# YUNOFDM 2.4G module manual

1.General Description

YUNOFDM is a point-to-point broadband access and data transmission module. The product is based on a custom wireless communication protocol and uses OFDM (Orthogonal Frequency Division Multiplexing). YUNOFDM modules has two ipex connectors for connecting 3dBi antenna, supports 1T2R MISO mode, the system configures one of them transmitting depending on better received signal quality at two antennas by system automatically recognizes. YUNOFDM only supports 10 MHZ bandwidth. flattening System architecture design, effectively reduce System latency, improve the ability to transfer and have the transmission distance data throughput big strong anti-interference characteristics of the product is the first of SOC (System on Chip) chips, provides the high level of integration point-to-point transmission module, greatly reduce the power consumption of the System, and reduce the module size, satisfy the customer the demand of the development of UAV video monitoring, YUNOFDM module supports 2.4g frequency band.

2.Application

YUNOFDM module provides upper computer four interfaces USB, RJ45, UART0 and COMUART for connection. Two modules on the platform can realize the connection of air port and realize wireless data transmission. The details are shown in the figure below:
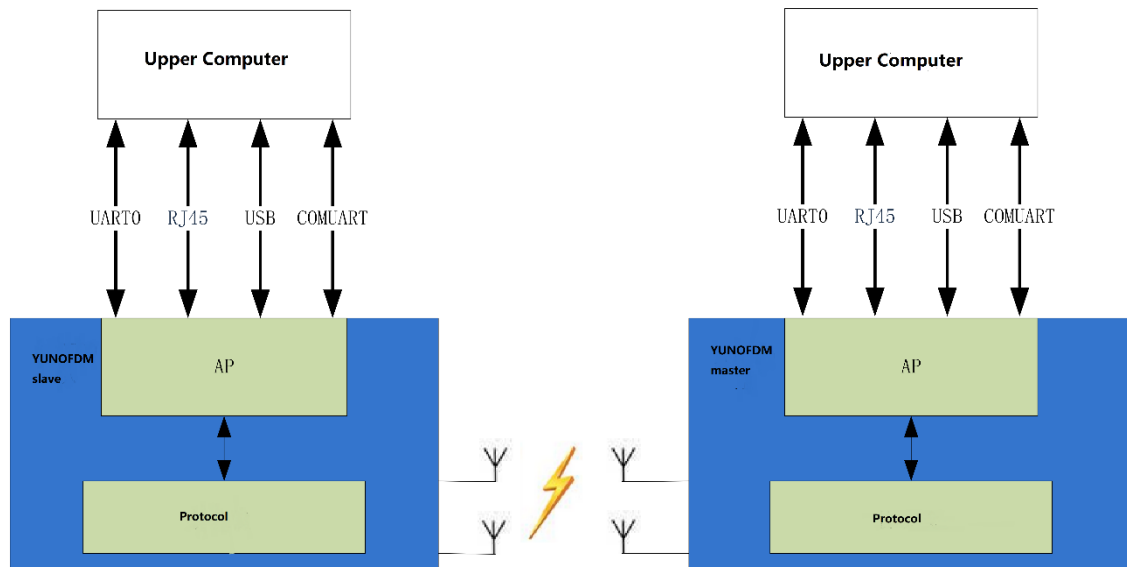
3.Interfaces

3.1 Hardware Interface

Modules support the following interface types on hardware:

Hardware interface type	Number of pins	Marks

UART0	4	Log output or issue the AT command
COM_UART	2	Flight control data usage
USB	2	
HSIC	2	Out to LAN
VCC_HSIC2LAN	1	HSIC to LAN chip 3.3v power supply
I2C3	2	
GPIOs	6	Control interactive interrupt information, etc
VBAT	3	Power
D1V8A	1	1.8V power supply
VRTC	1	RTC battery input 3V
POWER_KEY	1	Boot, high level active, VBAT domain
DLDL	1	Boot download, high level active,1.8-3.3V
DBB_RSTOUT_N	1	Reset button, low effective, 1.8v
D2V85A	1	2.85v interface power supply, for JTAG

3.1.1 Power supply interface

3.1.1.1 Module power supply VBAT

The module power supply shall be supplied by the external stabilized dc power supply through the VBAT pin, and the voltage range is 3.55v ~ 4.35v.

3.1.1.2 RTC power supply VSB

After VBAT power is off, external power supply is needed to maintain the RTC clock information, with a typical value of 3V, 1.8-3.3v.

3.1.1.3 D1V8A external power supply

1.8v external power supply, available for external use.

3.1.1.4 D2V85A external power supply

2.85v external power supply, available for external use.

