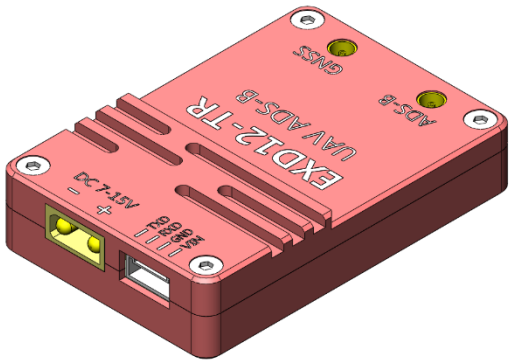
EXD12-TR

Highly integrated small size ADS-B transceiver

1. Brief introduction



EXD12-TR is a highly integrated and small-size ADS-B transceiver specially used in the field of unmanned aerial vehicles and small manned aircraft. It has the advantages of small size, light weight, high integration (integrated ADS-B out, ADS-B int, GNSS module, high-precision barometric pressure sensor, etc.), and low power consumption, especially suitable for UAVs, airships and other occasions with strict requirements for volume and weight.

EXD12-TR is fully compliant with the DO-260B standard and supports wide power input, which can meet the power supply needs of almost all types of drones on the market without the need for additional power adaptation circuits. It supports UART TTL communication protocol and MavLink protocol. The device RF output power (0.5W,1W, 2W,4W) is configurable by the UART command and it can be directly connected to various flight control computers (Pixhawk 4), does not need to modify the original aircraft, and is very convenient to use.

Features

- Compliant with DO-260B
- RF output power configurable 27 – 36dBm (0.5W -4W)
- ADS-B receive sensitivity -90dBm
- Integrated GNSS module, support SBAS
- Integrated ADS-B out, ADS-B in and barometric sensor
- UART TTL communication interfaces, baud rate 9600-921600

Fields of application

- UAV ADS-B out
- Unmanned airships, floating platforms,, small navigable aircraft

2. Absolute Maximum Ratings

Table 1 Absolute Maximum Ratings

parameter	value	unit
Supply voltage range Vin	-0.5-18	V
All other pin input voltage ranges	-0.5-Vin	V
Operating temperature	-30 to +85	ºC
Storage temperature	-40 to +125	ºC

3. Basic parameters

Table 2 Basic operating parameters

parameter	min	typical	max	unit
Supply voltage	7	12	15	V
Operating current		110	150	mA
Antenna impedance		50		Ω
Operating frequency		1090		MHz
RF transmit power	27-36dBm （configurable）			
Transmit Range	About 10km			
ADS-B receiver sensitivity	-90dBm			
GNSS sensitivity	-160			dBm
Average power consumption	Approx. 1.5W			
GNSS performance	Multi-mode positioning, support SBAS, horizontal accuracy < 2.5 meters			
Barometric pressure sensor	High-precision barometric pressure sensor with an accuracy of 10cm			
Antenna interface	ADS-B：SMA 1090MHz， GNSS：SMA			
Main power interface	XT30PW-M20			
Communication and power interface	GH1.25-4P standard interface, serial port 3.3V TTL level, data format UART, n,8,1, baud rate range 9600-921600			
Signal type (ADS-B out)	1090ES Intermittent Oscillation Signal (DF17, DF18)			
Signal type (ADS-B in)	DF17/DF18, CSV or MavLink			

1. Typical operating currents are measured at 12V operating voltage.

2. Note that the maximum range is also affected by the type of ADS-B transmitting antenna and the location where the antenna is mounted.

