HARDWARE

USER MANUAL

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UM981-EB&UM981S-EB

Evaluation Board

Revision History

Version	Revision History	Date
R1.0	First release.	May 2025

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Foreword

This manual provides information on the hardware composition and design of UM981 series evaluation boards.

Target Readers

This document is written for technicians who are familiar with GNSS modules.

Contents

1 Product Overview

The UM981 series modules include two models: UM981 and UM981S. The evaluation boards (EB) introduced in this manual are compatible with this series, corresponding to UM981-EB and UM981S-EB respectively. The structure of the evaluation board mainly consists of the UM981 series module, a 3.3V low dropout regulator (LDO), a 5V DC/DC boost circuit, an antenna detection circuit, and peripheral interfaces.

☞ The schematics of the UM981 series evaluation boards can be used as the reference design for the UM981 series modules.

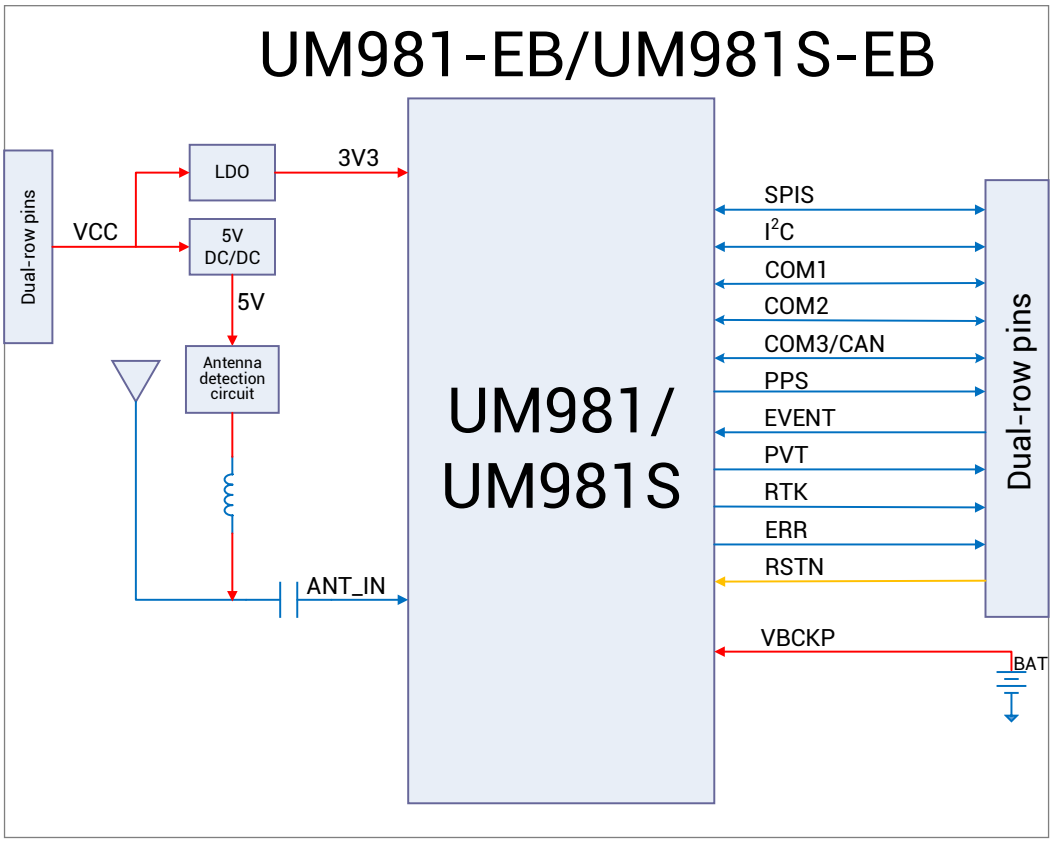


Figure 1-1 Block Diagram

Table 1-1 Differences Between UM981-EB and UM981S-EB

Evaluation Boards	Modules	Interfaces
UM981-EB	UM981	CAN
UM981S-EB	UM981S	COM3

The appearance of UM981-EB is shown as follows:

☞ **Figure 1-2** is the appearance of UM981-EB and the module is UM981. For UM981S-EB, the module is UM981S.

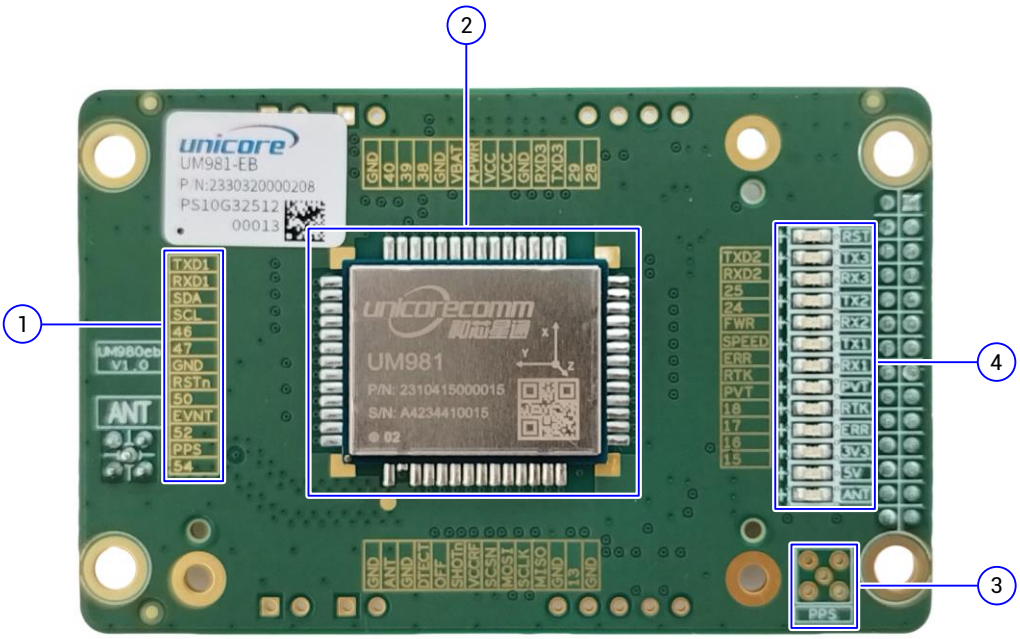


Figure 1-2 Top View of UM981-EB

(1) Silkscreen: It marks the signals of the pins. The smaller holes around are used to mount the UM981 socket. The printing adopts exposed copper to ensure the flatness of the surface.

(2) UM981 module: The pin pads are designed long, which is convenient for soldering, testing and debugging. For detailed packaging information, please refer to the PCB document.

(3) PPS connector: To measure the PPS signal, solder an MMCX connector here.

(4) LED indicators: Indicating the status of the power supply, reset, antenna short circuit, the positioning status and UART.

⚠ Note:

To facilitate testing, the dimensions of the module's functional pin pads on the evaluation board are extended outside the module package boundary.

This design applies only to testing scenarios and is not recommended to be used in mass production or formal product design.

For formal product design, the dimensions and layout of the pin pads need to be optimized in accordance with SMT process requirements to ensure optimal manufacturability and reliability.

