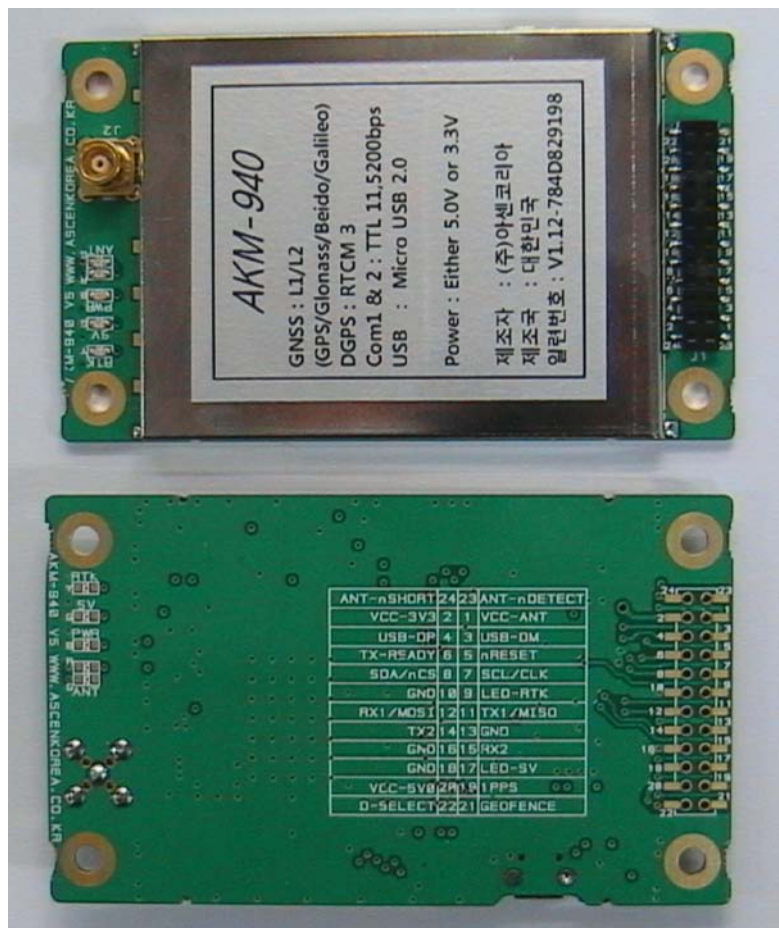


# AKM-940



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## **1. Functional Description**

- 184-channel u-blox F9P engine
  - GPS : L1C/A L2C
  - Glonass: L1OF L2OF
  - Galileo : E1B/C E5b
  - Beidou : B1L B2L
  - QZSS : L1C/A L2C
- Concurrent reception of GPS, GLONASS, Galileo and Beidou
- Multi-band RTK with fast convergence times and reliable performance
- High update rate for highly dynamic applications
- Centimeter accuracy in a small and energy-efficient module
  
- Fully shielded design
- Internal regulated antenna power source for 5.0V
- Antenna detect and short indicate function
- Antenna over current protection
- Power input Either 5.0V or 3.3V
- Internal fit backup battery for Cold/Warm/Hot start
- Fit micro USB 2.0 connector
- Communication port UART2 and UART1(Alternate UART1/I2C & SPI)
- Through type 2mm pitch 24pin dual header socket
- MCX antenna Connector (Changeable to order option SMA/MMCX)
- Size : 44 x 74 x 5.2mm
- Weight : 25 grams

**2. Performance**

PARAMETER		SPECIFICATION	UNIT
Accuracy of time pulse signal	RMS	33	nS
	99%	60	nS
Frequency of time pulse signal	configurable	0.25Hz ~10MHz	
Operational limits <sup>1</sup>	Dynamics	<=4	g
	Altitude g	50,000	m
	Velocity	500	m/S
Velocity accuracy		0.05	m/S <sup>2</sup>
Dynamic heading accuracy		0.3	Deg <sup>2</sup>