4. Interface description and pin definition

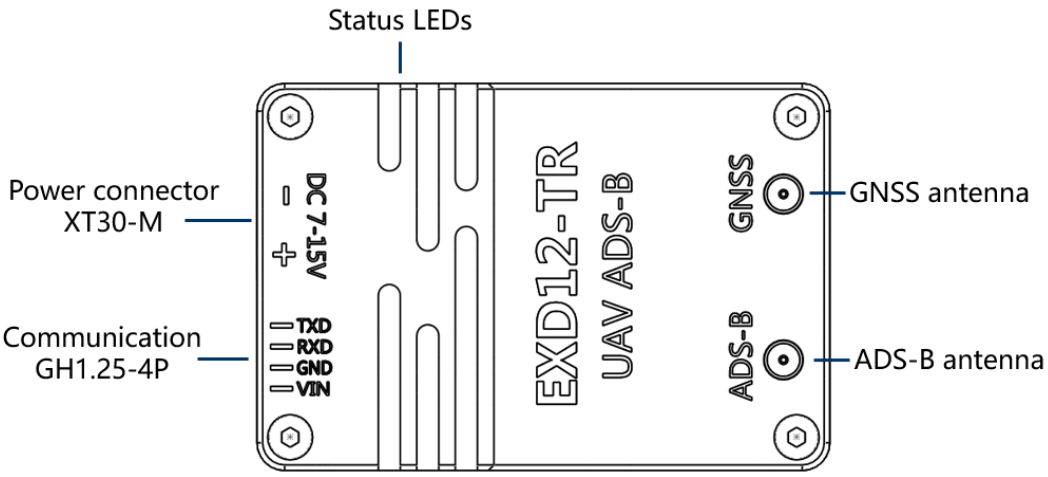


Figure 1 Interface description of the EXD12-TR transceiver

Table 3 Pin definitions

Pin number	name	type	illustrate
1	GND	Main power connector	Power Ground
2	VCC		Main power input, external 7-15V power supply
1	VIN	Communication and power connector	Power input, external 5-15V power supply
2	GND		Power Ground
3	RXD		UART data interface pin, 3.3V level
4	TXD		UART data transmit pin, 3.3V level

note

1. The device can work normally whether connect one of the power ports or connect both power ports.
2. The GNSS antenna needs to choose an active antenna, and the antenna surface should be facing the sky

Table 4 LED status description

LED	state	illustrate
red light	flashing	Flashing 1 time in 1 second, the transmitter works normally
	Solid on	If the self-test fails or fails, try restarting the device manually
	Long extinguished	The power supply is not connected or the transmitter is faulty
Orange light	Flash fast	ADS-B out is working and broadcasting data
	Solid on	The frequency phase-locked loop is locked, but no data is broadcast outward
green light	flashing	The 1pps signal of the GNSS module, flashing once in 1 second means that the GNSS positioning is successful

5. Detailed Introduction

The EXD12-TR transceiver is installed on the drone/aircraft, which can broadcast the aircraft's information includes altitude, latitude, longitude, heading, ground speed, uprate through 1090ES, and can receive ADS-B signals sent from other aircraft to achieve autonomous obstacle avoidance. The device is mainly composed of a frequency source (including a modulator), a RF power amplifier and a controller. The frequency source generates the required carrier frequency, and the modulator modulates the baseband signal on the carrier according to the requirements, and then amplifies the power of the signal through the amplifier, and finally outputs it through the antenna. The control circuit is mainly connected with the host computer/flight controller, and is used to set parameters such as flight number and address number.

The ADS-B transceiver can receive the navigation information from the flight control computer including latitude and longitude, speed, altitude and other information through the UART TTL interface, if the device does not receive the navigation information sent from the port within 10 seconds, the device will use the integrated GNSS module and the barometric sensor to calculate the corresponding information, and then divide it into a plurality of 56-bit data according to various types, and insert the ME field of DF17/DF18 format to assemble into a plurality The 1090ES datalink transmits different types of ADS-B messages, which are then modulated on the RF carrier, and transmitted in the form of ADS-B 1090ES via an omnidirectional

transmitting antenna.

The ADS-B transceiver needs to be configured for the first time of use. After powering on, the transmitter can broadcast ADS-B information to the outside in real time; After receiving the DF17/DF18 packet broadcast by the transceiver, the ground station demodulates the standard message format and sends it to the ground display and control terminal through the network, which can display the flight number, ICAO address, flight altitude, speed and heading of the aircraft. The transceiver can enable the receiving or transmitting function independently, if the receiving function is not required, only the power cable needs to be connected, and the data interface is not required.

6. Communication protocols

EXD12-TR can communicate with the computer or flight controller through the GH1.25-4P connector (UART TTL 3.3V level) to set the transmitter's ICAO, callsign and other parameters and receive data from ADS-B in.

6.1. Configure the command communication protocol

All configuration commands start with "VS", and the parameters in the command are separated by "," (note that the parameters in the flight parameters are hexadecimal, no need to use them, spaced). If it is a query command, you do not need to fill in the parameters.

