

APC240

Low Power ISM RF Transceiver Module

V1.1

Features

- FSK transceiver Module
- 433Mhz ISM frequency band
- 20k bps FSK data rate
- Multiple channels
- 10dBm Max. output power
- Baud rate configurable
- Two 256 bytes data buffers
- Standby current < 1.5uA
- Supply voltage 2.1~3.6V

Application

- Home automation
- Security alarm
- Telemetry
- Automatic meter reading
- Contactless access
- Wireless data logger
- Remote motor control
- Wireless sensor network

DESCRIPTION

APC240 is a low-cost sub-1 GHz transceiver module designed for operations in the unlicensed ISM (Industrial Scientific Medical) and LPRD bands. FSK (Frequency Shift Keying) modulation/demodulation, multi-channel operation, high bandwidth efficiency and anti-blocking performance make APC240 modules easy to realize the robust and reliable wireless link.

The module can be configured to work in different channels with 200 KHz space. It adopts high efficient looped interleaving EDAC (Error Detection and correction) coding with coding gain up to 3dB which keeps in advance in error correction and coding efficiency over normal FEC (Forward Error Correction) coding. Because of its high reliability in correction, modules can filter error and fake information automatically and realize truly transparent wireless link, which makes APC240 very suitable in the rigid communication environment.

APC240 integrates two 256 bytes buffer. When the buffer is empty, users can transfer 256 bytes data per time and even limitless data transfer can be achieved as long as RF data rate (RF module to RF module) is configured to be faster than UART data rate (MCU to RF module). APC240 provides standard UART/TTL interface for selection. Users can choose seven datarates and three parity checks which make APC240 possibly tailor-made for different applications. APC240 operates at 2.1~3.6V with extra low power consumption. The current in polling mode can be mini-mized to 20uA and the current in receive mode no more than 4mA makes modules very suitable for battery powered-up applications.

PIN FUNCTIONS

PIN	Name	Function	Description
1	GND	Ground	Ground (0V)
2	VCC	Power	Power supply
3	SETA	Input	Parameter setting A; pull-up resistor: 47K Ohm
4	RXD	Input	UART input, TTL level; pull-up resistor:47K Ohm
5	TXD	Output	UART output, TTL level
6	AUX	Output	Data In/out indication
7	SETB	Input	Parameter setting B; pull-up resistor: 1M Ohm
8	NC	---	No connection
9	NC	---	No connection

Table 1 APC240 Pin functions

ELECTRICAL SPECIFICATIONS

Symbol	Parameter (condition)	Min.	Typ.	Max.	Units
VCC	Supply Voltage	2.1		3.6	V
Temp	Operating temperature range	-20	25	70	°C
RH	Operating relative humidity	10		90	%
Freq	Frequency range	430		437	MHz
FDEV	Modulation deviation		67		KHz
Mod	Modulation type		FSK		
IDD	Receive mode @ 1K bps		2.9		mA
	Receive mode @ 10K bps		3.2		mA
	Transmit mode @ 0dBm		20		mA
	Transmit mode @ 10dBm		35		mA
	Sleep mode		1.5		uA
Pout	Output power			10	dBm
Sen	Receiving sensitivity @ 1K bps		-113		dBm
	Receiving sensitivity @ 10K bps		-107		dBm
DRFSK	FSK data rate	1k		20	Kbps
DRIN	UART data rate	1.2		57.6	Kbps
Tw	Wake-up & Search preamble time .@ 1K bps		20		ms
	@ 2K bps		12		ms
	@ 5K bps		7		ms
	@ 10K bps		4.5		ms
	@ 20K bps		3.8		ms
Ts	Switching time		20		us
CHBW	Channel spacing		200		KHz

Z _{ANT}	Antenna Impedance		50		Ohm
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Table 2 APC240 Electrical Specifications

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Min.	Max.	Units
VCC	Supply Voltage	-0.3	3.7	V
V _I	Input voltage	-0.3	VCC+0.3	V
V _O	Output voltage	-0.3	VCC+0.3	V
T _{ST}	Storage temperature	-55	125	°C

Table 3 APC240 Maximum Ratings

APPLICATION INFORMATION

1. Coding Format

PREAMBLE	SYNCWORD	ID	DATA+FEC+CRC
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Table 4 APC240 Coding Format

The preamble is alternative “1010” codes which is used to make the clock of receiver synchronous with transmitter. In normal conditions, 32 bits preamble is enough for use. When APC240 works in power-saving mode, the preamble also can be functioned to wake up the receiver and it must be long enough in order to obtain such a function.