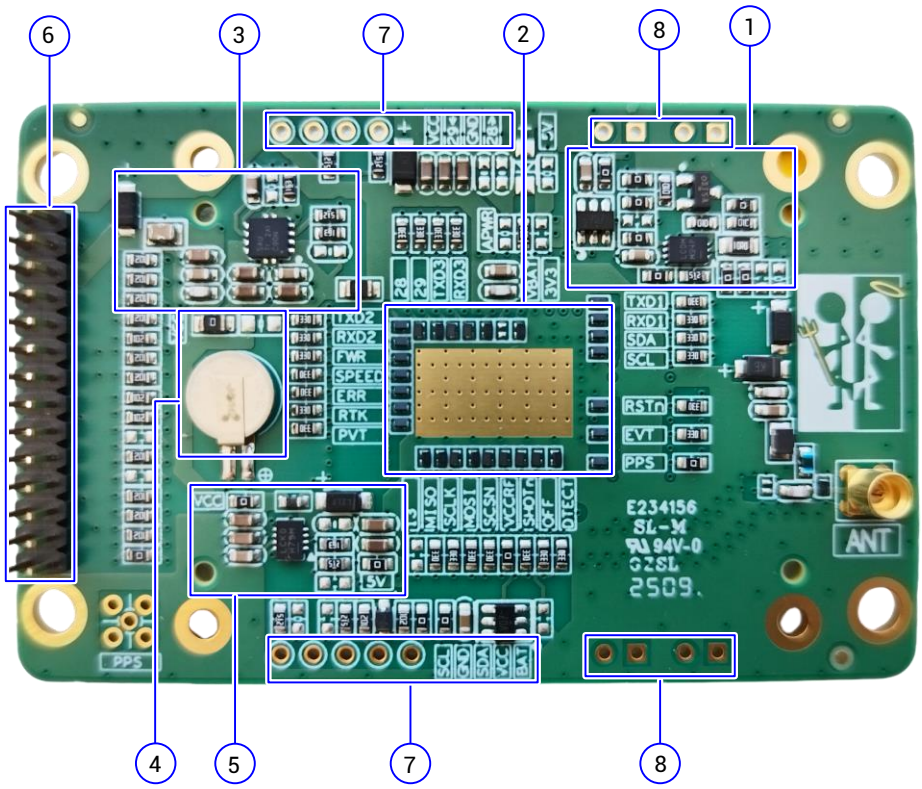


Figure 1-3 Bottom View of UM981-EB

(1) Antenna detection circuit

(2) Anti-static design and heat dissipation with exposed copper

(3) VCC power supply and LDO circuit

(4) Backup battery

(5) 5 V DC/DC boost circuit for antenna feeding

(6) Dual-row pins as external interfaces

(7) Debug ports

(8) Ports used to connect jumpers

2 Interfaces

The dual-row 28 pins serve as the external interfaces for the UM981 series evaluation board, and the pin pitch is 2 mm. The interfaces can be directly connected to the J18 interfaces on Unicore HPL EVK-V5.0 board.

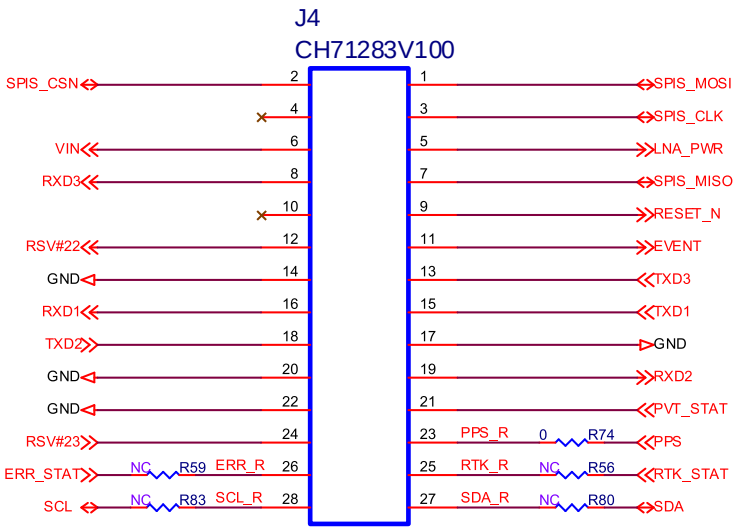


Figure 2-1 Interfaces

Table 2-1 Pin Descriptions

No.	Pin Names	I/O	Descriptions
1	SPIS_MOSI	I	Master Out / Slave In. This pin is used to receive data in slave mode.
2	SPIS_CSN	I	Chip select pin for SPI slave
3	SPIS_CLK	I	Clock input pin for SPI slave
4	NC	—	No connection inside
5	LNA_PWR	I	Antenna feed voltage for LNA
6	VIN	I	Main power supply

No.	Pin Names	I/O	Descriptions
7	SPIS_MISO	O	Master In / Slave Out. This pin is used to transmit data in slave mode.
8	RXD3	I	COM3 input for the UM981S module, LVTTL. CAN input for the UM981 module, LVTTL.
9	RESET_N	I	System reset, active low. The active time should be no less than 5 ms.
10	NC	—	No connection inside
11	EVENT	I	Event input, with adjustable frequency and polarity.
12	RSV#22	—	Reserved
13	TXD3	O	COM3 output for the UM981S module, LVTTL. CAN output for the UM981 module, LVTTL.
14	GND	—	Ground
15	TXD1	O	COM1 output, LVTTL.
16	RXD1	I	COM1 input, LVTTL.
17	GND	—	Ground
18	TXD2	O	COM2 output, LVTTL.
19	RXD2	I	COM2 input, LVTTL.
20	GND	—	Ground
21	PVT_STAT	O	PVT status, active high. High level when positioning and low level when not positioning.
22	GND	—	Ground

No.	Pin Names	I/O	Descriptions
23	PPS	O	Pulse per second, with adjustable pulse width and polarity.
24	RSV#23	—	Reserved
25	RTK_STAT	O	RTK status, active high. High level for RTK fixed solution and low level for other status.
26	ERR_STAT	O	Error status, active high. High level when failing self-test and low level when passing self-test.
27	SDA	I/O	I^2C data
28	SCL	I/O	I^2C clock

☞ The availability of the ports depends on the firmware version of the UM981 series modules.

3 Power Supply

The power supply for the UM981 series evaluation board is input from the VIN pin, passing through a circuit with surge protection and filter capacitors, to provide power for the 3.3 V LDO circuit and 5 V DC/DC boost circuit.

The input range of VIN is 3.2V to 5V.

