



Airtech I & C Co.,Ltd.

421-809, #101-807, Techno ParkComplex, 364, Samjung-dong,
Ojung-Gu,Bucheon-si,Kyeonggi-do,Korea

Tel : +82-32-234-2345 / Fax :+82-32-234-2350

Home : [www. Airtech21.com](http://www.Airtech21.com) /e-mail : sales@airtech21.com

[OPERATIONAL DESCRIPTION]

Description: FM HANDHELD TRANSCEIVER

FCC ID: ONKATP-400B

INTRODUCTION

ATP-400B is a micro size 256 channel portable FM transceiver constructed with a microprocessor controlled, temperature compensated Phase Locked Loop (PLL) frequency synthesizer. The radio features a double conversion receiver and a direct FM transmitter modulator. A special integrated circuit provides support to sub-audible signaling (CTCSS & DCS) and most of the receiving parts are switched off periodically in the power saver mode to reduce battery current drain during standby.

The Block Diagram RF and Control Circuit Diagrams for ATP-400B shall be used in associate with the following circuit description.

CIRCUIT DESCRIPTIONS

1) PHASE-LOCK LOOP (PLL) CIRCUIT

*** REFERENCE OSCILLATOR**

The reference oscillator consists of TCX301 in U301 with a frequency of 12.8MHz. The reference oscillator frequency drives a divider to produce a comparison frequency.

This comparison frequency is selected by decoding the first three bits of the data input from microcomputer.

*** PROGRAMMABLE DIVIDER**

The programmable divider in U301 consists of a two-modulus prescaler with a 7bit control register followed by a 11-bit internal programmable divider. The overall division ratio is selected by a single 19-bit word located on the serial data bus.

*** PHASE COMPARATOR**

A digital-type phase comparator in U301 with output(pin 15, 17) and an open drain lock detect output(pin 8) compares divided VCO frequency with the comparison frequency. It generates a correction voltage that is applied to a low-pass filter consisting of **R309, R310, and C314, C315, C316 then sent to the VCO circuit.**

*** VCO CIRCUIT**



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The transmit/receive frequency is directly generated by the Colpitts oscillation circuit contains Q401, Q402. The oscillation frequency is variable by applying the VCO control voltage to variable to variable capacitors D401, D402 and D403.

To switch between the transmit and receive frequencies, Q402 turn on, and Q401 (VCO for transmission) oscillates when the T/R pin is low.

2) TRANSMITTER

* MIC AMP CIRCUIT

Voice signal from the microphone are applied to microphone amplifier U601 through CON 601 .

U601 contains a low-pass filter that has a 6dB/oct response between 300Hz and 3 Khz, and eliminates harmonics above 3 kHz. The pre-emphasized audio signal is applied to VR303 from U606 pin 23 to adjust maximum frequency deviation.

* VCO AND AMPLIFIER

The VCO signal output is amplified by Q209,Q1,Q207 and then fed to power amplifier Q204.

* POWER AMPLIFIER CIRCUIT

Q204 is provided approximately 7.5V DC power source.

RF power output is adjusted by variable resistors VR201 (High Power) and VR202 (Low Power).

Signals from Q204 is supplied through antenna switch D202 to a low-pass filter made up of L201, L202, L203 and C201-C206, C214 then applied to Antenna Jack.

3) RECEIVER

* ANT SWITCHING CIRCUIT

Signals from antenna connector fed to the antenna switching circuit through the low pass filter consisting of L201, L202, L203 and C201-C206, C214, . In receive mode, D201 is turned off, isolates the antenna from the transmitter circuit and matching circuitry, so that the incoming signals are fed to the RF amplifier through L209.

* RF AMPIIFIER CIRCUIT

The signals from the switching circuit are fed to the RF amplifier Q101 through a band pass filter made up of mold coil , vvc diode and capacitor.



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* FIRST MIXER CIRCUIT

The amplified signals are fed to Gate 1 of the first mixer Q102 through L108.

First local oscillator signal is supplied to Gate 2 of Q102 from the PLL circuit through C129 to convert the RF signals into 45.3MHz first IF signal.

* IF CIRCUIT

The first IF signals from Q102 are fed to the matched pair crystal filter FL101, then IF signals are amplified in Q103. And those signals are fed to U101 which is composed of the second local oscillator, second mixer, limiter amplifier, quadrature detector and active filter circuit. The second local oscillator at 44.845MHz with X101 and is fed to the second mixer with the first IF signals to convert into 455kHz second IF signals..

The second IF signals leave through pin 3, and are fed to external ceramic filters FL102, FL103 which has excellent selectivity, then fed to U101 (pin 5) again to be amplified and detected. Narrow /Wide band are switched by Q541, Q542.

The detected AF signals are output from pin 9.

* AUDIO AND SQUELCH CIRCUIT

The detected audio signals are put through a 6dB/oct de-emphasis circuit made up of C143 and R132, R136. The signal is then applied to audio power amplifier U607 through the volume control SVR601 to obtain enough power to driver the speaker.