If the receiver is configured to wake up at the interval of one second, it wakes up and searches the preamble (T_w) every other second and lasting 16 bits. The transmitter must transmit preamble longer than 1 second and then send synchronous word, which means the receiver can detect the preamble and wake up receiver successfully.

2. Working Mode

APC240 can work in 4 different modes which can be configured through SETA and SETB pins.

Mode	SETA	SETB	Description	Working Status
1	0	0	Normal	Serial port enabled. Module works in continuous receive conditions. When data comes from MCU, AUX pin is set to low and module is switched to transmit status; then 32bits preamble and synchronous word will be sent. After data is

				<p>transferred, AUX pin will be sent to high and the module will enter into continuous receiver status again.</p> <p>In this mode the preamble in transmitted data package is not long so the receiver module must work in Mode 1 or 2. When receiver module detects data in the present wireless channel, it will verify the data and set AUX pin to low and then output data to serial port after data is confirmed correctly.</p>
2	0	1	Wake-up	<p>Serial port enabled. Module works in continuous receive conditions. When data comes from MCU, AUX pin is set to low and module is switched to transmit status; then preamble [1 wake-up period (E.g. 1second)+ 32bits] and synchronous will be sent. After data is transferred, AUX pin will be sent to high and the module will enter into continuous receiver status again.</p> <p>Because the longer preamble is introduced, the receiver module can work in Mode1, 2 or 3.</p> <p>When receiver module detects data in the present wireless channel, it will verify the data and set AUX pin to low and then output data to serial port after data is confirmed correctly.</p>
3	1	0	PWR-saving	<p>Serial port disabled. The receiver module wakes up at a preset period and search if there is any data coming in present channel. It will enter into sleep status when no signal is detected. As soon as the preamble is sniffed out, the receiver module will keep in receive status and wait for the synchronous word; then it will verify the data and set AUX pin to low. After 5ms delay, the receiver module outputs data to serial port.</p> <p>After data is transferred, the serial port is disabled and AUX pin is set to high. The module will enter into sleep status again and wait for the next wake-up when mode setting isn't changed</p>
4	1	1	Sleep	<p>Serial port disabled. The module stays in sleep status. In this mode. The RF circuit, the main clock circuit and peripherals are closed. The power consumption is extra low (about 1.5uA).</p>

