

VS36-12D

ADS-B High Performance Receiver Module

1. Brief introduction

The VS36-12D is a highly integrated, small, low-power ADS-B Mode S receiver with a typical operating current of only 60mA. This receiver has very good performance. A two-stage narrow-band filter and a one-stage low-noise amplifier are used at the signal input of the receiver to effectively filter out most of the out-of-band noise in the space channel to obtain a better signal-to-noise ratio. The integrated high-dynamic signal processing circuit allows simultaneous reception of ADS-B broadcast information from short to long distance.



The VS36-12D ADS-B receiver integrates a dual-core processor, and with the self-developed ADS-B information decoding algorithm and collision detection algorithm, it can output the original ADS-B message and the calculated aircraft plaintext information (aircraft identification number ICAO, flight number, latitude and longitude, altitude, speed, heading, transponder number, etc.), and Mavlink2 messages, and the Flag pin can be configured to output a high level when a collision risk is detected or an ADS-B signal is detected.

Features

- Maximum receiver sensitivity -90dBm
- Ultra-small size 50× 38× 5mm
- Low power consumption: <60mA (at input voltage 5V)
- USART TTL level data interface, baud rate between 9600-921600
- Working indicator (red LED) and output indicator (green LED)
- The antenna has an integrated lightning protection circuit

Application

- ADS-B signal receiver

- Ground equipment, virtual radar
- Aerial obstacle avoidance, drone collision risk monitoring
- Airspace monitoring

2. Absolute Maximum Ratings

Table 1 Limit parameter ranges

parameter	value	unit
Supply voltage range V_{in}	-0.5-10	V
All other pin input voltage ranges	-0.5- V_{in}	V
Antenna maximum input power	5	dBm
Operating temperature	-30 to +85	°C
Storage temperature	-40 to +125	°C

3. Basic parameters

Table 2 Basic operating parameters

parameter	Min	typical	Max	unit
Supply voltage	3.7	5	9	V
Operating current		60	68	mA
Receive sensitivity	-85	-90		dBm
Dynamic range	-100		-20	dBm
Antenna input impedance		50		Ω
Serial pin IO level high	2.8	3.3	3.3	V
Flag pin outputs level high	3.1	3.3	3.3	V
Maximum target	100			Batches/racks
Monitoring range		250		km

4. Pin definition

Table 3 Module pin definitions

Pin NO.	name	illustrate
1	Flag	Signal output (refer to operating mode description)
2	UART_RX	UART serial input pin, 3.3V level*
3	UART_TX	UART serial output pin, 3.3V level*
4	GND	Grounding (power supply negative).
5	VIN	Power supply (typical 5V)

5. Detailed introduction

The VS36-12D is a high-performance receiver for ADS-B. Due to the high input sensitivity, the receiver only needs to connect to an ordinary passive antenna to reach a monitoring range of more than 250km. The VS36-12D is very easy to use, and all communication and settings can be done through the serial port. The serial port is 3.3V TTL level, and the baud rate is between 9600-921600 (there are 4 baud rates to choose from, namely 9600, 115200, 460800, 921600, the default is 921600), it is recommended to use a higher baud rate, which can ensure the real-time data output in busy airspace. In order to improve the performance of the receiver, it is recommended to use a dedicated 1090MHz, 5dBi antenna or more, and add a 47uF and 100nF capacitor between the 5V supply and GND to reduce the power supply ripple, and a 47uF tantalum capacitor is recommended.

There are a total of 25 possible types of ADS-B text format data, but in general, types 17 & 18 (extended response signals) are the most important. The following table shows all the types in short form. For more information, please refer to ADS-B specifications, such as ICAO (International Civil Aviation Organization) publications.

5.1 Working Mode

VS36-12D has 6 working modes, and the default working mode is Mode 3. Use UART command in table 4 to configure the device in different working modes. The following table provides a brief description of the various modes.