GNSS		GPS	GPS	GPS	GPS	GPS	GPS	UNIT
		+GLO +GAL +BDS	+GLO +GAL	+GAL	+GLO	+DBS		
Acquisition <sup>3</sup>	Cold start	24	25	29	26	28	29	Sec
	Hot start	2	2	2	2	2	2	
	Aided start <sup>4</sup>	2	2	2	2	2	2	
Nav. Update rate	RTK	8	10	12	12	12	20	Hz
	PVT	10	12	16	25	25	25	
	RAW	20	20	25	25	25	25	
Convergence time <sup>5</sup>	RTK	<10	<10	<10	<10	<10	<30	Sec
Horizontal pos. accuracy	RTK <sup>5,6</sup>	0.01m+1ppm CEP						meter
Sensitivity <sup>5</sup>	Tracking & Nav	-167						dBm
	Reacquisition	-160						
	Cold Start	-148						
	Hot Start	-157						

- 1 Assuming Airborne 4g platform
- 2 50% @30m/s for dynamic operation
- 3 All satellites at -130 dBm, except Galileo at -127 dBm
- 4 Dependent on the speed and latency of the aiding data connection, command starts.
- 5 Depends on atmospheric conditions, baseline length, GNSS antenna, multipath conditions, satellite visibility and geometry, Demonstrated with a good external LNA
- 6 Measured using 1Km baseline and patch antennas with good ground planes.  
Does not account for possible antenna phase cent offset errors.  
ppm limited baselines up to 20Km.

### **3. Input Protocols : Differential GNSS (DGNSS)**

When operating in RTK mode, RTCM version 3 messages are required and the module supports DGNSS according to RTCM 10403.3.

Operating in ROVER mode can decode the following RTCM 3.3 input messages:

RTCM 1001	L1-only GPS RTK observables
RTCM 1002	Extended L1-only GPS RTK observables
RTCM 1003	L1/L2 GPS RTK observables
RTCM 1004	Extended L1/L2 GPS RTK observables
RTCM 1005	Stationary RTK reference station ARP
RTCM 1006	Stationary RTK reference station ARP with antenna height
RTCM 1007	Antenna descriptor
RTCM 1009	L1-only GLONASS RTK observables
RTCM 1010	Extended L1-only GLONASS RTK observables
RTCM 1011	L1/L2 GLONASS RTK observables
RTCM 1012	Extended L1/L2 GLONASS RTK observables
RTCM 1074	GPS MSM4
RTCM 1075	GPS MSM5
RTCM 1077	GPS MSM7
RTCM 1084	GLONASS MSM4
RTCM 1084	GLONASS MSM5
RTCM 1084	GLONASS MSM7
RTCM 1094	Galileo MSM4
RTCM 1094	Galileo MSM5
RTCM 1094	Galileo MSM7
RTCM 1124	BeiDou MSM4
RTCM 1124	BeiDou MSM5
RTCM 1124	BeiDou MSM7
RTCM 1230	GLONASS code-phase biases

## 4. Output Protocols

- Data format

WGS-84 NMEA 0183 Ver.4.1

- NMEA message

GGA, GLL, GSA, GSV, RMC, VTG, GRS, GST, ZDA, GBS, DTM, GNS, VLW

- UART signal format

Baud rate : 4800 ~ 921600 bps

Byte : 8bit

Stop bit : 1

Parity : none

- Up-date rate

1~10 Hz

- Operating as a BASE station can generate the following RTCM 3.3 output messages:

RTCM 1005

Stationary RTK reference station ARP

RTCM 1077

GPS MSM7

RTCM 1087

GLONASS MSM7

RTCM 1097

Galileo MSM7

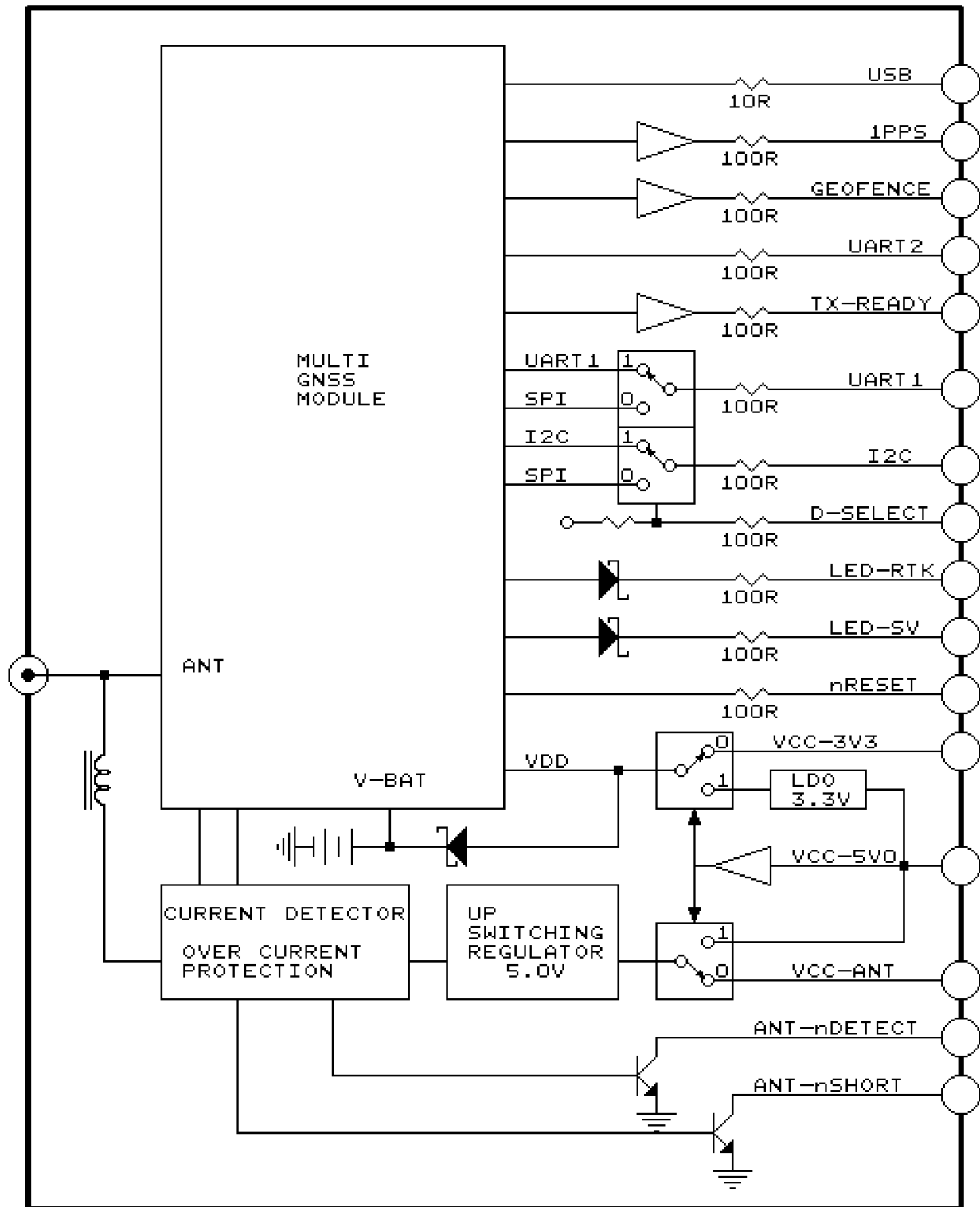
RTCM 1127

BeiDou MSM7

RTCM 1230

GLONASS code-phase biases

5. Block Diagram



## 6. Pin Description

No.	Name	Pin Description	I/O	Comment
1	VCC_ANT	Antenna Power Input	I	2.5V~5.0V (Internal 5V Up-D/D Reg.)
2	VCC_3V3	System Power 3.3V input	I	3.0~3.6V (Below 1V for VCC_5V0)
3	USB_DM	USB DATA MINUS	I/O	Leave unconnected if not used.
4	USB_DP	USB DATA PLUSE	II/O	Leave unconnected if not used.
5	nRESET	Active LOW reset.	I	Leave unconnected if not used.
6	TX_READY		O	TX_Buffer full and ready for TX1 of data
7	SCL/SPI_CLK		I/O	D_SEL=1 or open : I2C
8	SDA/SPI_CS		I/O	D_SEL=0 : SPI
9	LED_RTK	RTK status Indicator	O	Fixed=1, Receiving data = blinking
10	GND			
11	TX1/SPI_MISO	CMOS Level	O	D_SEL=1 or open : UART
12	RX1/SPI_MOSI	CMOS Level	I	D_SEL=0 : SPI
13	GND			
14	TX2	CMOS Level	O	
15	RX2	CMOS Level	I	
16	GND			
17	LED_SV	Satellite view indicator	O	2D Fix = 1 , not Fix = open
18	GND			
19	1PPS	Time pulse	O	
20	VCC_5V0	System Power 5.0V input	I	3.6~5.0V
21	GEOFENCE	Geofance status,	O	user defined
22	D_SEL	Data out select	I	Interface select for 7,8,11,12
23	ANT_nDETECT	Antenna connection detect	O	If detect then open collector low output
24	ANT_nSHORT	Antenna over current detect	O	If detect then open collector low output