Table 5 APC240 Working Mode

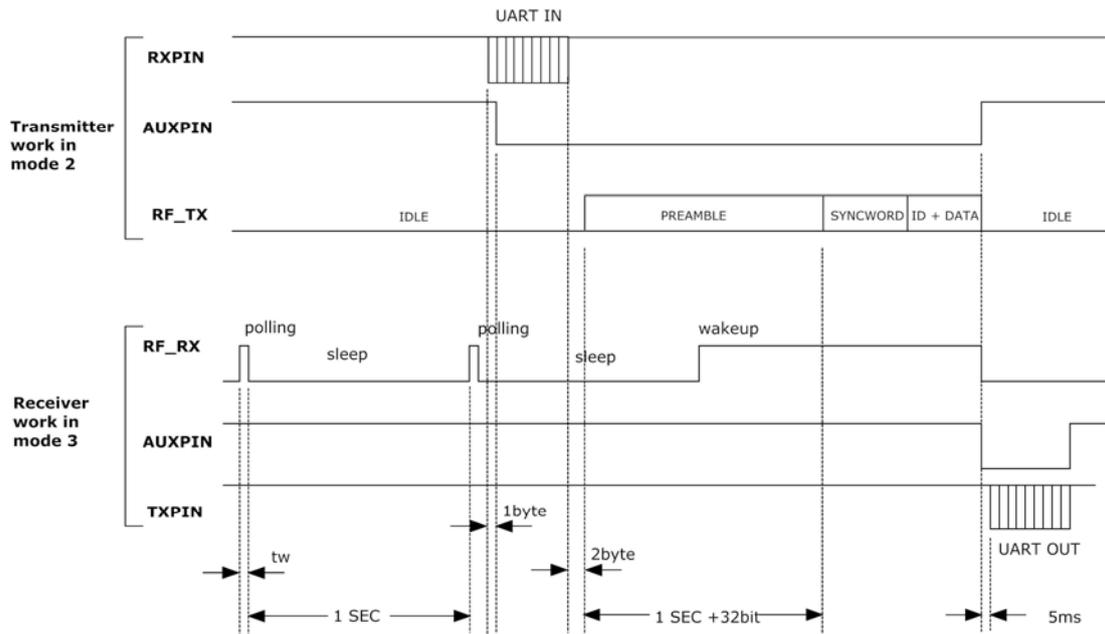


Figure1: Transmit module in Mode 2 and receive module in Mode 3

APC240 module enters into sleep mode by software control. In sleep mode the levels of serial port are kept in corresponding status and can be switched to any other status. It only needs 20uS to wake up the module from sleep mode, which means data can be output to serial port after SETA pin is set to low more than 20uS. When the module is in transmit or receive process, it only can enter PWR-saving or sleep mode after the transmitting or receiving process is finished even though the SETA pin is set to high. Users can take this advantage to set SETA pin to high and make the module enter into sleep status because it will detect SETA pin after a data transfer is finished.

3. Parameter Setting

Users can configure the parameters (frequency, data rate, output power, etc.) of RF modules by PC or MCU.

- ◆ **BY PC** The interface of APC240 is UART/TTL. If connecting it to PC, users need to use a TTL-to-RS232 level converter to transform the different levels. APPCON Technologies also provides converter board for configuration.

Firstly users need to connect converter board to PC by cable and open RF Magic software; then insert the module into converter board. After that the status column of tool should display “Found Device”. Users then can read/write the module.

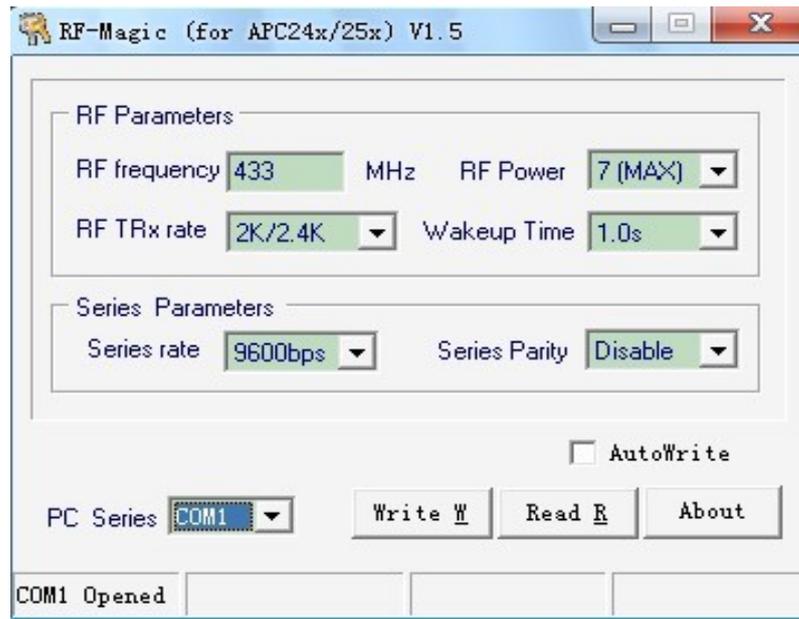


Figure 2: RFmagic for APC240 or APC250

- ◆ **BY MCU.** The module can work normally after powering on for 50ms (T1) or more. When configuring the module, users need to switch it to Mode 4 and monitor AUX pin which should be in high level without any transmit or receive. The module then can be configured after it enters into sleep mode for 10uS or more (T2).