Table 4 VS36-12D operation mode description

Mode	UART commands	Indicator status	Serial port output data format
Mode 0	VS11,0#	The Flag pin and green LED indicator status are controlled by the sensitivity parameter	Serial port data output is disabled
Mode 1	VS11,1#	The Flag pin and green LED indicator status are controlled by the sensitivity parameter	The serial port outputs the aircraft ICAO, call sign (flight number), latitude and longitude, altitude, speed, heading and other information in real time, and the format is as follows \$7810EA,DKH1157,022.5921,113.7482,3901,596,250,0,6321,56# \$7808A5,,022.6822,113.7679,3360,712,354,3.57,3360,44#
Mode 3 Default value	VS11,3#	When a valid ADS-B data frame is detected, the Flag output is high and the green LED is solid	The serial port only outputs DF17/DF18 ADS-B text data in the following format *8D89630AEA469858011C0864254E; *8D780BC5230D8078CF8C204F503E; *8D780BC5581BD30422CB6A10347F;
Mode 5	VS11,5#	When a valid ADS-B data frame is detected, the Flag output is high and the green LED is solid	The serial port only outputs the DF17/DF18 ADS-B text data with signal strength marker, and the format is as follows +1E8D7811AEF8230003004978F833A2; +1D8D7811AE990C3C0E98300794501F; +1B8D7804569908F021B0081E49DFE4;
Mode 6	VS11,6#	The Flag pin and green LED indicator status are controlled by the sensitivity parameter	The serial port outputs data in MavLink2 format FD 26 00 00 58 01 90 F6 00 00 37 04 78 00 4B 6C 5D 0D 09 48 CE 43 EC 34 2A 00 3F 5B EC 3A D3 04 03 00 00 00 01 00 00 00 00 00 00 00 00 00 0A 02 FD 25
Mode 7	VS11,7#	The Flag pin and green LED indicator status are controlled by the sensitivity parameter	The latitude and longitude of the aircraft are updated, and the serial port immediately outputs the plaintext information of the aircraft, in the following format \$7810EA,DKH1157,022.5921,113.7482,3901,596,250,0,6321,56# \$7808A5,,022.6822,113.7679,3360,712,354,3.57,3360,44#

- **Mode 0: Enables the internal collision detection algorithm and disables the data output of the serial port**

In operating mode 0, the VS36-12D serial port does not output any data, but the VS36-12D still operates at full power, in this mode, the VS36-12D receiver uses the saved sensitivity parameters to control the Flag pin output. A sensitivity of 0 means that

the internal collision monitoring is turned off, and the Flag outputs a low level all the time, 1 means that the Flag outputs a high level when the aircraft is detected and the speed is greater than the set speed, and 3 means that the Flag outputs a high level when the aircraft signal is detected. When the Flag output is high, the green LED indicator is always on. The sensitivity is set to 0 by default, and parameters such as sensitivity and warning radius height can be set through VS12 commands.

- **Mode 1: Enables the internal collision detection algorithm and outputs the plaintext information of the aircraft through the serial port**

In working mode 1, VS36-12D is similar to working mode 0, but the serial port will output all detected aircraft information in real time. The data format of the serial port output is as follows, each ASCII frame starts with \$ and ends with #+ <CR><LF>. where the altitude is the barometric altitude, the unit of speed is km/h, the unit of climb rate is m/s, and the check code is \$ (excluding \$) to the last "," (inclusive,) all data is taken as a hexadecimal value. The data format is as follow:

\$, ICAO, Cllsign, latitude, longitude, alt, speed, heading, uprate, squawk, Checksum, #

For example:

```
$4BA94E,THY24_,022.5175,113.5534,44927,958,118,-0.32,5740,16#
$78136B,CSZ9937,022.6667,113.9978,3299,578,349,-0.65,4225,22#
$780254,,022.6010,113.8319,3474,312,154,11.05,0000,08#
$78136B,CSZ9937,022.6673,113.9977,3299,578,349,-0.65,4225,28#
$78008A,CSN6082,022.5227,113.7874,15240,621,352,5.20,3373,2B#
```

- **Mode 3: Disable the internal collision detection algorithm and output DF17/DF18/DF19 text data from the serial port**

In this working mode, VS36-12D turns off the internal collision detection algorithm, and the serial port outputs DF17/DF18/DF19 ADS-B text data. In this mode, when the VS36-12D detects a valid ADS-B data frame, the Flag pin outputs high and the status indicator (green LED) is solid.

For example:

```
*8D780BC5581B86C4842957C96C3F;
*8D780BC599886F9B10C406E69A89;
*8D89630AEA469858011C0864254E;
*8D780BC5230D8078CF8C204F503E;
*8D780BC5581BD30422CB6A10347F;
*8D780BC59908749AD0D4050E898A;
*8D89630A58B9C2E9CCC8738B0747;
```

- **Mode 5: Disable the internal collision detection algorithm, and output DF text data with signal strength from the serial port**

In working mode 5, the serial port outputs ADS-B text data with signal strength flag in real time. In this mode, the output of a 112-bit raw data frame is a 15-byte ASCII frame with the MSB first, and each ASCII frame starts with +, starting with; + < CR><LF > ends. The first character is a "+" sign of additional signal strength, and the next information is the received ADS-B data.