Table 5 Configuration commands

Command description	command	illustrate
Get Version	VS00, #	Returns the firmware version and firmware time after receiving it.
Get device parameters	VS01, #	Return the current parameters of the device are returned.
Set the device parameters	VS11,AABBCC,TEST 1234,00,1,18, #	The data format is VS11, ICAO address (6 characters), flight number (less than 8 characters), working mode (2 characters), aircraft type (1 character), packet type (17 or 18), #
Set RF power	VS19,1W#	Parameter between 1-4. 1 represent 0.5w, 2 represent 1w, 3 represent 2w, 4 represent 4w
Set squawk code	VS17,1234#	Set the squawk code to 1234
Set the current flight parameters of the device	56 53 23 44 98 FE 0B D0 61 77 3D 58 1B 4F 06 82 FF 9D 08 FE	See Table 6 for hexadecimal data and communication protocols. If the device does not receive the flight parameters sent by the serial port for 5 seconds, the device will use the internal GNSS module and the barometric sensor to calculate the flight parameters of the transmitter independently

There are a total of 8 working modes: 11 represents ADS-B in and out, raw ADS-B packet; 12 represents ADS-B in and out, airplane plaintext; 13 represents ADS-B in and out, MavLink packet; 10 represents the ADS-B out only, 01 represents ADS-B in only, raw ADS-B packet; 02 represents ADS-B in only, aircraft plaintext; 03 represents t ADS-B in only, MavLink packet; and 00 represents standby. There are a total of 5 aircraft types to choose from: 1 for untyped, 2 for unmanned aerial vehicles, 3 for

gliders, 4 for hang gliders, parafoils, 5 for ultralight, and 6 for ultralight Light (less than 7000kg), 7 for Parachutist, skydriver, 8 for Space or transatmospheric vehicle.

The EXD12-TR has a built-in GNSS module and a barometric sensor, and if the transmitter does not receive the flight parameters sent by the flight computer within 5 seconds, the transmitter will use the internal GNSS module and the barometric sensor to calculate the flight parameters of the transmitter independently. The flight parameters can be sent to the transmitter through communication interface 1 or communication interface 2, and the data communication protocol is shown in Table 6.

Table 6 Flight parameter communication data protocol

	类型	长度	说明
帧头	无	3	固定 0X56 0X53 0X23
纬度	int32_t	4	输入的数值乘10^7
经度	int32_t	4	输入的数值乘10^7
高度	uint16_t	2	输入的数值
航向角	uint16_t	2	输入的数值乘10
升降率	int16_t	2	输入的数值乘10
速度	uint16_t	2	输入的数值乘10
校验码	无	1	除了帧头所有字节取异或

Note that all data is low in front and high in the back. For example, the current flight parameters latitude 20.12345, longitude 103.1234, altitude 7000 (unit meters), heading 161.5 (unit degrees), uprate -12.3 (unit m/s), ground speed 220.5 (unit m/s), then the flight parameters sent by the flight computer to the transmitter are:

56 53 23 44 98 FE 0B D0 61 77 3D 58 1B 4F 06 82 FF 9D 08 FE

The CRC function is

```
unsigned char CRC8 (unsigned char *buffer, unsigned int len)
{
    unsigned char crc = 0;
     unsigned int j;
     for (j =0; j < len; j++)
     {
          crc ^= buffer[j];
      }
     return crc;
}
```

6.2. ADS-B in data communication protocol

The EXD12-TR integrates a high-sensitivity receiver chip with a typical sensitivity of <-90dBm, which can receive aircraft signals from a range of 200km. There are three ADS-B in data output formats, and the data is output in real time through communication and power interface 1 and communication and power interface 2. The data format can be configured through the serial port. The three data output formats are detailed below.

- **Raw ADS-B packet (DF17/DF18).**

In this working mode, the EXD12-TR outputs DF17/DF18 ADS-B text data in real time through the serial port, and each ASCII frame starts with *, to; + < CR><LF > ends.

