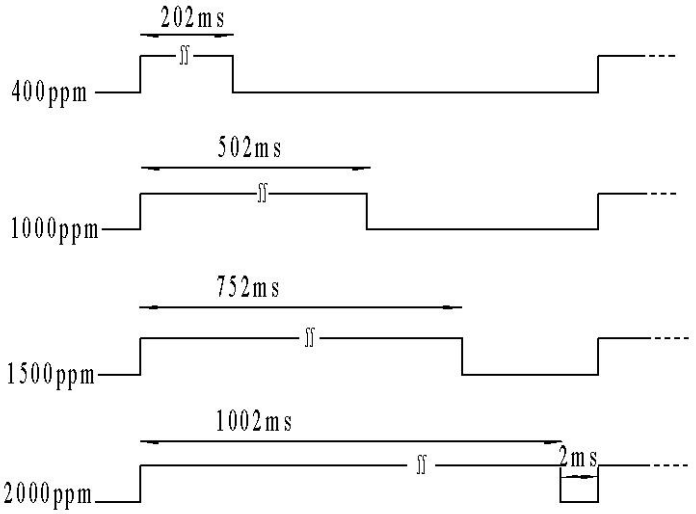
Output Method

1.PWM output

Take 400~2000ppm for example	
CO2 output range	400~2000ppm
Cycle	1004ms±5%
Cycle start high level output	2ms (theoretical value)
The middle cycle	1000ms±5%
cycle end low level output	2ms (theoretical value)
CO2 concentration: Cppm=2000×(TH-2ms)/(T-4ms)	
C_{ppm}: CO2 concentration could be calculated by PWM output TH high level output time during cycle T output time during cycle(1004ms±5%)	



2.Serial port output (UART)

Hardware connection

Connect module's Vin-GND-RXD-TXD to users' 5V-GND-TXD-RXD.

(Users must use TTL level. If RS232 level, it must be converted.)

Software setting

Set serial port baud rate be 9600, data bit 8 bytes, stop bit 1byte, parity bit null.

Commands	
0x86	Read CO2 concentration
0x79	Turn on/off self-calibration function

0x86- Read CO2 concentration								
Sending command								
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
Start Byte	Reserved	Command	-	-	-	-	-	Checksum
0xFF	0x01	0x86	0x00	0x00	0x00	0x00	0x00	0x79
Return value								
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
Start Byte	Command	Concentration (High 8 Byte)	Concentration (Low 8 Byte)	-	-	-	-	Checksum
0xFF	0x86	HIGH	LOW	-	-	-	-	Checksum
For example: CO2 concentration = HIGH * 256 + LOW How to calculate concentration: convert hexadecimal 01 into decimal 1, hexadecimal F4 into decimal 244, then 1*256+244=500ppm								

0x79- On/Off Self-calibration for Zero Point								
Send command-No return value								
Byte 0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
Start Byte	Reserved	Command	-	-	-	-	-	Checksum
0xFF	0x01	0x79	0xA0/0x00	0x00	0x00	0x00	0x00	Checksum
No return value **NOTE:** when byte3 is 0xA0, the auto calibration function is on; when byte3 is 0x00, the auto calibration function is turned off. The sensor factory by default is on self-calibration function.								

Checksum calculation method								
Checksum = (Negative (Byte1+Byte2+Byte3+Byte4+Byte5+Byte6+Byte7))+1								
For example:								
Byte0	Byte 1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
Start Byte	Reserved	Command	-	-	-	-	-	Checksum
0xFF	0x01	0x86	0x00	0x00	0x00	0x00	0x00	Checksum
Calculating Checksum： 1、Add Byte 1 to Byte 7: 0x01 + 0x86 + 0x00 + 0x00 + 0x00 + 0x00 + 0x00 = 0x87								

2、Negative: 0xFF - 0x87 = 0x78

3、Then+1：0x78 + 0x01 = 0x79

C language

```
char getCheckSum(char *packet)
{
    char i, checksum;
    for( i = 1; i < 8; i++)
    {
        checksum += packet[i];
    }
    checksum = 0xff – checksum;
```

3. Zero Point Calibration

This module has two methods for zero point calibration: hand-operated method and self-calibration. All the zero point is at 400ppm CO2.

Hand-operated method:

Connect module's HD pin to low level(0V), lasting for 7 seconds at least. Before calibrating the zero point, please ensure that the sensor is stable for more than 20 minutes at 400ppm ambient environment.

Self-calibration:

After the module works for some time, it can judge the zero point intelligently and do the zero calibration automatically. The calibration cycle is every 24 hours since the module is power on. The zero point is 400ppm.

This method is suitable for office and home environment, not suitable for agriculture greenhouse, farm, refrigerator, etc.. If the module is used in latter environment, please turn off this function.

Calibration Commands

Set a certain concentration calibration function:
For example: Current environmental concentration is 600ppm, send the following command via serial port;
FF 01 AD 02 58 00 00 00 F8 (this data is hexadecimal, i.e., 600ppm converted to hexadecimal is 02 58)
The sensor returns following command:
FF AD 01 00 00 00 00 00 52 means the sensor receives command correctly and then performs calibration. The sensor will be calibrated to the set concentration within a few minutes, usually there will be a +/-10ppm deviation;
The sensor returns following command:
FF AD 00 00 00 00 00 00 53 means the sensor has not received command correctly and cannot be calibrated.
When you send this command to the sensor, there must be 3 prerequisites:
1. The sensor has been powered on for more than 2 hours;
2. CO2 concentration of the sensor in current environment shoule be between 400 and 1000 ppm and cannot exceed this range, otherwise sending this command will be invalid.
3. CO2 concentration of the environment needs to stabilize for more than 10 minutes before sending this command, otherwise the calibration deviation will be relatively large.