For example:

```
+908D7811AEF8230003004978F833A2;
+9F8D7811AE990C3C0E98300794501F;
+858D7804569908F021B0081E49DFE4;
```

- **Mode 6: MavLink2 packet output**

For aircraft data in MavLink2 protocol format, please refer to the MavLink2 protocol document, data bit hexadecimal data stream, each frame of data starts with 0xFD, and is output once per second: The format is as follows:

```
FD 26 00 00 56 01 90 F6 00 00 2D 07 78 00 ED F2 67 0D 9F 72 A6 43 40 5D 80
00 58 4D 3E 5E 00 00 03 00 00 00 01 4F 4B 41 32 39 33 31 00 00 0A 01 7B 84 FD
26 00 00 57 01 90 F6 00 00 B6 0D 78 00 30 24 65 0D 51 19 9F 43 90 E5 A7 00 87
4C 5C 5C 00 00 0F 00 00 00 01 43 45 53 36 33 33 31 00 00 0A 01 EF 39 FD 26 00
00 58 01 90 F6 00 00 37 04 78 00 4B 6C 5D 0D 09 48 CE 43 EC 34 2A 00 3F 5B EC
3A D3 04 03 00 00 00 01 00 00 00 00 00 00 00 00 00 00 0A 02 FD 25
```

- **Mode 7: Enables the internal collision detection algorithm, and the serial port outputs the plaintext information of the aircraft in real time**

The operating mode 7 is the same as the aircraft plaintext information protocol format output by working mode 1, except that the mode 1 device aggregates all the aircraft information received in the previous second every second, and then outputs all the aircraft plaintext information once a second, and will stop outputting the plaintext information of the aircraft if the aircraft signal is not received for 3 consecutive seconds. When the equipment works in mode 7, as long as the latitude and longitude of the received aircraft changes, the plaintext information of the aircraft will be output immediately, which is suitable for the occasions with high real-time requirements for monitoring the position of the aircraft.

Important Notes:

The signal strength indicator in front of the data is only an indicator of the field

strength of the received frame, not a measurement of the distance to the transmitter from which it can be derived. The range of values is approximately between 0x30 (long-range signal) and 0x80 (short-range signal).

5.2 UART interface information

The VS36-12D can be connected to a host system or microcontroller via a UART interface. The UART interface can be used to send ADS-B text messages and receive control messages. There are 4 types of baud rate to choose from, namely 9600, 115200, 460800 and 921600, the default baud rate is 921600, and the I/O level is TTL 3.3V (refer to basic parameter data), if you need a 5V level, you need to do a level conversion.

The UART interface protocol is: n,8,1

5.3 Introduction to Configuration Commands

All configuration directives start with "VS" and end with "#". The parameters in the configuration directive are separated by ",". If it is a query command, you do not need to fill in the parameters. OK is returned if the configuration is successful, otherwise ERR is returned.

Table 6 Configuration commands

Command description	commands	illustrate
Get version	VS00, #	Returns device's firmware version and firmware time after receiving it.
Get working mode	VS01, #	Returns working mode of the device.
Get collision detection parameters	VS02, #	Returns collision detection parameters.
Get device position	VS03, #	Return latitude, longitude and altitude of the device.
Set working mode	VS11,1#	In the example on the left, the device is set to Mode 1.
Set collision detection parameters	VS12,1,1000,50000,100#	The four parameters are sensitivity, warning height (meters), warning radius (meters), and warning speed (km/h). There are 3 levels of sensitivity, ranging from 0 to 2. 0 means that the internal collision monitoring is turned off, 1

