section control signals**

Functions of each control pin are described in the following section.

### 4.1.1. SAT_PWR_ON

The input signal of SAT_PWR_ON is provided to allow when the SM-2700 is powered off. This signal controls the power regulators on the SM-2700. When the SAT_PWR_ON holds high during minimum 50m/s, the SM-2700 starts up after VPWR power is applied.

A timing diagram for this signal is shown in Figure 10.

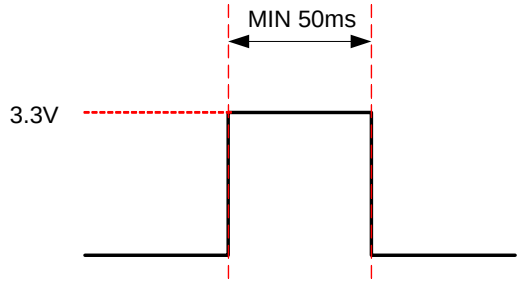



**Figure10 Turn on & off timing diagram**

## 4.1.2. SAT_PWR_OFF

This signal controls the power off in the SM-2700. When the SAT_PWR_OFF holds high during minimum 50m/s, the SM-2700 is power off.
A timing diagram for this signal is shown in Figure 10.

## 4.1.3. SYSTEM_ RESET

/SAT_RESET is used to reset the SM-2700. Whenever this signal is pulled low, the SM-2700 is reset.
The SM-2700 provides two methods for the system reset. One is software reset by using AT command, and another is hardware reset by /SAT_RESET signal.
When user should reset the SM-2700, it can be executed by using AT command at host generally. But if there is no reaction at uart port because of misoperation of the SM-2700, reset process can be done by the method of hardware as follow:

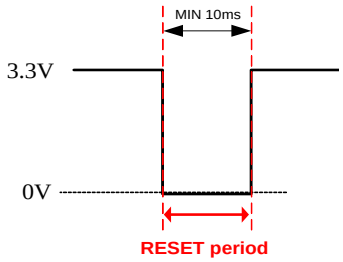



**Figure11 System reset timing diagram by using /SAT_RESET**

The picture above tells the time which executing system reset by using /SAT_RESET signal.
SM-2700 became reset if /SAT_RESET signal is maintained as low level during about 10ms. But VPWR pin should be maintained as High during SM-2700 reset period because when /SAT_RESET signal falls by low level, SM-2700 become shut down.

## 4.1.3.1. Feature of /SAT_RESET pin

/SAT_RESET signal is connected by input signal of manual reset of internal reset block. This procedure prolongs maintaining time of /RESET by low level during booting status because Reset generator chip which is executing inside is connected each other.

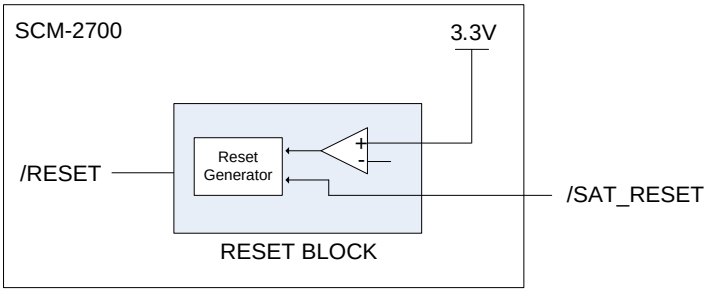



**Figure12 Function diagram of RESET GENERATOR**

When boot up of the SM-2700, Reset signal is generated by internal circuit to fit the processor reset timing as Figure 11, so it doesn't need to generate at external circuit.

## 4.1.4. HOST_WAKE_UP

This signal is used for waking up HOST before data transmission to prevent loss of data delivered from the SM-2700 in HOST sleep status.
If HOST enables to enter into sleep status, connect pin which enable to execute high level interrupt wake up function with HOST_WAKE_UP signal to prevent error during transfer of data to HOST.
If this signal is High level, host is a wake up status

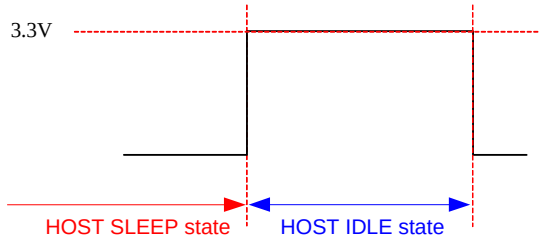



**Figure13 HOST_WAKE_UP timing diagram**

## 4.1.5. HOST_STATE

This signal is used for informing current condition of HOST to the SM-2700.
If this signal is high level, HOST is status of IDLE(wake_up). In the opposite case, it is status of sleep as shown in Figure 14.
Before the data is transmitted from the SCM-2700 to HOST, the SM-2700 must know a state of HOST to prevent loss of data.

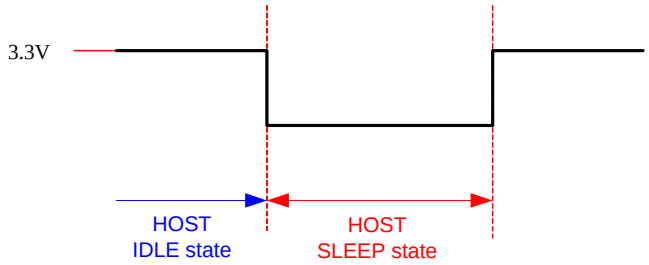



**Figure14 HOST_STATE timing diagram**

## 4.1.6. SAT_WAKE_UP

This signal is used for waking up the SM-2700 before data transmission to prevent loss of data delivered from HOST in the SM-2700 sleep status.
If user make this signal as rising high when the SM-2700 is status of sleep, it is awaked from sleep condition. If user is not used sleep mode, this pin is always must maintain high level.
Detail timing diagram is shown in Figure 15.