For example:

*8D780BC5581B86C4842957C96C3F;
*8D780BC599886F9B10C406E69A89;
*8D89630AEA469858011C0864254E;
*8D780BC5230D8078CF8C204F503E;
*8D780BC5581BD30422CB6A10347F;

- **Aircraft plaintext**

In this working mode, the EXD12-TR the device outputs aircraft plaintext information immediately if the latitude and longitude of the aircraft are updated. The data format of the data is as follows, each ASCII frame starts with $ and ends with #+ <CR><LF>. The parameters are separated by a "," sign. 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 "," between which all data is taken as hexadecimal values. The data format is as follow:

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

For example:

$7811AD,CSZ9457,022.4753,113.7895,8930,474,230,10.72,2433,4E#
$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#

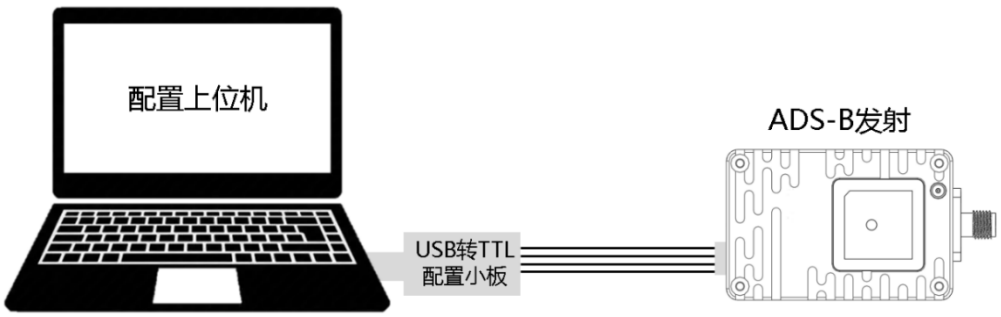
- **Packets in MavLink2 format**

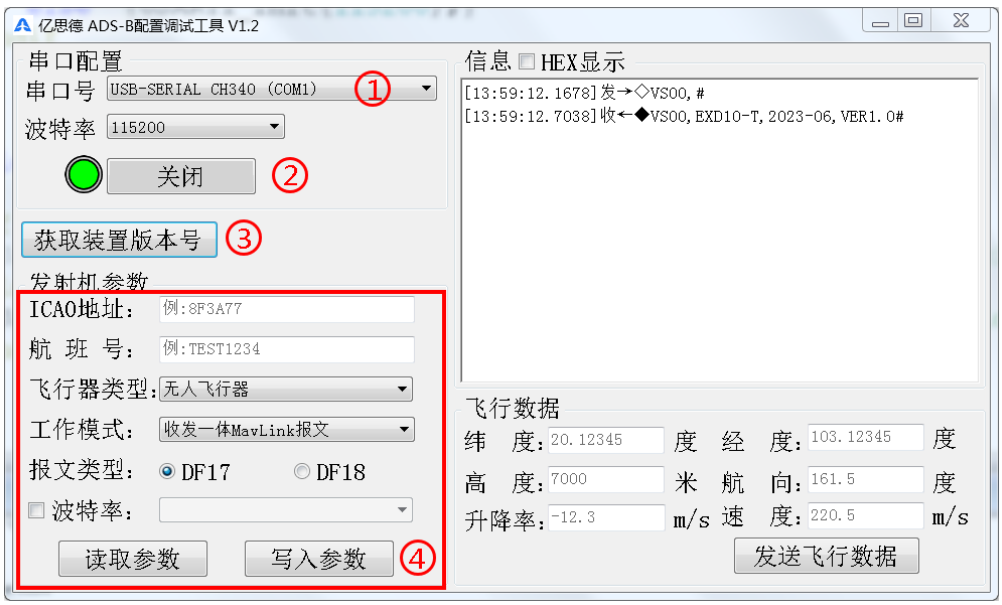
In this working mode, the device outputs aircraft data in Mavlink2 protocol format through the serial port, once per second: in the following format:

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 0A 02 FD 25

7. Configure Tool

Use the USB to TTL configuration board provided by our company to connect the computer and the transmitter, double-click the ADS-B Configure Tool.exe to open the configuration host computer software, as shown in the following figure