## !! NOTE PIN NUMBER !!

D_SEL	<b>22</b>	<b>21</b>	GEOFENCE
VCC-5V0	<b>20</b>	<b>19</b>	1PPS
GND	<b>18</b>	<b>17</b>	LED_SV
GND	<b>16</b>	<b>15</b>	RX2
TX2	<b>14</b>	<b>13</b>	GND
RX1/SPI_MOSI	<b>12</b>	<b>11</b>	TX1/SPI_MISO
GND	<b>10</b>	<b>9</b>	LED_RTK
SDA/SPI_CS	<b>8</b>	<b>7</b>	SCL/SPI_CLK
TX_READY	<b>6</b>	<b>5</b>	nRESET
USB_DP	<b>4</b>	<b>3</b>	USB_DM
VCC_3V3	<b>2</b>	<b>1</b>	VCC_ANT
ANT_nSHORT	<b>24</b>	<b>23</b>	ANT_nDETECT



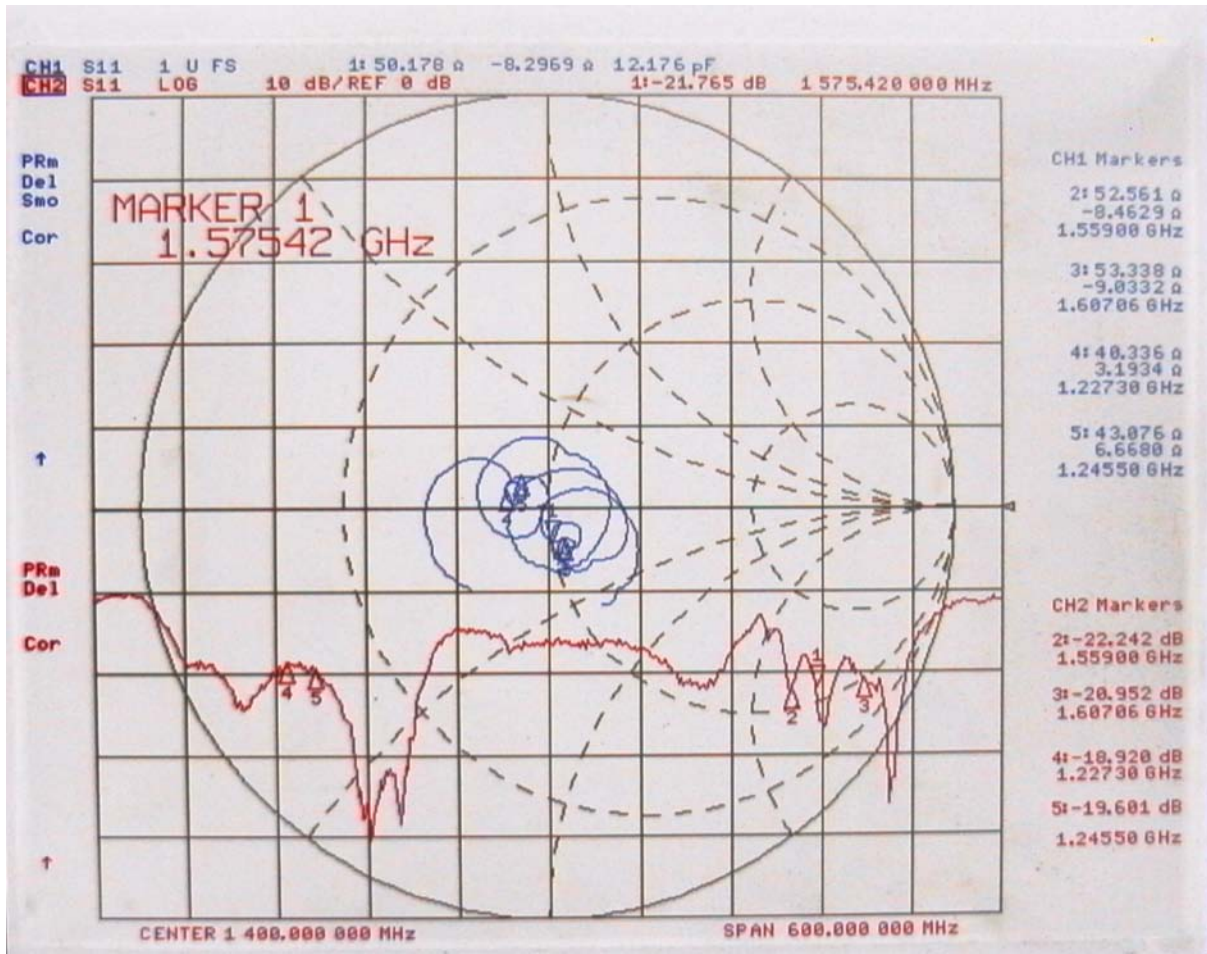
## 7. Absolute Maximum Ratings

Parameter	Min	Max	Unit
Power supply voltage (VCC_5V0)		5.5	V
Power supply voltage (VCC_3V3)		3.6	V
I/O port voltage	-0.3	3.6	V
I/O port current		±10	mA
Storage temperature	-40	85	°C

## 8. Electrical Characteristics

Parameter		Condition	Min.	TYP	Max.	Unit
Operating supply voltage	(VCC_5V0) < 1V	VCC_3V3	3.0	3.3	3.6	V
		VCC_5V0	3.6	5.0	5.5	
Operating supply ripple voltage		VCC_3V3			50	mV
Sustained supply current (ex. : at 3D Fixed) (Without antenna load)		VCC_3V3		110	120	mA
Peak current		VCC_3V3			140	mA
I/O INPUT level	High		1.96		3.3	V
	Low		-0.2		0.84	
I/O OUTPUT level	High	Ioh=2mA	2.4		3.3	V
	Low	Iol=2mA	0.1		0.4	
Antenna	Input voltage	VCC_ANT	2.5	3.3	5.0	V
Power supply	Up-D/D regulation efficiency	50mA Load		70		%
Antenna	output Voltage	none Load		5.0	5.2	V
		20mA Load	4.4	4.7	4.9	
		50mA Load	4.1	4.4	4.7	
Port	connection OFF current detect				4	mA
	connection ON current detect		8			mA
	over current production		80	90	100	mA
	maximum Input power				-40	dBm
	Input return loss (50Ω)	IN BAND			-15	-10
Back-up Current consumption				80		uA
Back-up full charge time (Battery capacity: 4mAh)				4		hours
Operating temperature			-40	25	+80	°C