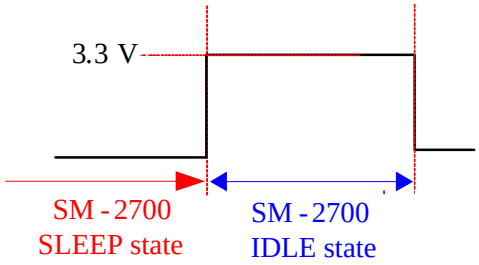



**Figure15 SAT_WAKE_UP timing diagram**

## 4.1.7. SAT_STATE

This signal is used for informing current condition of the SM-2700 to HOST.
If this signal is high level, the SM-2700 is status of IDLE(wakeup). In the opposite case, it is status of sleep as shown in Figure 16.
Before the data is transmitted from HOST to the SM-2700, HOST must know a state of SM-2700 to prevent loss of data.

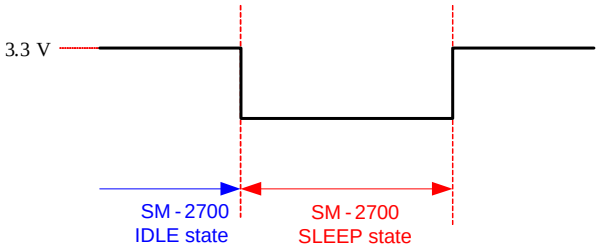



**Figure16 SAT_STATE timing diagram**

# 5. UART Interface

The SM-2700 provide the following UART communication interfaces.

- UART 0 : UART0(8pin) interface available on SM-2700 for AT commands interface, data communication, FW upgrades.
- UART 1: UART1(2pin) interface available on SM-2700 for trace log capture(Debug purpose)

Driving current of each pin and voltage level of UART port are as follows.

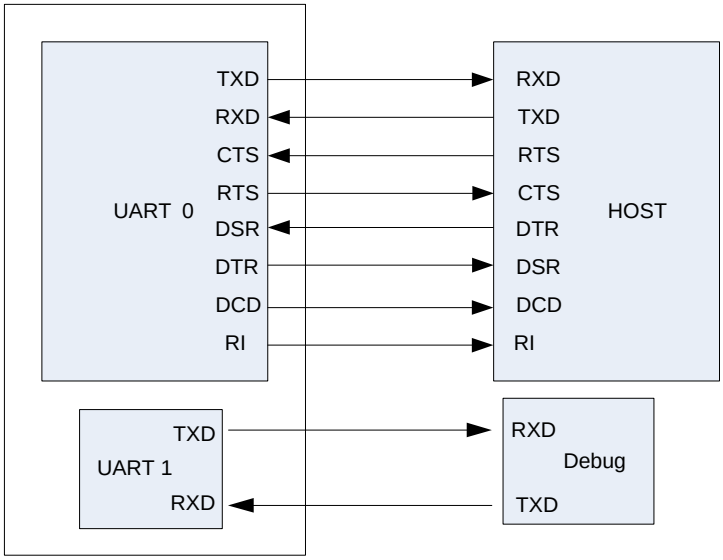



**Figure17 UART connection block diagram**

## 5.1. UART0

8-pin full port interface:TXD, RXD, CTS, RTS, DTR, RI, DSR, DCD
This signal is used as a port to control SM-2700 by using AT command and to transmit DATA/FAX.
Transferred baud rate that supported 115200bps.

## 5.2. UART1

2-pin port interface: TXD, RXD. This signal is used for communicating to debug SM-2700.
Transferred baud rate that supported 115200bps.

# 6. USB Interface

The SM-2700 provide the following USB communication interfaces.
The USB interface is connected to the UART0 interface trough UART to USB chip .
TheUSB interface available on SM-2700 for AT commands interface, data communication, FW upgrades.