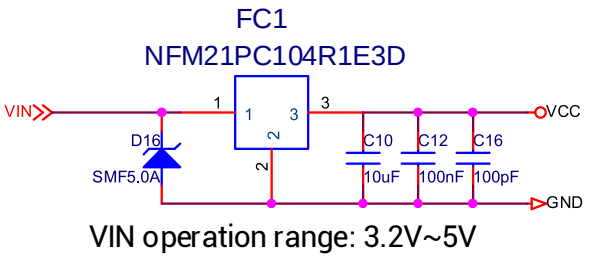


Figure 3-1 Power Filter Circuit

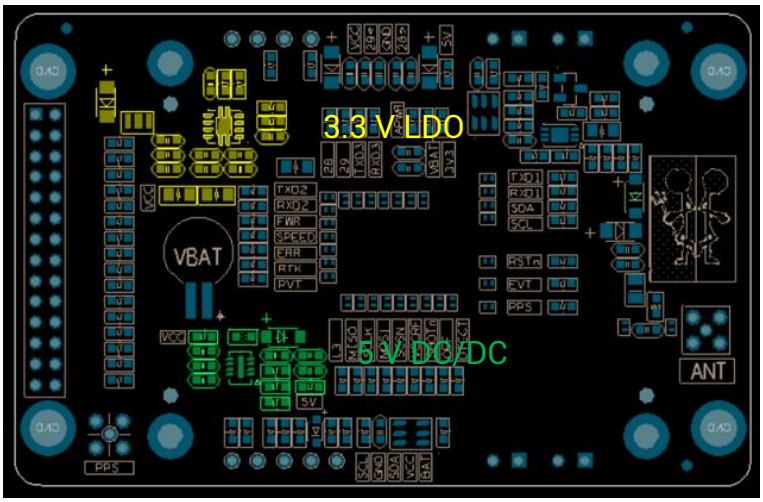


Figure 3-2 3.3 V LDO and 5 V DC/DC on the Bottom of the Evaluation Board

3.1 3.3V LDO Power Supply

VCC outputs 3.3 V voltage after passing through the LDO circuit to provide power to the evaluation board.

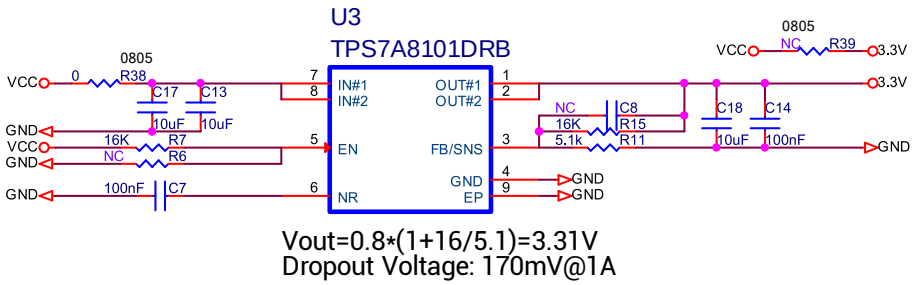


Figure 3-3 3.3V LDO Circuit

Notes:

The rated output current of LDO should be more than twice the current of the UM981 series module.

R38 is a series resistor placed at the input of the LDO, which is used for debugging. When selecting the resistor, choose one with high rated power to ensure the current capability. Here, a 0805 0-ohm resistor is selected.

R39 is a resistor connected in parallel with LDO. After removing R38 and soldering R39, you can use VCC to power the module.

☞ When using the LDO to power the module, you should consider the power dissipation of the LDO.

3.2 5V DC/DC Power Supply

VCC outputs 5 V voltage after passing through the DC/DC boost circuit to feed the antenna.

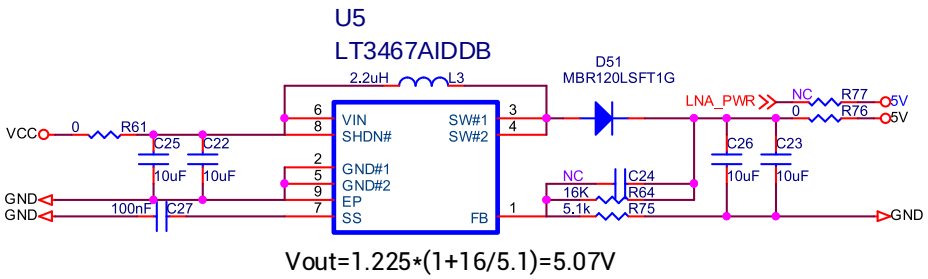


Figure 3-4 5V DC/DC Boost Circuit

Notes:

You can choose whether to use the 5 V power on the board to feed the antenna according to the antenna type.

R61 and R76 are series resistors connected to the DC/DC circuit at the input and output, which are used for debugging. When selecting the resistors, choose those with suitable rated power according to the power consumption of the antenna load. Here, a 0603 0-ohm resistor is selected.

R77: After removing R61/R76 and soldering R77, you can use the external LNA_PWR to feed the antenna.

3.3 Backup Power Supply

When using the hot start function, please provide backup power for the module.

The input range of V_BCKP is 2.0 V to 3.6 V.

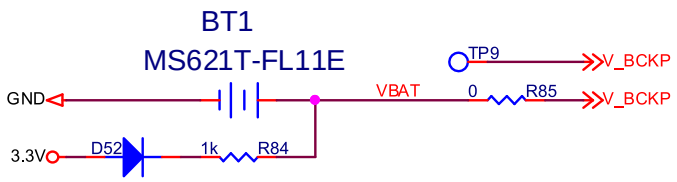


Figure 3-5 Backup Power Circuit

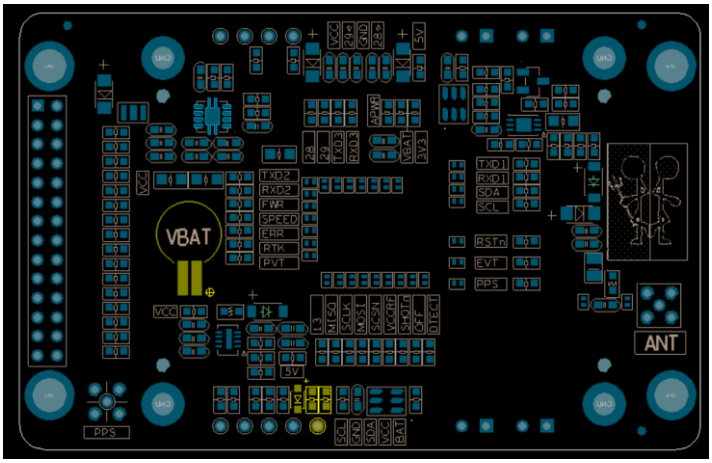


Figure 3-6 Backup Power Circuit on the Bottom of the Evaluation Board

Notes:

When the backup battery supplies power to V_BCKP, the battery charging circuit should be designed to prevent reverse current to ensure that the battery only supplies power to V_BCKP and the current does not flow back into the 3.3 V power domain, as the D52 shows in **Figure 3-5**.

According to the maximum charging current of the battery, a current-limiting resistor should be added, as the R84 shows in **Figure 3-5**.

V_BCKP can also be powered through the test point TP9. Removing R85, connecting a power supply wire at TP9 and a ground wire at TP6, you can use an external power to supply V_BCKP. This method can be used to measure the supply voltage and current of V_BCKP.

☞ In the case of normal power supply to the evaluation board, the micro battery charging circuit on the board will automatically charge the micro battery.

☞ If the evaluation board has been placed for a long time, the power of the battery may be low and the hot start test may fail. Therefore, it is recommended to charge the board as long as possible before testing the hot start function.

1) Use a multimeter to measure the voltage of the micro battery. If the voltage is above 2.6 V and is stable, it indicates that the power of the micro battery is sufficient.
2) Use a multimeter to measure the voltage of the micro battery. If the voltage drops rapidly, it indicates that the power of the micro battery is insufficient.
3) When the micro battery runs out of power, it will take more than 96 hours to fully charge the battery.
4) Under normal circumstances, after powering the evaluation board for one night, the hot start test can be done normally the next day.

4 Antenna Circuit

4.1 Antenna Detection Circuit

The antenna detection circuit consists of a MOS switch, a current detection chip and two buffers.