When commands are output to RXD pin, the module will be waken up no matter what status of UART interface is in and it will use 9600 bps (data rate) and no parity check as default format to configure parameters. If the commands are set correctly, the module will feed back the written commands; then it will be reset and initialized. After 100ms (T4), the module will work with the new parameters. Please note that if the commands are set incorrectly, the module will give no feedback but it will still be reset and initialized. Users can take this advantage to wake up modules in long-term sleep or reset the modules.

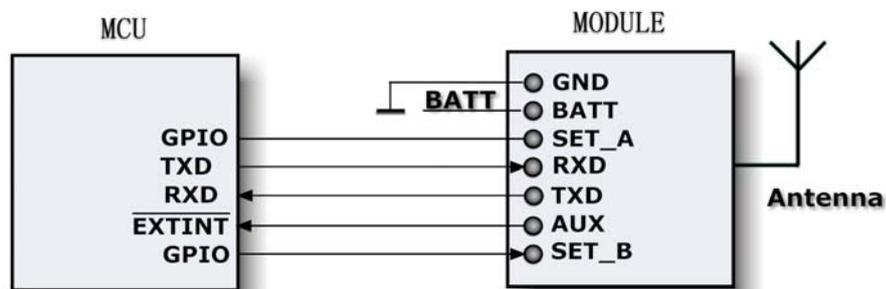


Figure 3: Connecting Diagram

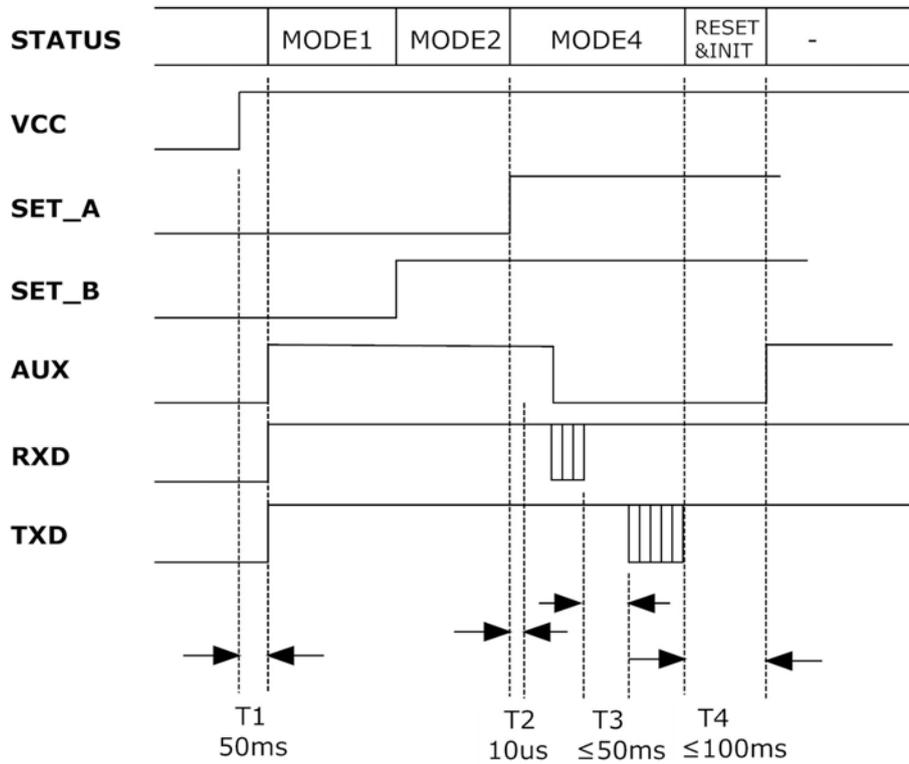


Figure 4: Timing Sequence for Setting Parameters

The commands of APC240 are in HEX format. The configuring data rate is 9600 bps and no parity check included. The command set include two commands: Read command and Write command.