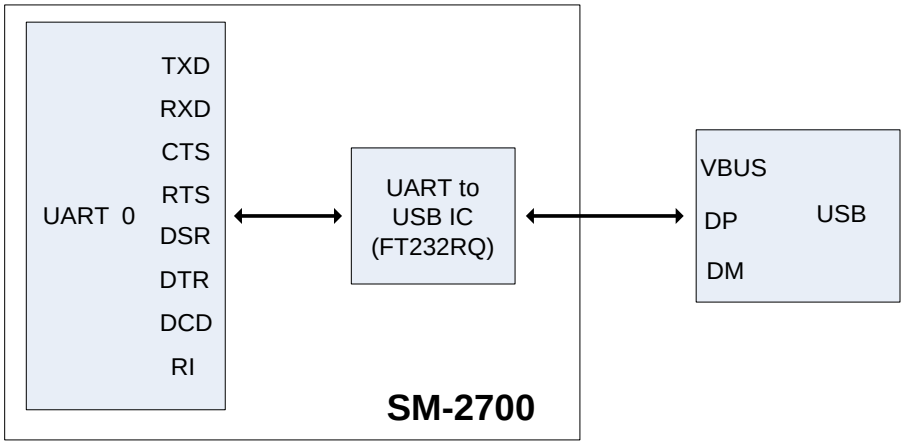



**Figure18 USB connection block diagram**

** NOTE*
*UART to USB chip IC (FT232RQ) of FTDI co.( http://www.ftdichip.com/)*

# 7. AUDIO Interface

## 7.1. Analog Audio Interface

The analog audio interface consists of differential microphone inputs (MIC+, MIC-) and differential earphone outputs (SPK+, SPK-).
If it is connected to microphone or speaker directly, External audio circuitry should be included ESD, RF by pass capacitors and MIC Bias,
Mic Bias voltage is shown in the diagram but not stated here.
Anlog interface can be affected by the demodulation of 1600 MHz RF frequency from the own antenna. Semiconductors are the main source of RF-Rectification. This causes stray voltages to be induced into the external interfaces.
It is recommended to use a microphone with a sensitivity of at least -44±dB/Pa at 2V and 2kΩ(0dB=1V/Pa, 1kHz). It should be equipped with an internal EMI capacitor for 1600 MHz bands. This should say that small value surface mount capacitors should be used to decouple the transmit RF. Even a high-quality microphone should be placed at least 10 cm away from the antenna. Other audio problems may be due to insufficient filtering of power supply and different GND levels between PCBs. Some detail about grounding requirements and schemes is required along with detail of power supply filtering requirements.

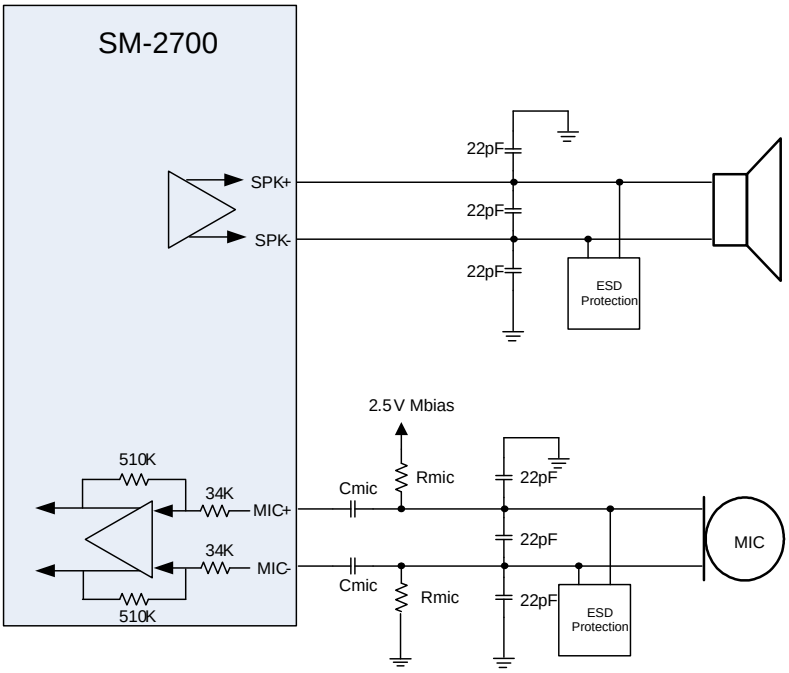



**Figure19 Analog audio interface**

## 7.2. Principles of MIC & SPK

SM-2700 has no internal mic bias, therefore you should compose a balanced microphone feed. to the module's audio input (MIC+/-) as shown in figure 19. The microphone signal is very sensitive to any disturbances from the power supply, poor ground or induced RF. A balanced microphone feed gives high common mode rejection and helps reduce RF induced standing voltages.

**Table3 MIC interface specification**

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|
| Input offset voltage at MIC | | -5 | | 5 | mV |
| Input bias current at MIC | | -300 | | 300 | nA |
| Input capacitance at MIC | | | 5 | | pF |
| MIC input referred noise | MIC amp 1 gain = 23.5 dB<br>MIC amp 2 gain = 0 dB | | 3 | 4.7 | μVrms |
| Output source current of MBIAS | | 1 | | 1.2 | mA |
| MIC bias supply voltage | | 2.3 | 2.5 | 2.65 | V |
| MICMUTE | | -80 | | | dB |
| Input impedance | Fully differential | 35 | 60 | 100 | kΩ |

The speaker signal is balanced because this is not a technical term. You are talking about ground

impedance variations RF induced voltages are reduced when balanced feeds are used in analog circuits due to the inherently high common mode rejection. Therefore the speaker feed should be balanced.

**Table4 Speaker interface specification**

| PARAMETER | TEST CONDITION | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|
| SPK AMP output power | VDD=3V, fully differential, 8Ω load, 3dB0 output, volume control=-3dB, RXPGA=-4dB level | | 161 | 200 | ㎽ |
| | VDD=3V, fully differential, 16Ω load, 3dB0 output, volume control=-3dB, RXPGA=-2dB level | | 128 | 160 | ㎽ |
| | VDD=3V, fully differential, 32Ω load, 3dB0 output, volume control=-3dB, RXPGA=-1dB level | | 81 | 100 | |
| Output offset voltage at SPK | | | 10 | 12.5 | ㎷ |
| Maximum output current for SPK | | | 141 | 178 | ㎃ |
| | | | 90 | 112 | |
| | | | 50 | 63 | |
| SPK MUTE | | -80 | | | dB |

## 7.3. Buzzer Interface

BUZZER pin in SM-2700 is used as incoming calling signal by operating external buzzer.

$V_{type}$ = +3.3V
IL = +1mA

Reference circuit is as below.

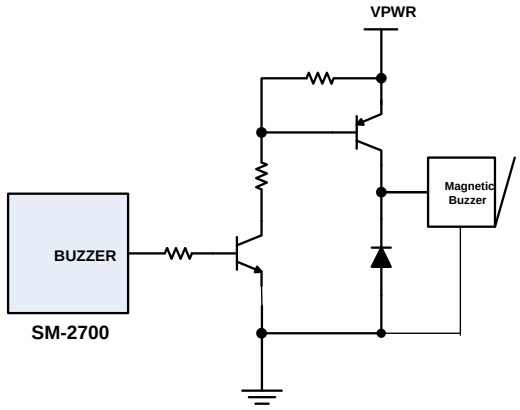



**Figure20 Buzzer interface refence circuit**

This signal is used as output of PWM signal.
We recommend Buzzer (TR-7520) of HS techvic co. (http://www.hstechvic.co.kr/)
If unused, this pin must be left unconnected.