The antenna feed supply can be selected from the 5 V DC/DC circuit output or VCC_RF (supplied by the module). VCC_RF provides 3.3 V voltage, but the circuit has less protective design; therefore, it is not recommended to use VCC_RF to supply power to the antenna.

U6 and U2 are two buffers with open-drain output. ANT_OFF1 needs to be pulled up through ANT_BIAS1 to make sure that MOS can be turned off.

The current threshold can be adjusted by changing the resistance value of R24/R13/R14. Since the feed current flowing through R24 will generate a voltage drop, this solution is not suitable for antennas with high power consumption.

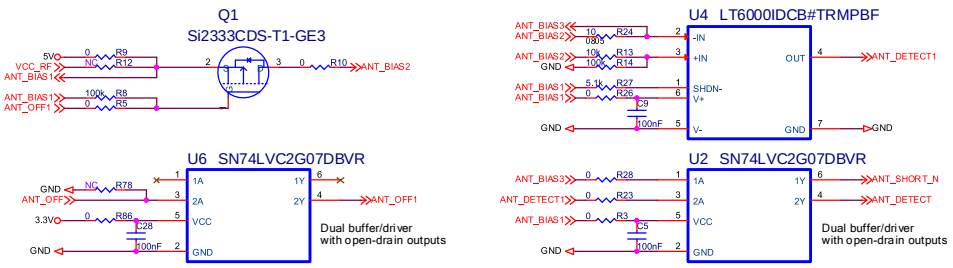


Figure 4-1 Antenna Detection Circuit

Table 4-1 Truth Table of the Antenna Detection Circuit

ANT-OFF	ANT-DETECT	ANT-SHORT-N	
1	X	X	The antenna feed supply is turned off
0	0	0	An error occurred in the circuit
0	0	1	The antenna feed current < 50 mA; no antenna detected
0	1	0	The antenna feed circuit is shorted to ground
0	1	1	The antenna feed current > 50 mA; the antenna status is normal

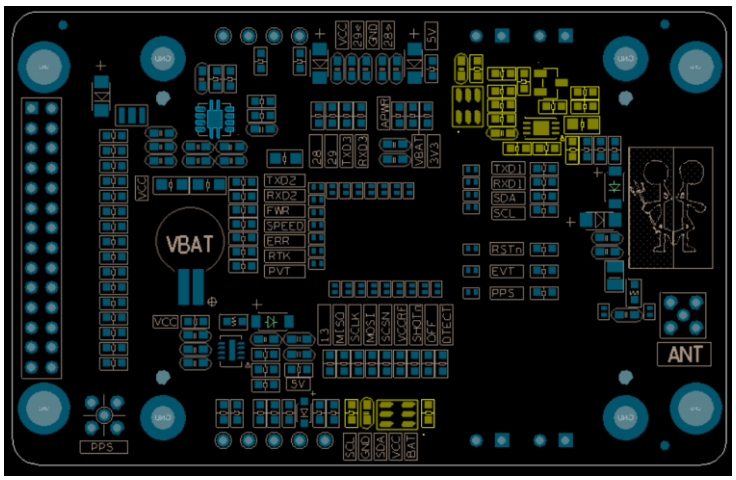


Figure 4-2 Antenna Detection Circuit on the Bottom of the Evaluation Board

4.2 Antenna Feed Circuit

The antenna feed circuit consists of the anti-reverse current design, anti-surge design, filter inductors, and ESD protection.

The supply voltage can be selected from 5 V, VCC_RF or ANT_BIAS3 through R31/R29/R30. When using the 5 V voltage or VCC_RF, the antenna detection circuit on the evaluation board will be bypassed.

The ESD protection diode should support high-frequency signals (above 2000 MHz). Nexperia PESD5V0F1BL is recommended here.

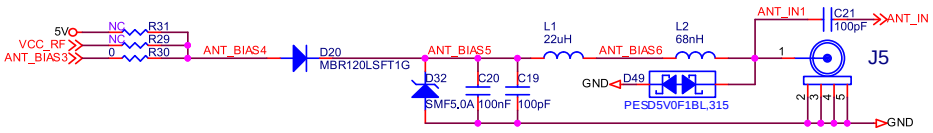


Figure 4-3 Antenna Feed Circuit

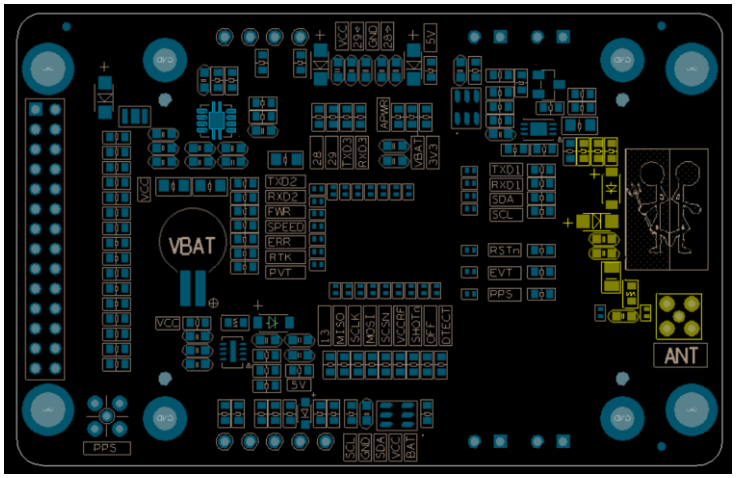


Figure 4-4 Antenna Feed Circuit on the Bottom of the Evaluation Board

5 LED Indicators

The LED indicators on the evaluation board indicate the working status of each functional unit.

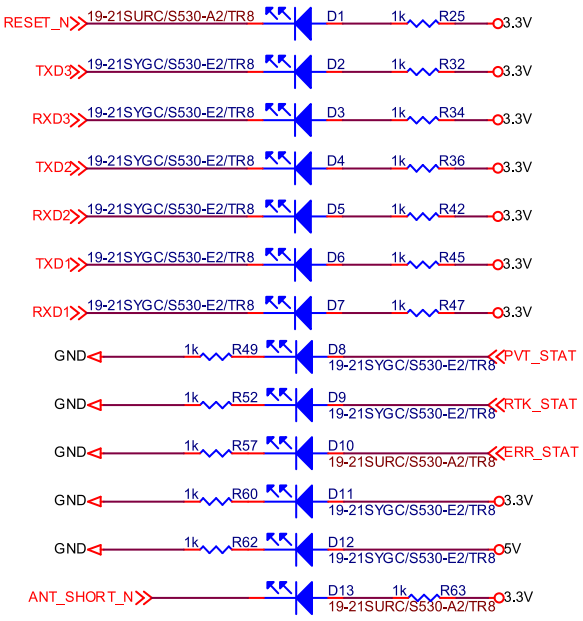


Figure 5-1 LED Indicators

Table 5-1 Descriptions of the LED Status

LED Indicators	Colors	Descriptions
Power (5V or 3.3V)	Green	Light on when the power is normal
Reset	Red	Light on when pressing the reset button
Antenna	Red	Light on when antenna is shorted
PVT	Green	Light on when position is fixed
RTK	Green	Light on when RTK is fixed
ERR	Red	Light on when failing self-test
UART	Green	Blinking when UART is working

The silkscreen markings on the right of the LED indicators identify the corresponding functions, as shown in the figure below.