Read command: 0xFF,0x56,0xAE,0x35,0xA9,0x55,0xF0

Response: 0x24, 0x24, 0x24+Freq+DR_{FSK}+P_{OUT}+DR_{IN}+Parity+Tw

Write command: 0xFF,0x56,0xAE,0x35,0xA9,0x55,0x90+Freq+DR_{IN}+P_{OUT}+DR_{FSK}+Parity+Tw

Response: 0x24, 0x24, 0x24+Freq+DR_{FSK} +P_{OUT}+ DR_{IN}+Parity+Tw

Parameter	Unit	Length (Byte)	Explanation
Freq.	KHz	3	433.92MHz = 0x06, 0x9F, 0x00
DR _{FSK}	K bps	1	1, 2, 5,10, 20, 40 equals to 0x00,0x01,0x02,0x03,0x04,0x05
P _{OUT}	dB	1	From 0 to 7 represents 0x00 to 0x07. One increment increases 3dBm. “0x07” equals to the Max. output power (10dBm).
DR _{IN}	Kbps	1	1.2, 2.4, 4.8, 9.6, 19.2, 38.4, 57.6 equals to 0x00,0x01,0x02,0x03,0x04,0x05,0x06

Parity		1	0x00: No parity; 0x01: Even parity; 0x02: Odd parity
Tw	S	1	0.05, 0.1, 0.2, 0.4, 0.6, 1, 1.5, 2, 2.5, 3, 4, 5 corresponding to 0x00~0x0b

Table 6 APC240 Parameter Coding

E.g. If the user wants to set the module work at Freq (433.92MHz), DR_{FSK} (10K bps), P_{OUT} (10 dBm), DR_{IN} (9.6k bps), Parity (no parity), Tw (1second), the command could be written as below:

Write Command: 0xFF,0x56,0xAE,0x35,0xA9,0x55,0x90, 0x06,0x9F,0x00, 0x03, 0x07, 0x03, 0x00,0x05

Response: 0x24,0x24,0x24, 0x06,0x9F,0x00, 0x03,0x07,0x03,0x00,0x05

Mechanical Data

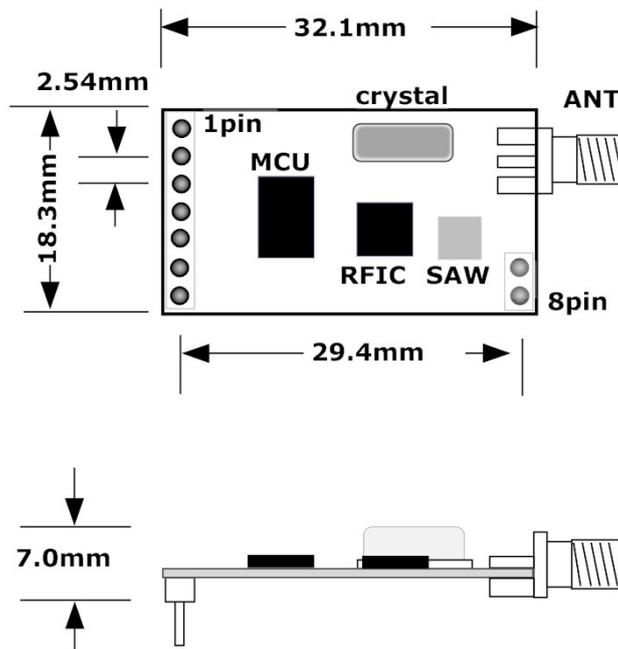


Figure 5: Mechanical Data

<p style="text-align: center;">APPCON Technologies</p> <p> Add.: Room 1005,Zhongyangxigu Building, Xinzhou,Futian district, Shenzhen, China 518000 Tel: 0086-755-33370185 Fax.: 0086-755-33370186 Email: sz0755@yahoo.cn Web: www.appcon.com.cn </p>	<p>APPCON Technologies Co., Ltd reserves the right to make corrections, modifications, improvements and other changes to its products and services at any time and to discontinue any product or service without notice. Customers are expected to visit websites for getting newest product information before placing orders.</p> <p>These products are not designed for use in life support appliances, devices or other products where malfunction of these products might result in personal injury. Customers using these products in such applications do so at their own risk and agree to fully indemnify APPCON Technologies for any damages resulting from improper use.</p>
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