3.1.2 Functional interface

3.1.2.1 POWER_KEY switch on and off signals

Raise 1.5 seconds module start up, lower 1.5 seconds module shutdown, 1.8V~VBAT voltage domain support;

3.1.2.2 RSTOUT_N reset signal

Output low level 32ms above hardware reset the entire module, 1.8V voltage domain.

3.1.3 Data communication interface

3.1.3.1 USB interface

USB2.0 interface, support HS high-speed transmission.

3.1.3.2 HSIC interface

Support USB2.0 HS high speed, can connect HSIC to LAN chip, connect camera of LAN interface. For external conversion IC, provide a 3.3v power supply (300mA), VCC_HSIC2LAN.

3.1.4 Other control interfaces

3.1.4.1 serial port

With flow control serial port UART0, 1.8v voltage domain, default baud rate 115200bps, the highest theoretical value can support 19.5mbps. COMUART is used for flight control, directly controlled by CP, with lower delay.

3.1.4.2 GPIOs

Six GPIOs are reserved in the module, which can realize the functions of handshake, interaction and interrupt indicator.

3.2 USB Interface programming

USB Virtual VCOM and NCM support Linux and Windows only

The Host recognizes the USB port	Host VCOM port	USB interface	Recommend function
ttyUSB0	COM1	1	AT command communication port
ttyUSB0	COM1	2	AT command communication port
ttyUSB0	COM1	3	AT command communication port
ttyUSB0	COM1	4	AT command communication port
ttyUSB0	NCM	5	virtual network card

3.3 IP address assignment

The YUNOFDM module and the host IP address are configured as follows:

	client）		server	
	Interface	IP	Interface	IP
Upper USB net card	Usb0	192.168.42.xx	Usb0	192.168.43.xx
Module rndis net card	Rndis0	192.168.42.129	Rndis0	192.168.43.129
Module LMI net card	Lmi40	192.168.0.2	Lmi40	192.168.0.1
Module LMI net card	Lmi41	192.168.0.4	Lmi40	192.168.0.3
Module eth net card	Eth0	192.168.2.129	Eth0	192.168.1.1

When the host computer is the android operating system, the configuration command of the reference network card is as follows:

Client side:

The host computer Usb network card device establishment process:

ifconfig usb0 192.168.42.58 up

ip route add default via 192.168.42.129 dev usb0

Module rndis network card establishment process

busybox ifconfig rndis0 192.168.42.129 up

iptables -t nat -A POSTROUTING -o lmi40 -j MASQUERADE

echo "1" > /proc/sys/net/ipv4/ip_forward

Server side:

The host computer Usb network card device establishment process:
ifconfig usb0 192.168.43.58 up
ip route add default via 192.168.43.129 dev usb0
Module rndis network card establishment process
busybox ifconfig rndis0 192.168.43.129 up
iptables -t nat -A POSTROUTING -o lmi40 -j MASQUERADE
echo "1" > /proc/sys/net/ipv4/ip_forward

The module RNDIS network card is CONFIGURED by detecting the USB status (CONFIGURED) or listening for the uevent event, and the IP address is queried by the AT command to the module master slave mode setting.
The module LMI network card is established, and the bridge driver is set according to the NVRAM configuration parameters.