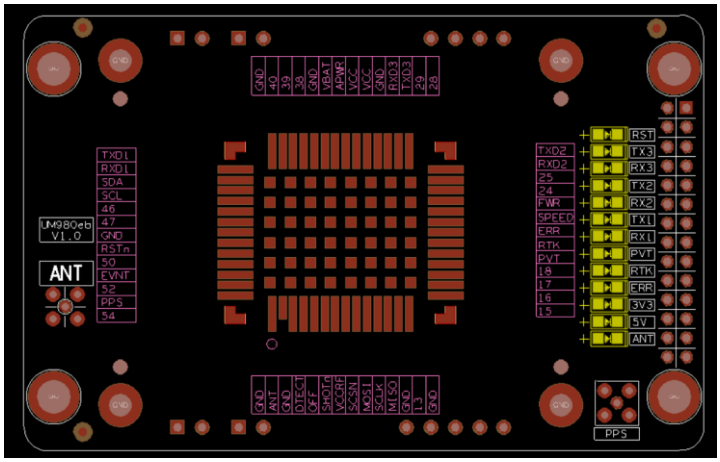


Figure 5-2 Markings on the Right of the LED Indicators

6 UM981 Series Module's Peripheral Design

TVS anti-surge protection is added at the input of the UM981 series module. ESD protection is added at all pins.

Use large and small VCC filter capacitors together, with a total capacitance greater than 30 uF.

Add series resistors at the IO pins for the convenience of debugging.

VCCIN powers the UM981 series module only. R33 is a large-size resistor (with high rated power) to ensure the current capability. In the figure below, a 0805 resistor is used.

Removing R33, connecting a power supply wire at TP1 and a ground wire at TP3 (as shown in **Figure 7-1**), you can use an external power to supply the module. This method can be used to measure the input voltage and current of UM981 series module.

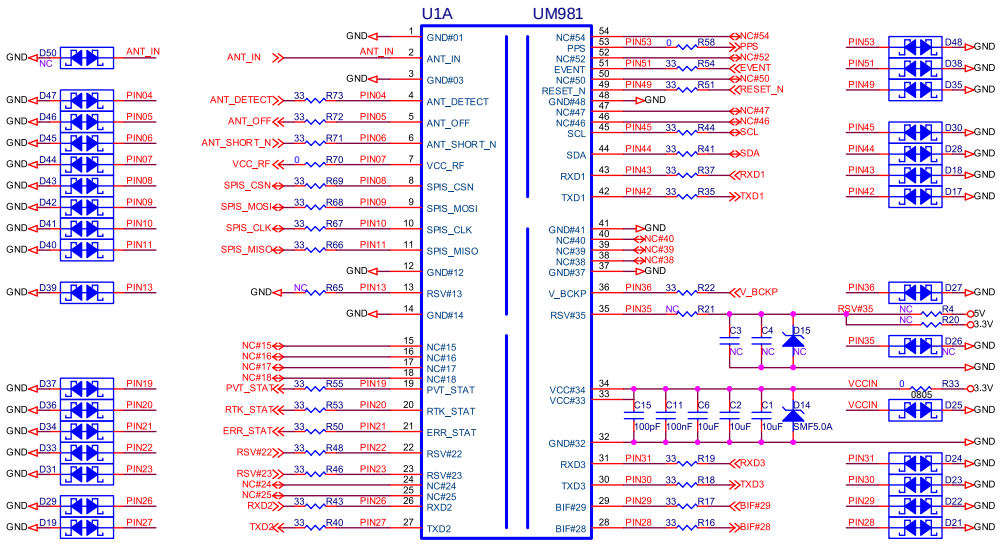


Figure 6-1 UM981 Series Module's Peripheral Design

The pin definitions of UM981 and UM981S are the same except for Pin 30 and Pin 31.

Table 6-1 Differences Between the Pins of UM981 and UM981S

Modules	Pin 30	Pin 31	Descriptions
UM981	CAN_TXD	CAN_RXD	CAN interface
UM981S	TXD3	RXD3	COM3 interface

Silkscreen markings are printed around the UM981 series module to identify the resistors, which is convenient for measurement.

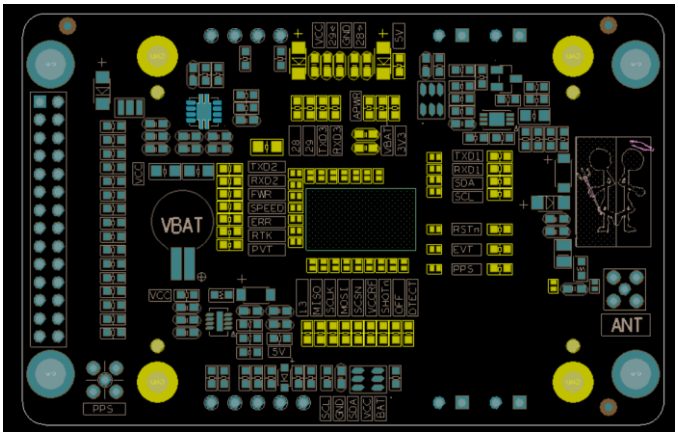


Figure 6-2 UM981 Series Module's Peripheral Circuit

The GND pads at the bottom of the module should be grounded to ensure heat dissipation. The evaluation board has copper exposed on the bottom of the UM981 series module, which not only enhances heat dissipation, but also provides a large area

for grounding and is convenient to test.

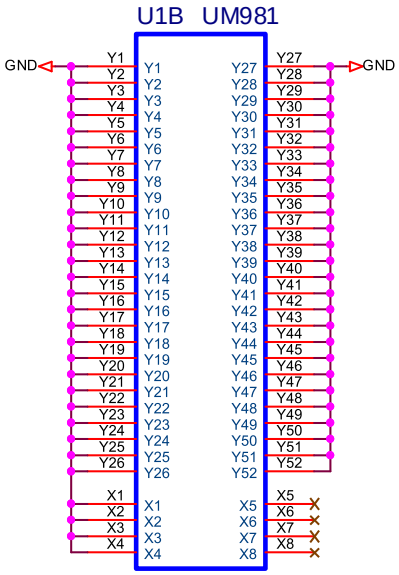


Figure 6-3 Pads (Y1-Y52) and Socket Mounting Holes (X1-X8)

7 Debug Support

As mentioned above, TP1 and TP9 can be used to connect an external power to supply VCCIN and V_BCKP and to measure the supply voltage and current.

TP2, TP3, TP5 and TP7 are used for internal debugging, of which TP5 and TP7 can be used to debug I^2C.

J1 is used for MMCX connection. After soldering the MMCX connector, it can be used to measure the PPS signals.

J2, J3, J6 and J7 are debug ports. Connect the signal that needs to be tested to the square hole and test the round hole, or connect the round hole to a measuring instrument. Using these debug ports can avoid damage to the PCB pads and traces.