# 8. SIM card Interface

The SM-2700 requires a SIM card to operate in SAT mode (except for emergency call).

Support to the standard plug-in SIM card as defined in ETSI standard GSM 11.11, as modified by GSM 11.12. Both 1.8V and 3.0V only SIM cards are supported.

**Table5 SIM card interface pins function description**

| | |
|---|---|
| **SIM_VDD** | SIM card power supply.<br>1.8V(MAX:±10%)/3V(MAX:±10%) SIM card auto detect, provided by SM-2700. |
| **SIM_CLK** | SIM card clock, provided by SM-2700 . |
| **SIM_RST** | SIM card reset, provided by SM-2700 . |
| **SIM_DATA** | SIM card data line, input and output. |

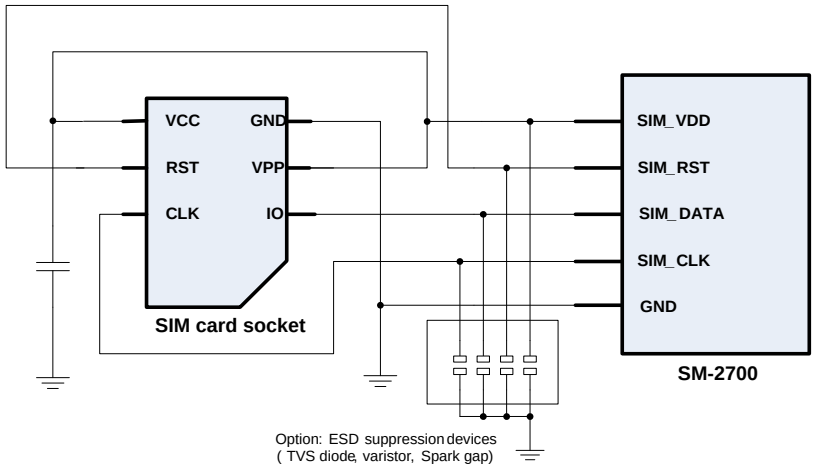



**Figure21 SIM interface reference circuit**

It is recommended that use external ESD protection device (varistor or TVS diode) for protection of SIM card, and the total cable length between the board-to-board connector pins on SM-2700 and the pins of the SIM card holder routes must satisfy the requirements of EMC compliance.

To avoid possible cross-talk from the SIM_CLK signal to the SIM_DATA signal be careful that both lines are not placed closely next to each other. A useful approach is using the GND line to shield the SIM_DATA line from the SIM_CLK line.

If you will use ESD suppression device, it should be placed in close to SIM card. It is recommended that NZQA6V8AXV5T1 (ON semiconductor: http://www.onsemi.com) as ESD suppresstion device.

# 9. LCD Interface

SM-2700 provides 22-pins interface with a LCD.
Specific characteristics are as below.

**Table6 LCD Specific Characteristics**

| Feature | | Spec |
|---|---|---|
| **Dispaly Spec** | Size | 2.0 inch |
| | Resolution | 176(RGB) x 220 |
| | Interface | CPU 16/8 bits |
| | Color Depth | 262K/65K |
| | Technology Type | a-Si |
| | Pixel Pitch(mm) | 0.180x0.180 |
| | Pixel Configuration | R.G.B. Vertical Stripe |
| | Display Mode | With Nomally White |
| | Surface Treatment(Up Polarizer) | Clear Type(3H) |
| | Viewing Direction | 6 o'clock |
| | Grey Scale Inversion Direction | 12 o'clock |
| **Mechanical Characteristics** | LCM(WxHxD) (mm) | 38.03x51.65x2.50 |
| | Active Area(mm) | 31.68x39.60 |
| | With/Without TSP | Without TSP |
| | Weight(g) | 8.15 |
| | LED numbers | 3 LEDs |
| **Electronic** | Driver IC | HX8340-B |

** NOTE*
*Support to Driver IC : (http://www.himax.com.tw)*

**Table7 LCD interface pins function description**

| PIN NAME | FUNCTION DESCRIPTION |
|---|---|
| LCD_D0 ~ D15 | LCD data bit 0 ~ 15 |
| LCD_CS | LCD chip select (Active LOW) |
| LCD_RS | Data/Instruction select (H:data, L:instruction) |
| LCD_WR | LCD data write enable (Active LOW) |
| LCD_RD | LCD data read enable (Active LOW) |
| LCD_DIM | White LCD to backlight of LCD module dimming control pin. |
| LCD_ RESET | LCD reset (Active LOW reset) |

# 10. Keypad

## 10.1. Keypad interface

SM-2700 provides keypad interface of 5*5 matrix scan method.
All of functions of module can be controlled by keypad.
Method of keypad interface and functions of each key are as below.