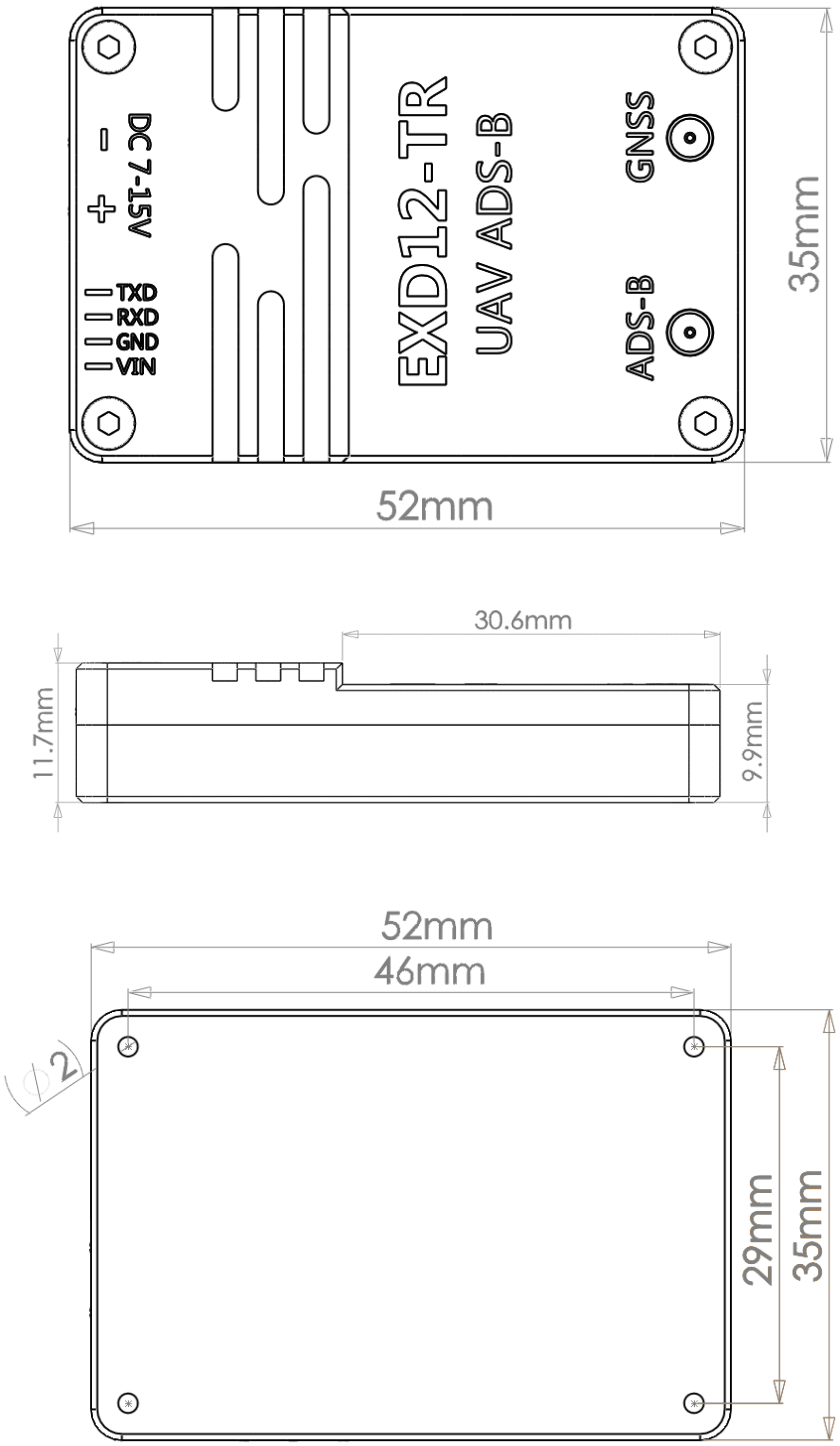


1. Select the correct baud rate and baud rate, the transmitter default baud rate is 115200.
2. Click to open the serial port.
3. Click to get the device version number, if the right information window has the

return device version information, it proves that the host computer and the transmitter have successfully communicated, otherwise check whether the serial slogan and baud rate are correct, and whether the connection is good.

4. Fill in the correct ICAO number and flight number, select the aircraft type, transmitter working mode, and packet type, and then click Write Parameters, if VS11 is returned in the information window on the right, OK# indicates that the parameters are written successfully. Note that the ICAO number must consist of 6 characters, and the legal characters are 0-9, A-F, such as 8D3A45. The flight number is generally composed of 3 English characters and 4 digits, such as CSN1234, the flight number cannot exceed 8 digits.

8. Mechanical dimensions



EXD12-TR mechanical size

All dimensions in the above picture are in mm.

Update history

Time	version	Modify the record
2023-07-11	V1.0	Initial release
2024-2-7	V1.1	Added the description of the communication interface data protocol

Cooperative consulting

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