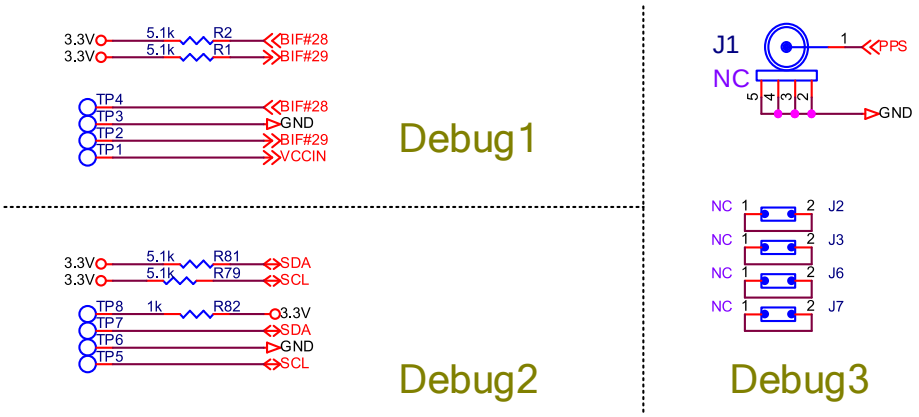


Figure 7-1 Debug Ports

The silkscreen markings on the right of the test points are arranged in order to identify the function of each port.

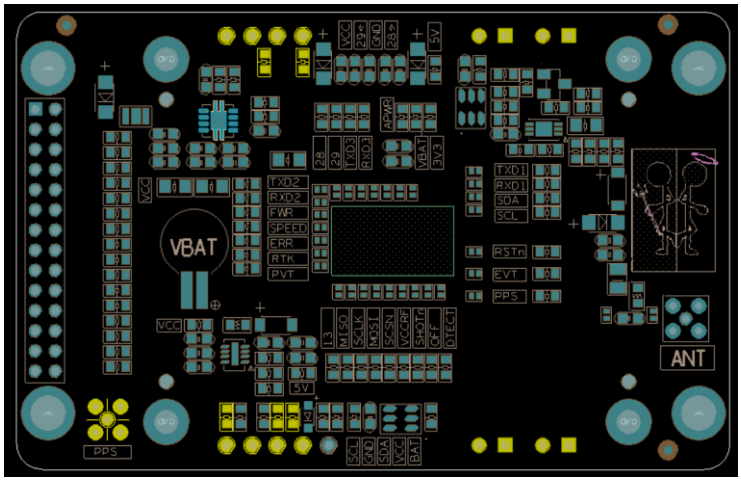
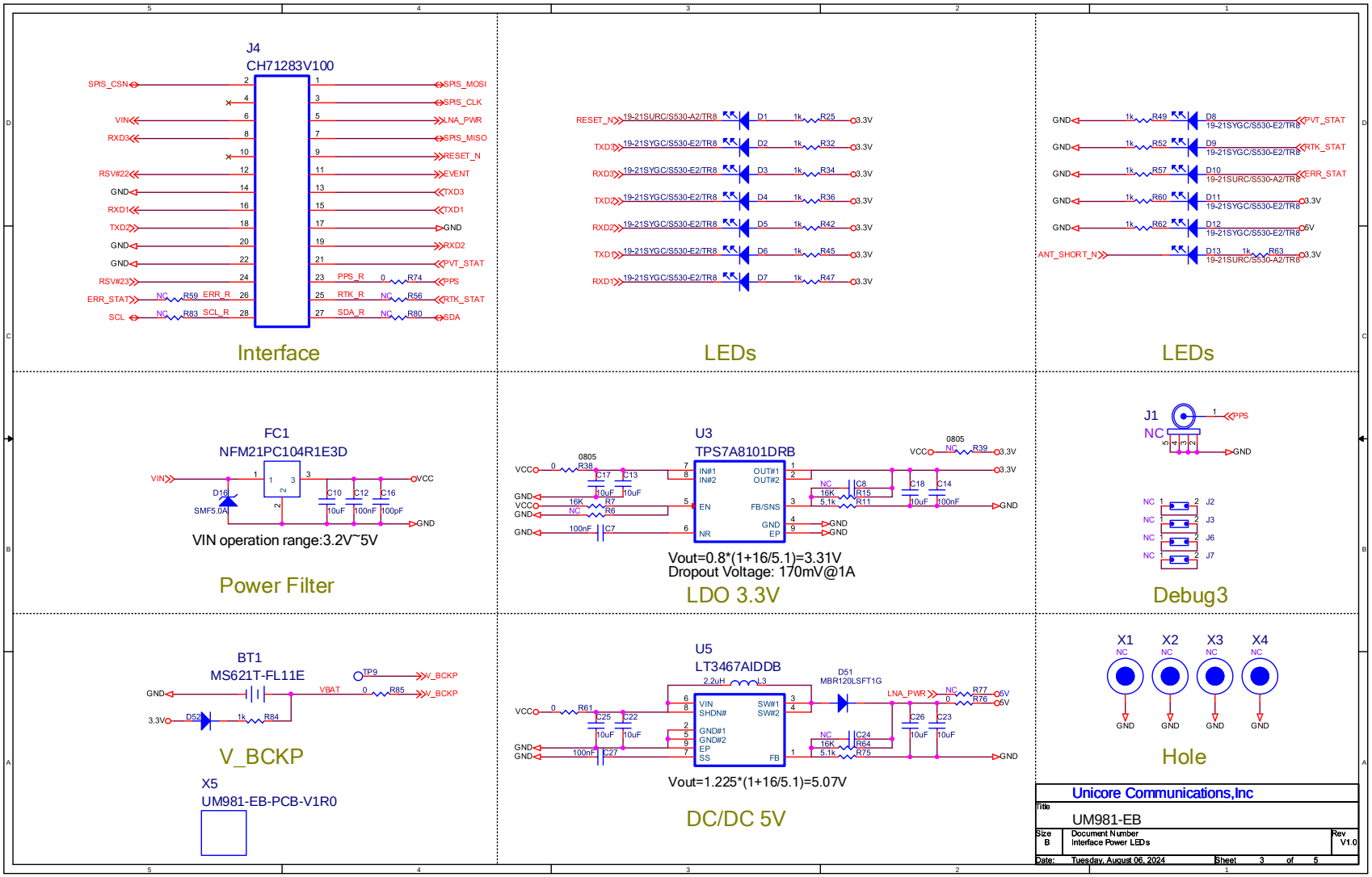
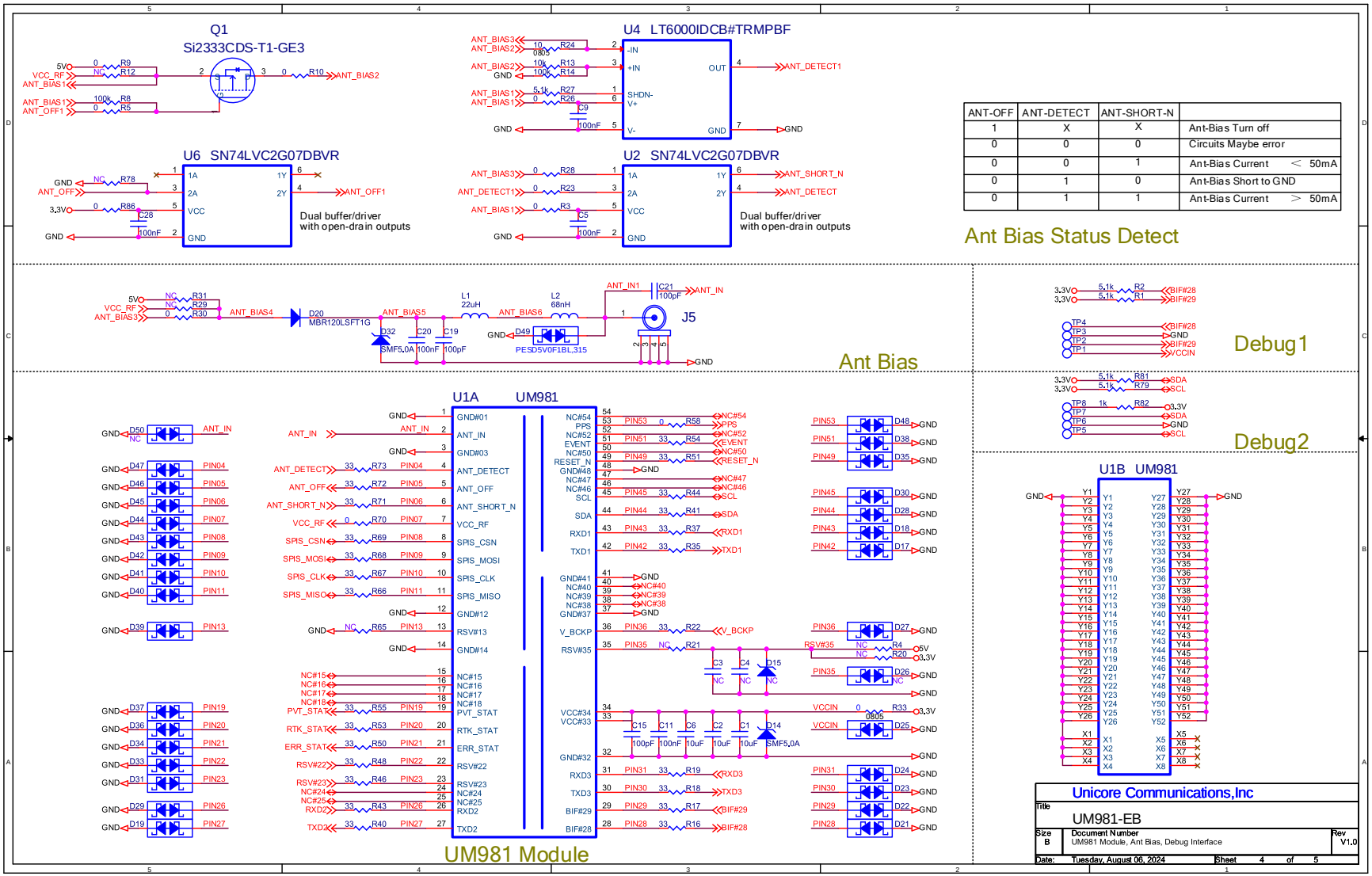