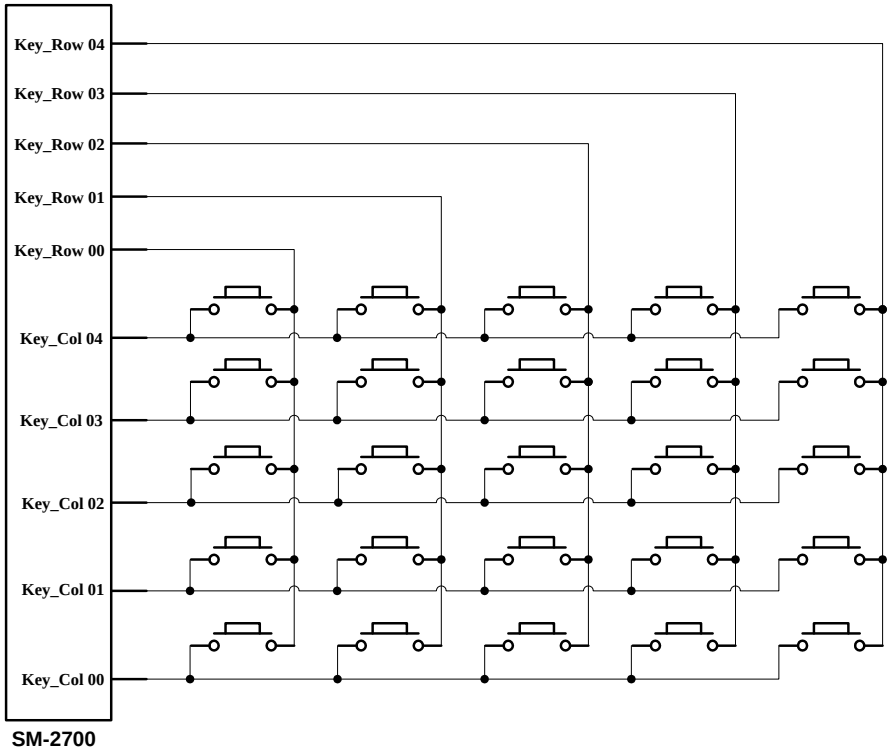



**Figure22 Keypad interface reference circuit**

**Table8 Keypad functional mapping table**

| | Key_row00 | Key_row01 | Key_row02 | Key_row03 | Key_row04 |
|---|---|---|---|---|---|
| **Key_col00** | RESERVE | * | 0 | # | RIGHT |
| **Key_col01** | RESERVE | 7 | 8 | 9 | LEFT |
| **Key_col02** | RESERVE | 4 | 5 | 6 | CENTER |
| **Key_col03** | RESERVE | 1 | 2 | 3 | DOWN |
| **Key_col04** | MENU | SELECT | SEND | END | UP |

## 10.2. Keypad backlight interface

KEYPAD_BL_EN pin is used for ON/OFF of external keypad's backlight.
When the key is pressed, backlight is placed at ON and then OFF several moments later.

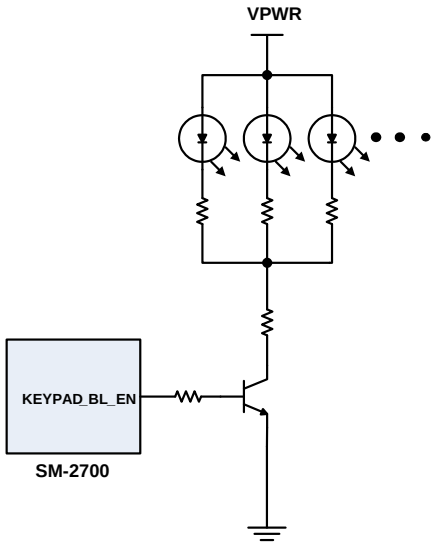



**Figure23 Keypad backlight interface reference circuit**

# 11. Power_Class_Control

The SM-2700 offers power class control pins that assigned to each power class are as follow.
The power class is control by I2C device interfaces.
The I2C bus is compliant to Philips I2C-bus specification version 2.1 and support standard mode (up to 100kbps) and fast mode (up to 400kbps).

12C port of SM-2700 is used for controlling power class that suits for application purpose that module is used.
IC that is supposed to interface classified by class from the outside is the product of Philips Co. (http://www.semiconductors.philips.com) as follow.

Class1~8: PCF8574
Class9~16: PCF8574A

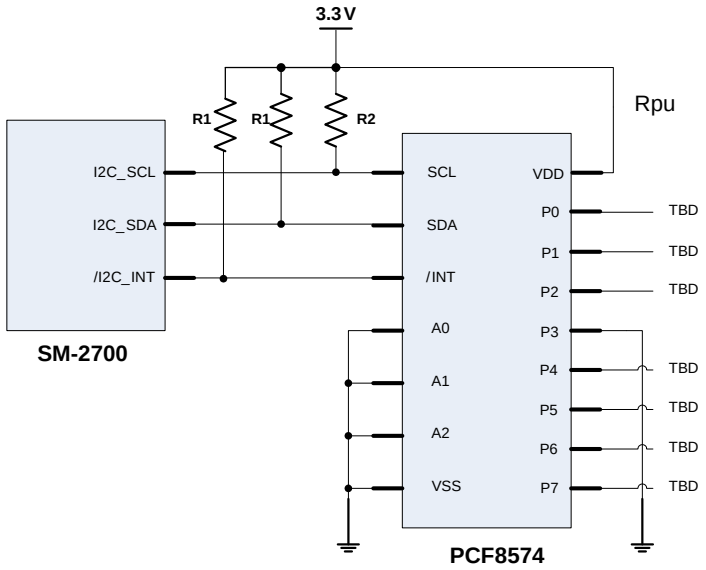



**Figure24 I2C device interface reference circuit (EX. power class 1)**

** NOTE*

*It is recommended to use that R1 is 470Ω and R2 is 100 kΩ when PCF8574 or PCF8574A is connected with I2C interface lines.*