4.Process

4.1 Summary
YUNOFDM is a module that supports point-to-point communication, so device types distinguish between master and slave devices. There is a difference in the boot process between the master and slave devices.
Taking the application of UAV industry as an example, the UAV end is the main device end, and the remote control is the slave device end.
The current design is to take the main device as the initiator of the network, so the main device first selects a clean frequency point to send the system message by sweeping, and at the same time starts the monitoring of the access channel.
The slave device is the access end of the network, so the same step frequency point is first found through the search network from the device end, the system message is received, and then the corresponding frame to initiate the access process.
After the system tasks are initialized, some pre-configuration work needs to be done before the system protocol is started.
The pre-configuration information may contain, but is not limited to, the device ID, the opposing ID, the access secret key, the user's operating frequency band, and so on. This information can be pre-configured in the file system according to product planning requirements.
After successful device access, the user can change the Settings of power, frequency band, rate and other parameters.
At the same time, after the completion of the chain can carry out data services such as graph transmission.
The specific process is as follows:
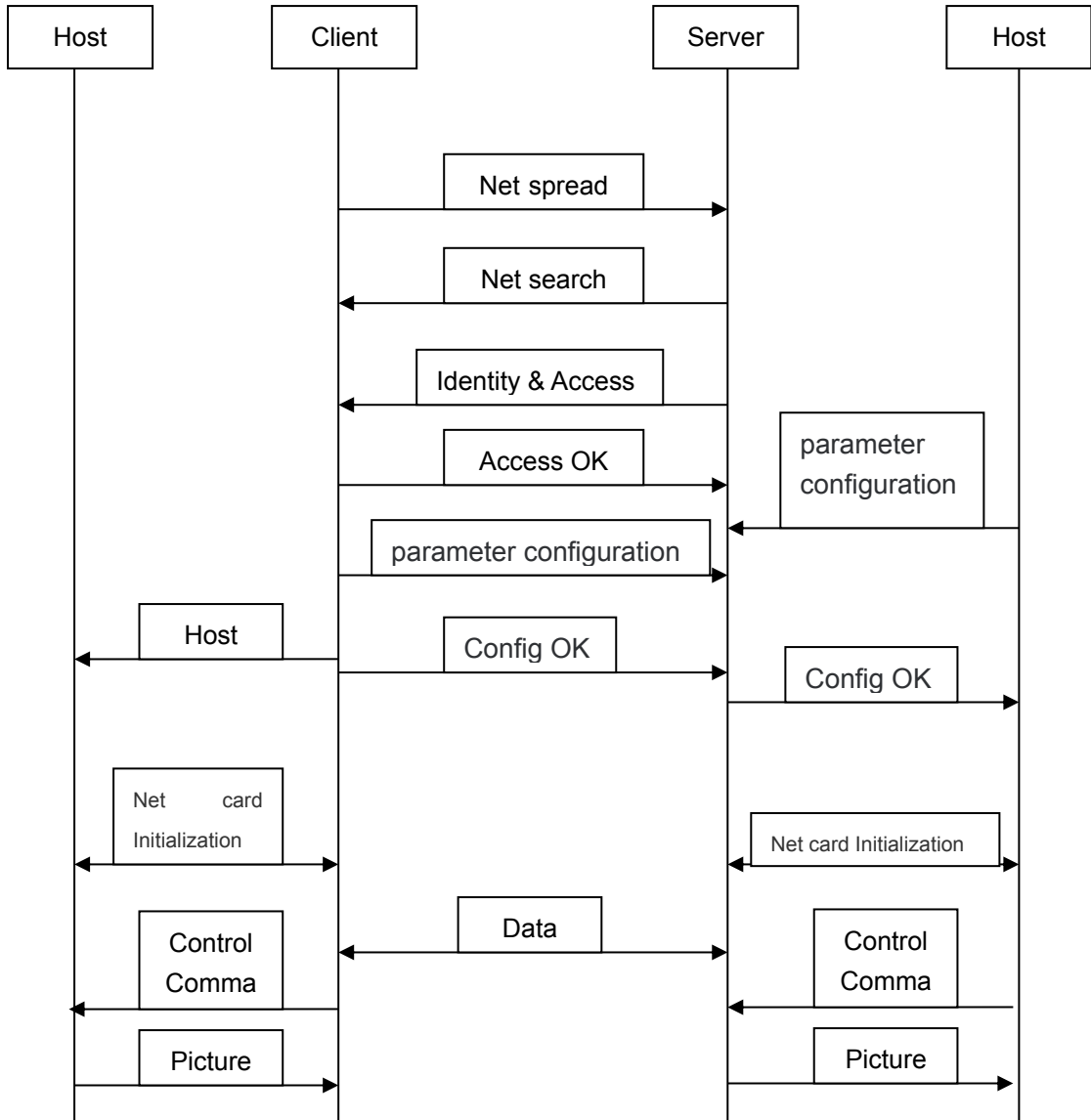
4.2 STARTING

The main module/slave module boot process is initiated by AT+CFUN=1.

After YUNOFDM module power on, the internal will automatically carry out the network/search, synchronization, chain building process, and internal opening

Status is actively reported.

The upper computer can judge the status of the module according to the result of active report.

The upper computer can judge that the YUNOFDM module has been started and successfully connected, and can do the necessary conditions for business

The following information was reported:

DACSI: 1 (the node starts up normally and spreads the network or searches the network successfully)

^DSYSI: 0 (connection between access node and control node)

DPDBSI: 1,1 (priority 1 business channel initialized)

DPDBSI: 2,1 (priority 2 business channel initialized)

DPDBSI: 3,1 (the business channel with priority 3 has been initialized)

If YUNOFDM

reports^DRPRI:<index>,<earfcn>,<cell_id>,<rssi>,<pathloss>,<rsrp>,<rsrq>,<snr>,<distance>,<tx_power>,<dl_throughput_total_tbs>,<ul_thrpughput_total_tbs>,<dlsch_tb_error_per>,<mcs>,<rb_num>,<wide_cqi>   during boot.