Figure 7-2 Through-Hole Test Points

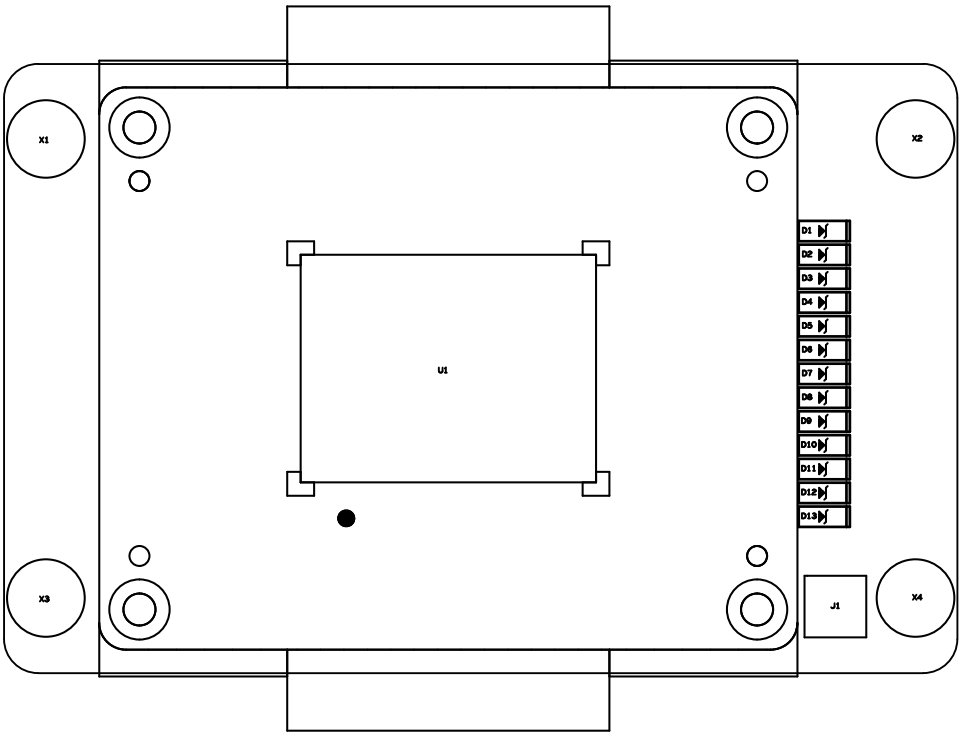
Appendix

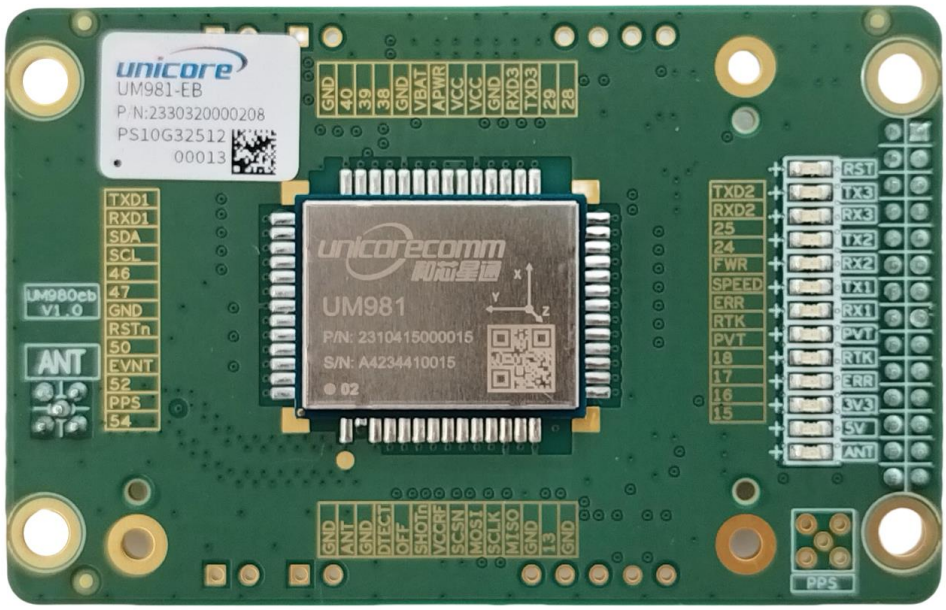
Schematics of UM981 series evaluation boards