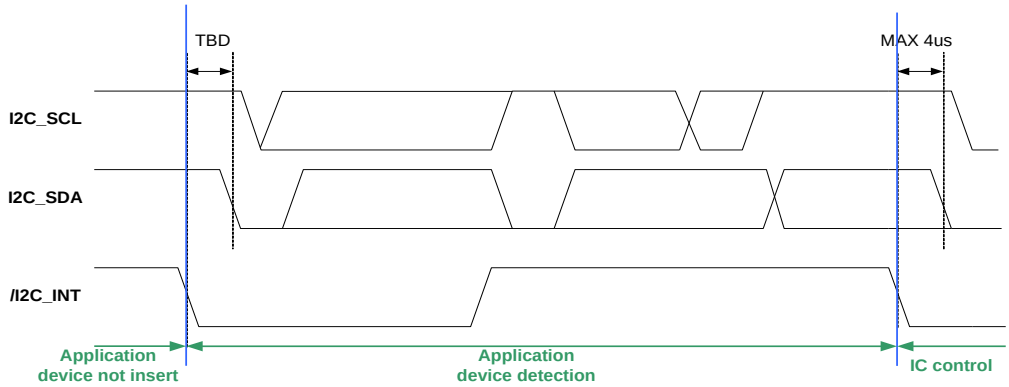



**Figure25 I2C device interface timing diagram (EX. power class 1)**

There are 3 types of mode like the above of timing.

1. Application device not detect: This is the situation of not connecting the IC with 12C port and all of the 12C_SCL, 12C_SDA and /12C_INT is at the high level condition. If connection is done but the power at IC (PCF8574) is not permitted, be sure to permit the power on IC at connection condition because SM-2700 is not booting.
2. Application device detection: When /12C_INT is placed at first low SM-2700 recognizes exterior device, understands kind of exterior device by scanning 16 addresses and provides setting of power class. To maintain low level of /INT when IC (PCF8574, PCF8574A) is booted, IO has to stay at low level. For more information, refer to the IC datasheet.
3. /12C_INT uses as different interrupting signal at input change that appointed as IO port among the IO port of IC (PCF8574, PCF8574A)

12C device addresses that assigned to each power class are as follow.

**Table9 Device address table assigned by power class**

| Power Class | Minimum EIRP(dbw) | Maximum EIRP(dbw) | G/T | Application | I2C device addresses |
|---|---|---|---|---|---|
| 1 | 5 | 7 | -24 | UT, Handheld, Data terminal C, Data Cable | 0100 000X |
| 2 | 5 | 7 | -24 | Vehicular, No adjustable antenna | 0100 001X |
| 3 | 7 | 11 | -22 | Vehicular, Adjustable Antenna | 0100 011X |
| 4 | 7 | 11 | -22 | Vehicular, Adjustable Antenna | 0100 101X |
| 5 | 7 | 11 | -22 | Maritime Antenna | 0100 110X |
| 6 | 5 | 9 | -18 | Fixed | 0100 010X |
| 7 | 5 | 9 | -18 | PCO | 0100 111X |
| 8 | 9.1 | 14.9 | -16.2 | Data terminal A & B | Not used |
| 9 | 5 | 7 | -24 | External Encrypter | 0111 000X |
| 10 | Reserved | Reserved | Reserved | Reserved | 0111 001X |
| 11 | Reserved | Reserved | Reserved | Reserved | 0111 010X |
| 12 | Reserved | Reserved | Reserved | Reserved | 0111 011X |
| 13 | Reserved | Reserved | Reserved | Reserved | 0111 100X |
| 14 | Reserved | Reserved | Reserved | Reserved | 0111 101X |
| 15 | Reserved | Reserved | Reserved | Reserved | 0111 110X |
| 16 | Reserved | Reserved | Reserved | Reserved | 0111 111X |

# 12. Antenna Interface

There are two antenna interfaces on the SM-2700.
The one is for Thuraya satellite network(SAT) , another is for Global Positioning system(GPS). Two connectors, MCX(73366-6191), are the same electrical and mechanical characteristics. Counter part plugs can be also found out http://www.molex.com

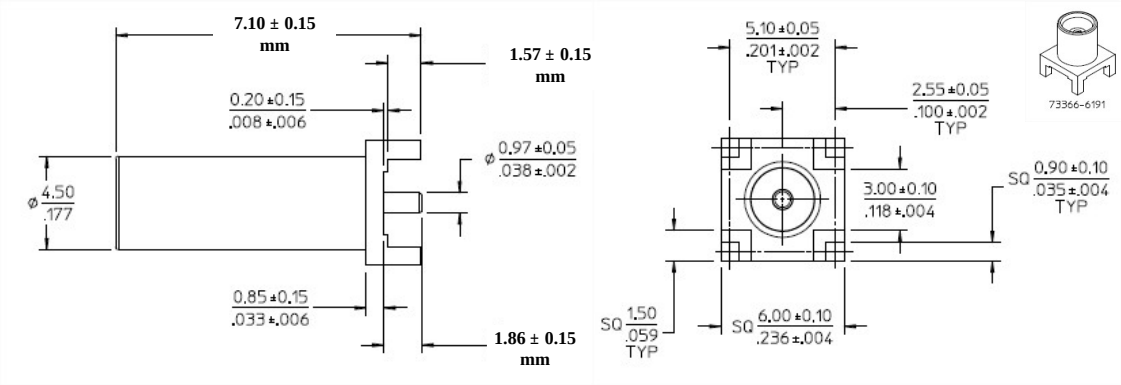



**Figure26 SAT RF & GPS Connector Specification**

There are no DC output from antenna connector port. In the case of using external active antenna, Appropriate bias network should be composed at the outside of the SM-2700.
Figure 1. shows the connector port of satellite antenna and GPS antenna port.
For SAT and GPS antenna specification requirements, Please refere to the GMR-1 05.05.
All of the external RF requirement, are driven by the GMR-1.