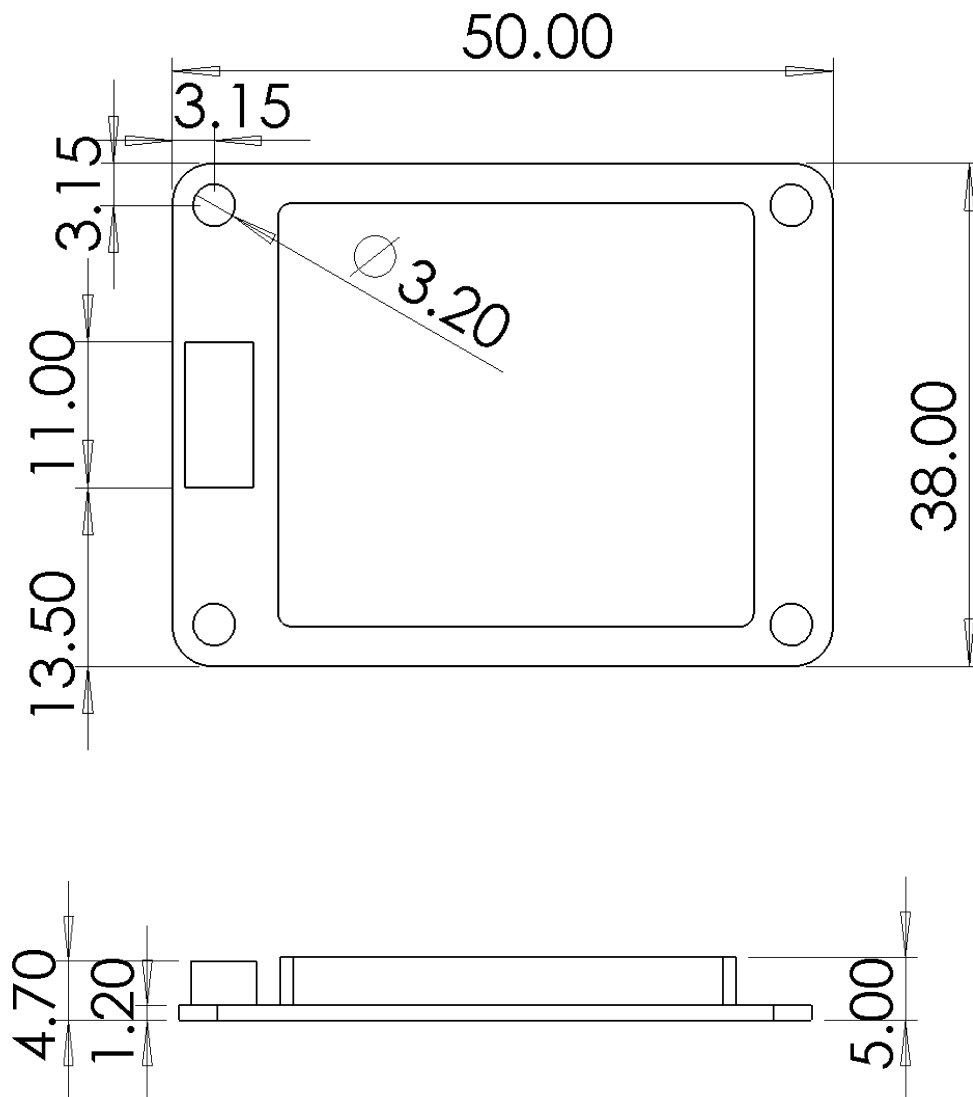
		<p>means that when the aircraft is enter the set radius and altitude range, and the speed is greater than the set speed, the flag output is high, and 2 means that when aircraft signal is detected the flag output is high.</p> <p><u>This value is used for collision detection warning, and the sensitivity factory default value is 0.</u></p>
Set device position	VS13,22.56,113.87,123#	<p>The three parameters are latitude, longitude, and altitude of the device. East longitude and north latitude are positive, and west and south latitudes are negative.</p> <p><u>This value is used for collision detection warnings.</u></p>
Set device baud rate	VS14,3#	<p>0 represents 9600, 1 represents 115200, 2 represents 460800, 3 represents 921600, and the factory default is 921600.</p>

LED indicator status description

LED	state	illustrate
red light	flashing	Slow flash standby, fast flash to receive the data frame
	others	The module is abnormal
green light	Mode 0 and 1 Solid on/always off	<p>When the sensitivity is 0: the LED is always off, and the Flag output is low;</p> <p>When the sensitivity is 1: the LED is always on when an aircraft is detected to enter the preset radius and altitude range, and the Flag output is high;</p> <p>When the sensitivity is 2: the LED is always on when the aircraft signal is detected, and the Flag output is high</p>
	Mode 2 is always on	A valid ADS-B data frame is detected, the LED is always on, and the Flag output is high
	Mode 3,4,5 Solid on	A valid ADS-B data frame is detected, the LED is always on, and the Flag output is high

Mechanical dimensions

The size of the VS36-12D ADS-B receiver module is 50×38×5mm, and the board has 4 positioning holes with a diameter of 3.2mm, which is convenient for fixing and installation.



All dimensions in the above picture are in mm.

Cooperative consulting

Our team is skilled in software and hardware development and support tailor made for special application. If you need to customize products, please contact our sales.

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