J4
CH71283V100
SPIS_CSN
SPIS_MOSI
SPIS_CLK
VIN
LNA_PWR
RXD3
SPIS_MISO
RESET_N
RSV#22
EVENT
GND
TXD3
RXD1
TXD1
TXD2
GND
GND
RXD2
GND
PVT_STAT
RSV#23
PPS_R
R74
PPS
ERR_STAT
NC
R59
ERR_R
RTK_R
NC
R56
RTK_STAT
SCL
NC
R83
SCL_R
SDA_R
NC
R80
SDA
Interface
RESET_N
TXD3
RXD3
TXD2
RXD2
TXD1
RXD1
19-21SURC/S530-A2/TR8
19-21SYGC/S530-E2/TR8
D1
D2
D3
D4
D5
D6
D7
1k
R25
R32
R34
R36
R42
R45
R47
3.3V
LEDs
GND
R49
R52
R57
R60
R62
R63
D8
D9
D10
D11
D12
D13
PVT_STAT
RTK_STAT
ERR_STAT
5V
ANT_SHORT_N
LEDs
FC1
NFM21PC104R1E3D
VIN
D16
SMF5.0A
C10
C12
C16
10uF
100nF
100pF
VCC
GND
VIN operation range:3.2V~5V
Power Filter
U3
TPS7A8101DRB
VCC
R38
0805
C17
C13
10uF
GND
R7
16K
R6
NC
C7
100nF
IN#1
IN#2
EN
NR
OUT#1
OUT#2
FB/SNS
GND
EP
R39
C8
R15
5.1k
R11
C18
C14
Vout=0.8*(1+16/5.1)=3.31V
Dropout Voltage: 170mV@1A
LDO 3.3V
J1
NC
PPS
GND
J2
J3
J6
J7
Debug3
BT1
MS621T-FL11E
TP9
V_BCKP
GND
VBAT
R85
3.3V
D52
1k
R84
V_BCKP
X5
UM981-EB-PCB-V1R0
U5
LT3467AIDDB
2.2uH
L3
VIN
SHDN#
GND#1
GND#2
EP
SS
SW#1
SW#2
FB
D51
MBR120LSFT1G
LNA_PWR
R61
C25
C22
C27
C24
R64
R75
C26
C23
Vout=1.225*(1+16/5.1)=5.07V
DC/DC 5V
X1
X2
X3
X4
Hole
Unicore Communications,Inc
Title
UM981-EB
Size
B
Document Number
Interface Power LEDs
Rev
V1.0
Date:
Tuesday, August 06, 2024
Sheet
3
of
5

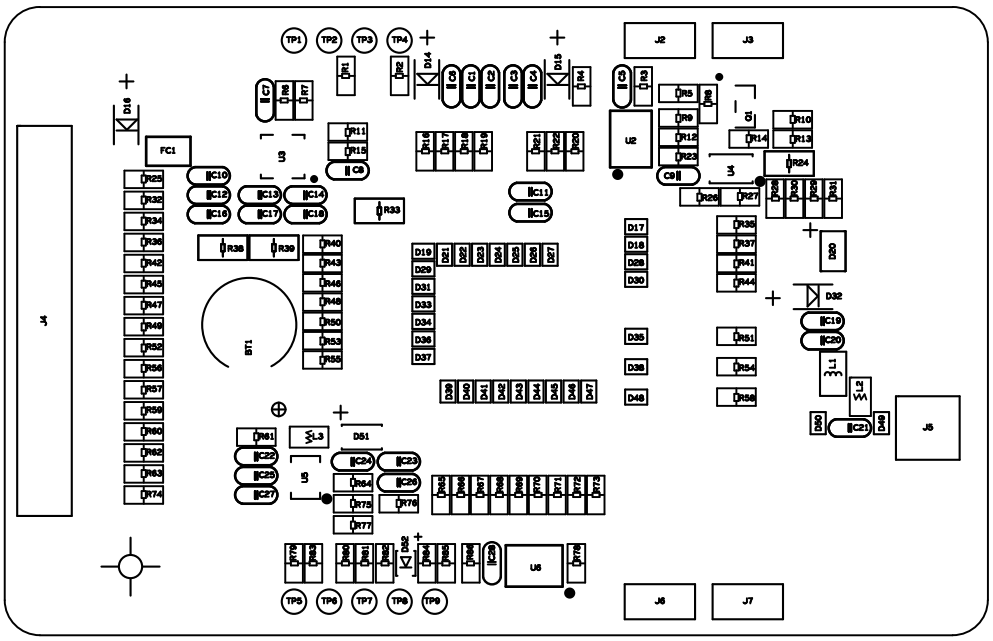

Q1
Si2333CDS-T1-GE3
U4 LT6000IDCB#TRMPBF
U6 SN74LVC2G07DBVR
Dual buffer/driver
with open-drain outputs
U2 SN74LVC2G07DBVR
Dual buffer/driver
with open-drain outputs
ANT-OFF | ANT-DETECT | ANT-SHORT-N
1 | X | X | Ant-Bias Turn off
0 | 0 | 0 | Circuits Maybe error
0 | 0 | 1 | Ant-Bias Current < 50mA
0 | 1 | 0 | Ant-Bias Short to GND
0 | 1 | 1 | Ant-Bias Current > 50mA
Ant Bias Status Detect
Ant Bias
Debug1
Debug2
U1A UM981
U1B UM981
UM981 Module
Unicore Communications,Inc
UM981-EB
UM981 Module, Ant Bias, Debug Interface
V1.0
Tuesday, August 06, 2024

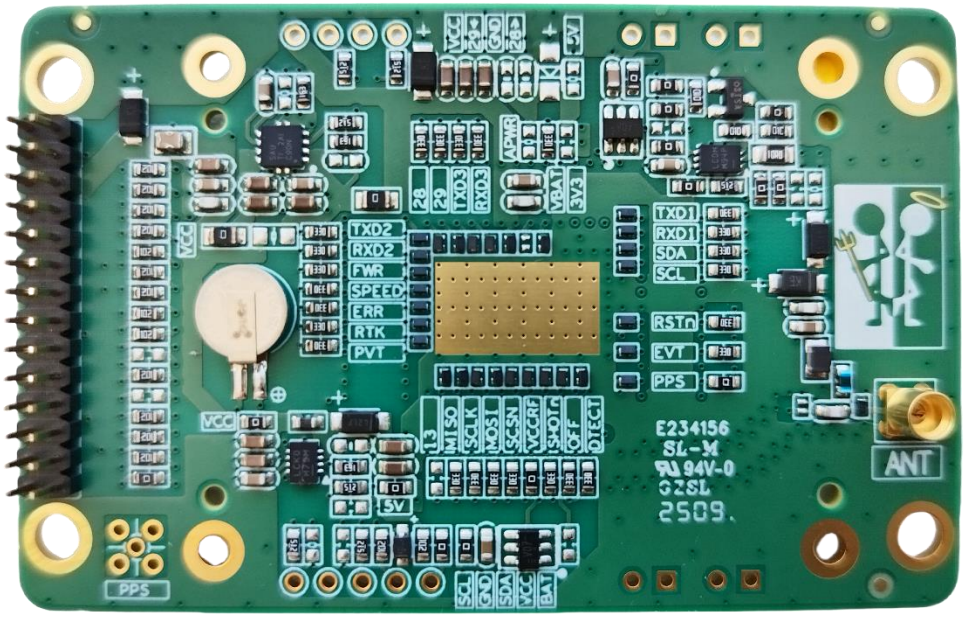
Assembly Top of UM981-EB





Assembly Bottom of UM981-EB





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