Antenna Port Input Impedance

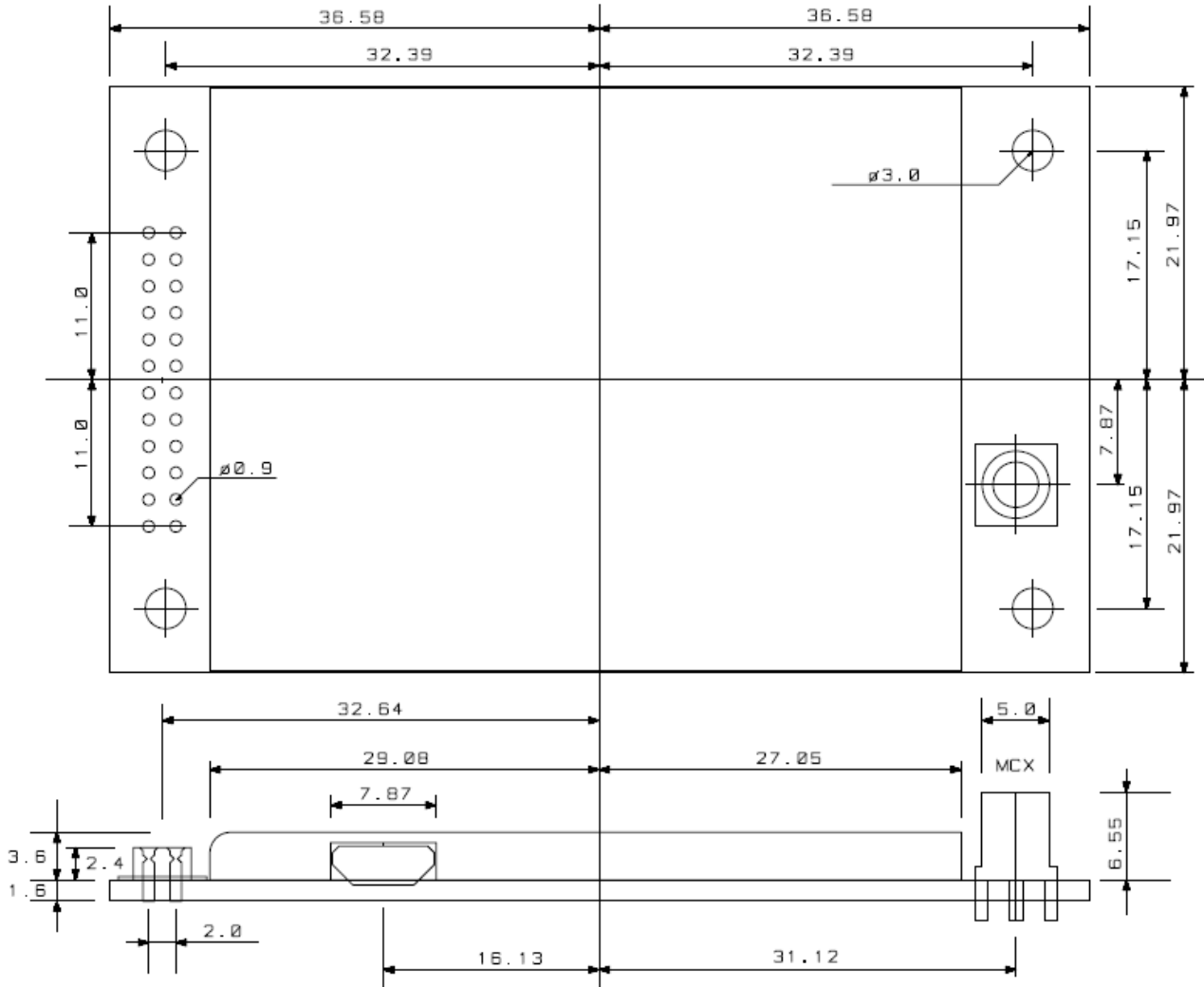


**9. Active Antenna Selection Guide Recommend**

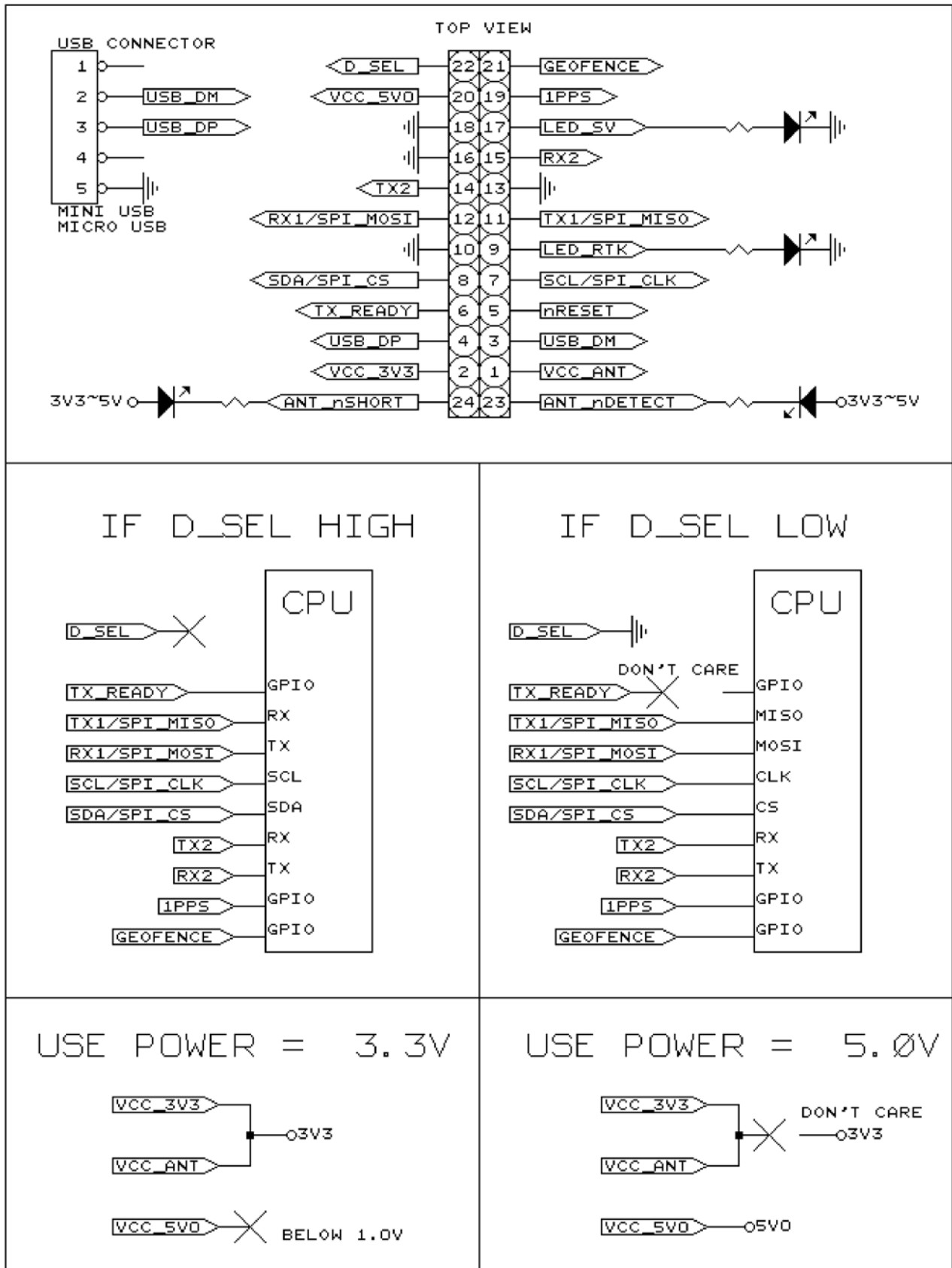
Parameter	Condition
Frequency Range	GPS:L1/L2 GLONASS:L1OF/L2OF BEIDOU:B1/B2/B3 GALILEO:E1/E5b
Polarization	RHCP
V.S.W.R	Less than 2.0
Output Impedance	50 $\Omega$ (Return loss $\geq$ -10dB)
LNA Gain	More then 30dB (With RF Cable)
Noise Figure	2.0dB(Max)
Azimuth Coverage	360 $^\circ$
Operating Voltage	DC 3.3~5.0
Current	50mA(Max)

### 10. Mechanical Specification

Unit : mm



### 11. Application Schematics



## 12. Factory Default setting

Interface		Settings
TX1	115200 bps 8bit, no parity bit 1 stop bit	UBX + NMEA + RTCM3 Configured to transmit NMEA protocols. 1Hz out GGA, GLL, GSA, GSV, RMC, VTG
RX1		UBX + NMEA + RTCM3
TX2		NMEA Configured to transmit NMEA protocols. 1Hz out GGA, GLL, GSA, GSV, RMC, VTG
RX2		RTCM3
USB		UBX + NMEA + RTCM3 Configured to transmit NMEA protocols. 1Hz out GGA, GLL, GSA, GSV, RMC, VTG
I2C		UBX + NMEA + RTCM3 Operated in slave mode only. Default message and protocols available as in TX1/RX1 Maximum bit rate 400kb/s
SPI		UBX + NMEA + RTCM3 Operated in slave mode only. Default message and protocols available as in TX1/RX1 SPI is not available unless the D_SEL interface is set up accordingly
1PPS		1 pulse per second, synchronize at rising edge, pulse length 100mS