**Table10 SAT RF Parameters**

| | |
|---|---|
| **RX frequency band** | 1525.0 to 1559.0MHz |
| **TX frequency band** | 1626.5 to 1660.5MHz |
| **G/T limit** | -24dB/K |
| **Min. nonbacked off RF PA output** | 2W |
| **Power control step size** | 0.4 dB |
| **RSSI range** | -125 to -105 dBm |
| **Receiver Noise Figure** | < 1.8dB |

**Table11 GPS Parameters**

| | |
|---|---|
| **Frequency range** | 1575.42 MHz |
| **Impedance** | 50Ω nominal |
| **V.S.W.R** | Less than 1 : 2 |
| **Gain** | 2 dBi |
| **Polarization** | RHCP(Right-Hand Circular Polarization ) |

# 13. Physical Specifications

## 13.1. Mechanical Drawing

The Figure26 shows the mechanical drawing of SM-2700.

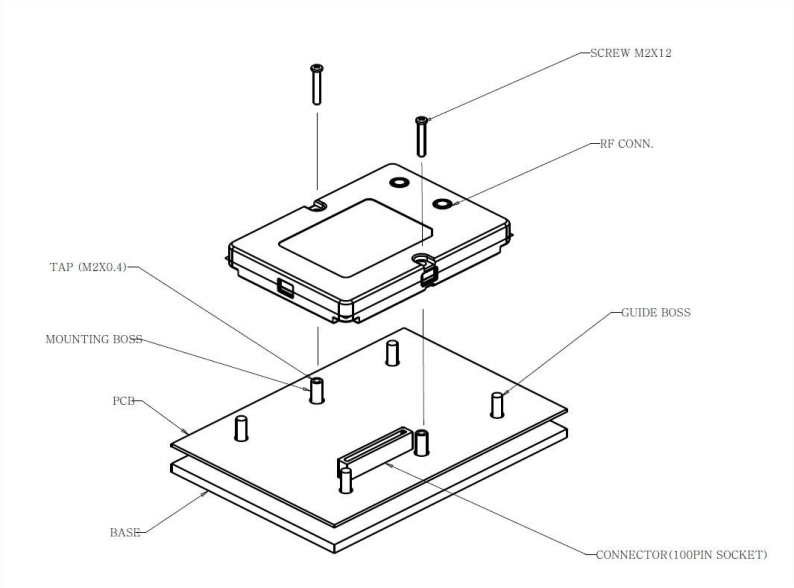



**Figure27 Mechanical drawing**

The overall dimensions of SM-2700 are summarized in Figure 27.