Then the upper computer can analyze and confirm the network state between master and slave devices.

4.3 Identity Authentication

The YUNOFDM implements a point-to-point communication solution, and the node indirectly has a two-level identity authentication mechanism to ensure the security of matching point-to-point access.

a) Access secret key

1. Master device and slave device need to preset the same access secret key, otherwise the underlying random access process cannot be completed.
2. The YUNOFDM version file system is configured with the same set of access keys by default, but allows users to customize the changes.
3. YUNOFDM provides the AT interface for setting the secret key:
AT^DAPI=<password_id>.
4. After setting, you need to power up and start up again, which can take effect permanently.

b) Authentication of device ID

1. Each device has its own unique device ID, no matter whether the master device or the slave device wants to set the device ID of the opposite end to each other.
2. When the connection is normally started, the slave device will inform the master device of its own device ID; After the master device is authenticated, the slave device will be informed of its own device ID, and the slave device also needs to be authenticated with

identity matching.

3. Boot access is completed only after authentication is bidirectional.

4. The AT instruction used to set the device ID is: AT^DTTEST=< CMD >(AT+CFUN=0/ set in production test scenario).

5. The AT instruction used to set the device ID is AT^DPDIL=< ID >.

6. After setting, you need to power up and start up again, which can take effect permanently.

7. The AT instruction used to query the device ID is AT^DAOCNDI?

4.4 Frequency

YUNOFDM only supports 2.4G band.

FCC statement

15.19

1. This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference.

(2) This device must accept any interference received, including interference that may cause undesired operation.

15.21

2. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

or

Note: The grantee is not responsible for any changes or modifications not expressly approved by the party responsible for compliance. Such modifications could void the user's authority to operate the equipment.

15.105(b)

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

  - Reorient or relocate the receiving antenna.

  - Increase the separation between the equipment and receiver.

  -Connect the equipment into an outlet on a circuit different from that to which the receiver is

connected.

  -Consult the dealer or an experienced radio/TV technician for help

IC Statement

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :
(1) l'appareil ne doit pas produire de brouillage, et
(2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

RF exposure statement

This equipment complies with FCC and IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Cet équipement est conforme aux limites d'exposition aux rayonnements de la IC établies pour un environnement non contrôé. Cet équipement doit être installé et fonctionner à au moins 20 cm de distance d'un radiateur ou de votre corps.

ORIGINAL EQUIPMENT MANUFACTURER (OEM) NOTES

The OEM must certify the final end product to comply with unintentional radiators (FCC Sections 15.107 and 15.109) before declaring compliance of the final product to Part 15 of the FCC rules and regulations. Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change.

The OEM must comply with the FCC labeling requirements. If the module's label is not visible when installed, then an additional permanent label must be applied on the outside of the finished product which states: "Contains transmitter module FCC ID: 2ACS5-YUNOFDM. Additionally, the following statement should be included on the label and in the final product's user manual: "This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interferences, and
(2) this device must accept any interference received, including interference that may cause undesired operation."

The module is limited to installation in mobile or fixed applications. Separate approval is required

for all other operating configurations, including portable configuration with respect to Part 2.1093 and different antenna configurations.

A module or modules can only be used without additional authorizations if they have been tested and granted under the same intended end‑use operational conditions, including simultaneous transmission operations. When they have not been tested and granted in this manner, additional testing and/or FCC application filing may be required. The most straightforward approach to address additional testing conditions is to have the grantee responsible for the certification of at least one of the modules submit a permissive change application. When having a module grantee file a permissive change is not practical or feasible, the following guidance provides some additional options for host manufacturers. Integrations using modules where additional testing and/or FCC application filing(s) may be required are: (A) a module used in devices requiring additional RF exposure compliance information (e.g., MPE evaluation or SAR testing); (B) limited and/or split modules not meeting all of the module requirements; and (C) simultaneous transmissions for independent collocated transmitters not previously granted together.

This Module is full modular approval, it is limited to OEM installation ONLY.
Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change. (OEM) Integrator has to assure compliance of the entire end product include the integrated Module. Additional measurements (15B) and/or equipment authorizations (e.g. Verification) may need to be addressed depending on co-location or simultaneous transmission issues if applicable. (OEM) Integrator is reminded to assure that these installation instructions will not be made available to the end user

The OEM integrator is responsible for ensuring that the end-user has no manual instruction to remove or install module.

IC labeling requirement for the final end product:

The final end product must be labeled in a visible area with the following "Contains IC: 11554B-YUNOFDM"

The Host Marketing Name (HMN) must be indicated at any location on the exterior of the host product or product packaging or product literature, which shall be available with the host product or online.