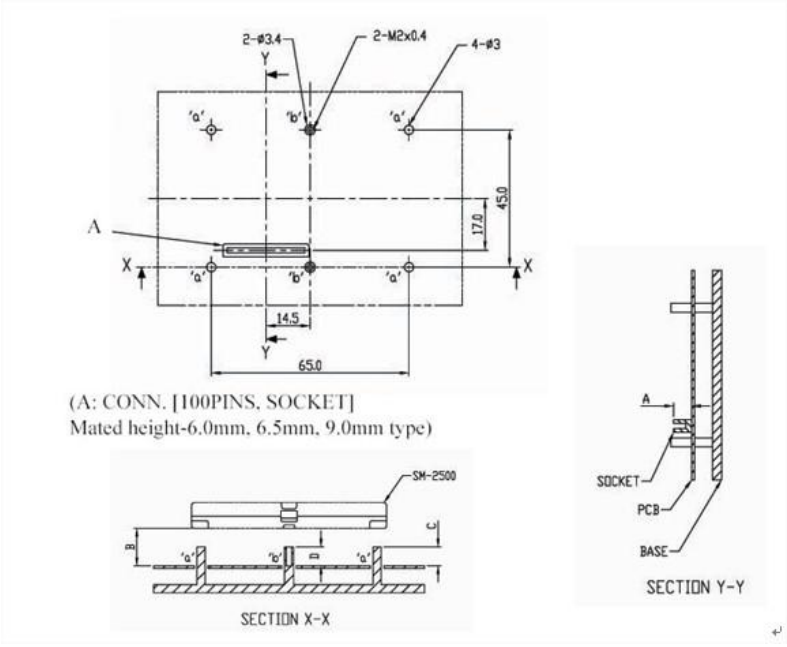


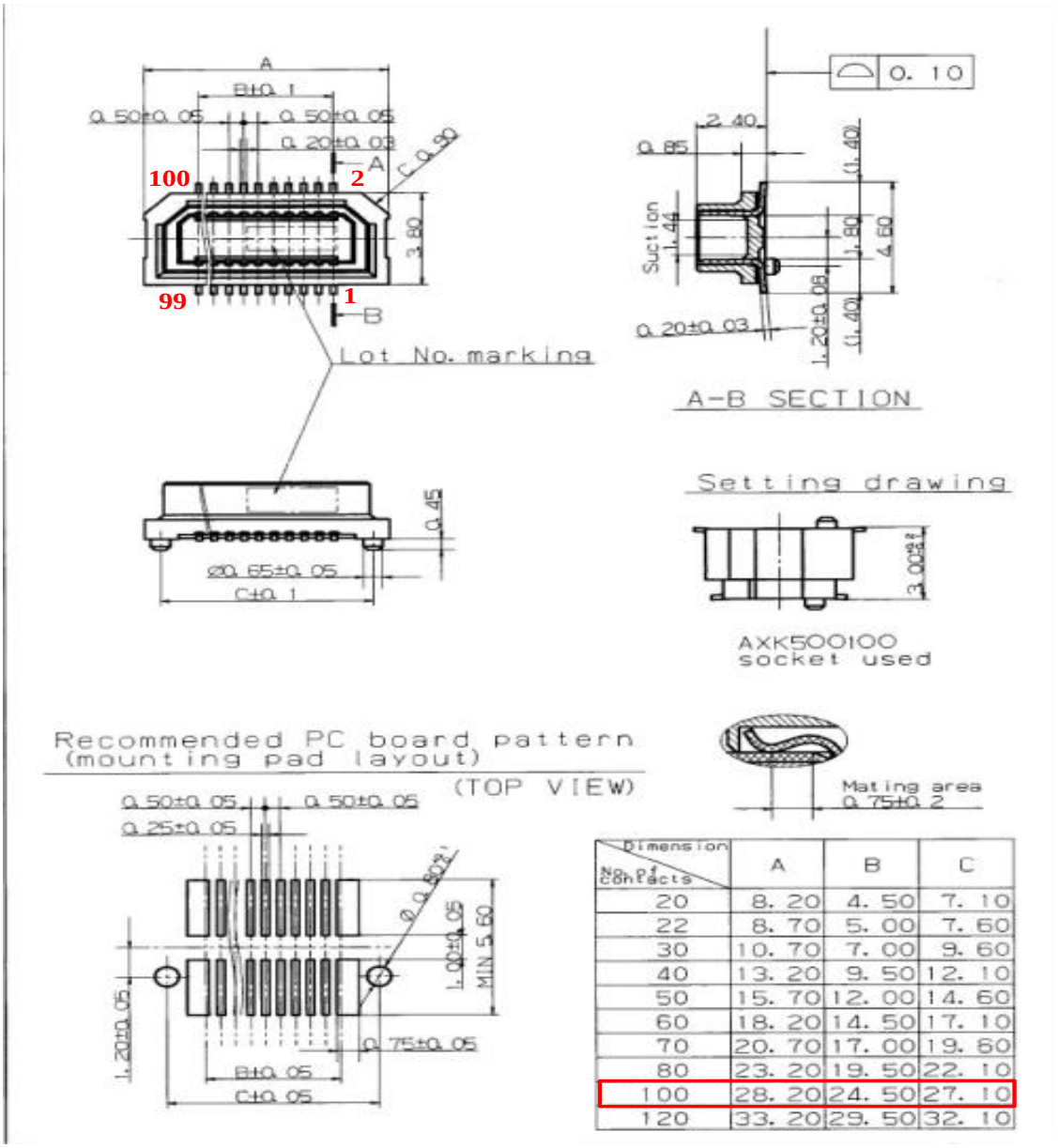

**Figure28 Mechanical dimension**

# 13.2. User Connector Type Mechanical Drawing

Recommended board to board female connector are also shown in Table 11.

**Table12 Recommended Board to Board Female Connector**

| Mated Height | No. of pins | Part No. (Socket) | Vendor |
|---|---|---|---|
| 6.5mm | 100 | AXK5S00237YG | Panasonic |




| Dimension / No. of contacts | A | B | C |
|---|---|---|---|
| 20 | 8.20 | 4.50 | 7.10 |
| 22 | 8.70 | 5.00 | 7.60 |
| 30 | 10.70 | 7.00 | 9.60 |
| 40 | 13.20 | 9.50 | 12.10 |
| 50 | 15.70 | 12.00 | 14.60 |
| 60 | 18.20 | 14.50 | 17.10 |
| 70 | 20.70 | 17.00 | 19.60 |
| 80 | 23.20 | 19.50 | 22.10 |
| 100 | 28.20 | 24.50 | 27.10 |
| 120 | 33.20 | 29.50 | 32.10 |

**Figure29 Recommended Board to Board Female Connector PCB pattern**

# 13.3. Environment

## 13.3.1. Environmental Specifications

**Table13 Environmental Specifications**

| Parameter | Value |
|---|---|
| Operating Temperature Range | -20℃ to +70℃ |
| Operating Humidity Range | ≤ 95% RH |
| Storage Temperature Range | -40℃ to +85℃ |

## 13.3.2. Environmental Tests Performed

It is expected, based on testing performed on a system that incorporates the SM-2700, that the SM-2700 would pass the tests listed in Table 14.

**Table14 Environmental Tests**

| Test | Value |
|---|---|
| Thermal Shock | -20℃/+70℃, soak 1hr,<br>24cycles, 48hrs, power off |
| Operating Low Temperature | -20℃, 12hrs, power on |
| Operating High Temperature | +70℃, 12hrs, power on |
| Temperature Cycling | +70℃(1hr) ~(0.5hr)~ -20℃(1hr),<br>24cycles, Power on, 72hrs |
| Transport Temperature | -20 ~ +55℃, 8cycles,<br>48hrs, power off |
| Storage Temperature | -40/+85℃, 72hrs each, Power off |
| Humidity | +40℃, 95%, 72hrs, power off |
| Unpackaged Drop | 120 ㎝, 6 sides, power off |
| Random Vibration | 3 axes, 2h each, 10~350Hz, 3G |
| Shock | 300m/s2, 6ms |
| ESD | Con:±6 ㎸,Air:±8 ㎸<br>10times each |

**Notice on installed on the host device*

This equipment complies with EN62311 human exposure restrictions for electromagnetic fields uidelines. It is desirable that it should be installed and operated keeping the radiator at least 40cm or more away from person's body in normal use position.