Part of the recovered noise signal is fed to the integrated operational amplifier inside U101, which, with R126, R127, C137, C139 makes up an low pass filter . The DC signal detected by U101 (pin13) reaches the integrated DC amplifier in U101 which has hysteresis to prevent jitter. The sensitivity of squelch is adjusted by VR101.

4. Alignment Procedure

Measurement Condition

The following sections describes the alignment procedure for ATP-400B LMR transceiver under the following reference environment conditions:

Temperature	:	25 (77)
Relative Humidity	:	65%
Power Supply Voltage	:	7.5VDC

Test Equipment / Tools required



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The following list of equipment is recommended for use in setting up the radio properly. Please ensure the test equipment are calibrated according to the manufacturer's instructions:

- Frequency counter more than 300MHz +/-100Hz tolerance, high input impedance and high sensitivity
- UHF FM Signal generator, 300MHz with adjustable frequency, FM deviation, and RF output attenuators. 50Ω Output impedance.
- Oscilloscope, high input impedance.
- 16Ω 1 Watt resistor as loudspeaker load
- Audio Signal Generator, 10Hz to 20KHz, 600Ω impedance with attenuators.
- RF Watt meter, with 50Ω 5 Watt termination resistor (Or RF Voltmeter with 50Ω termination and external 50Ω attenuators)
- Regulated Power Supply 7.5VDC 3A output
- Digital A-V-O Multimeter
- SINAD Meter
- External Speaker Mic plug (or special audio test jig)
- Interconnection test cable for RF and Control PCB
- Circuit Diagram for ATP-400B
- PCB layout diagram for ATP-400B
- Tuning tools for RF/IF transformer and the VR potentiometers

Disassembling the unit

The antenna

Disconnect the antenna

The Cover

- Remove the battery.
- Remove Volume Knob.
- Remove Studd Connector and the 2 Nuts.
- Remove the 6 screws.
- The case could then be opened for servicing.

The PCBs

- The radio consists of two PCBs, the RF (rear side) and control board (front side).
- The flexible connector joins the two PCBs. Don't disconnect two PCBs.



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- On the RF Board, connect ANT1 to a signal generator or RF power meter.
- On the RF Board, connect Power Supply to the battery terminal contacts.
- Connect External Speaker Mic Plug (or Audio Test Jig) to J601.

Transmitter Circuit Adjustment

- Crystal frequency

On receiving mode, check Crystal output is at 12.8MHz

- Transmitter Frequency

Connect RF Power meter to ANT1, Activate PTT to transmit on 440.025MHz. check transmitting frequency error is within +/- 150Hz.

- Transmitter Output Power

Activate PTT to transmit on 440.025MHz, Set VR201 for 4W power output at ANT1. And Set VR202 for 2W power output at ANT1 after changing Low power output mode.

- Transmitter Sub-Audible Tone Deviation

Set radio to transmit on 440.025MHz, with CTCSS code 01 (67Hz) and no audio modulation. Adjust VR302 for 0.45KHz deviation.

- Transmitter Deviation Limit

Set radio to transmit on 440.025MHz, with CTCSS code 01 (67Hz) and no audio modulation. At the external microphone input, inject 1KHz tone at -20dBm. Adjust VR303 for 2.3KHz deviation.

Receiver Circuit Adjustment

- FM Demodulator Adjustment

Set radio to receive on 440.025MHz, No CTCSS or DCS. Connect RF Signal Generator to ANT1, Set generator to 440.025MHz at -60dBm (50Ω) output with 1KHz tone modulation at 1.5KHz deviation.

- Receiver Squelch Adjustment

After checking the receiver sensitivity, further lower the RF Signal Generator output to 8-10dB SINAD and observe the squelch circuit operates. Adjust VR101 if necessary.



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5. TECHNICAL SPECIFICATIONS

Model Number ATP-400B , Airtech Information & Communication Co., Ltd.

A. GENERAL

- 1) Frequency Range : 440 ~ 470 MHz
- 2) Modulation Type : 8.5KOF3E /16KOF3E (FM)
- 3) Channel capacity : 256 channels
- 4) Channel spacing : 12.5 KHz/25KHz
- 5) Power Supply : DC 7.5V, NiMh Rechargeable Pack
- 6) Current Drain : High Transmitter (4W) ----- <2.5A (NiMh Rechargeable Pack)
Low Transmitter (2W) --- <1.2A (NiMh Rechargeable Pack)
Receiver (0.5W) ----- <500mA
- 7) Battery Life : 10hrs (NiMh Rechargeable Pack)
(at 5%-5%-90% transmit-receive-standby cycles)
- 8) Operating Temperature : -20 to +55
- 9) Dimensions : 102(H) x 50(W) x 38(D) mm
- 10) Weight (W/Batteries) : 300g (1350mAH Rechargeable battery)

B. TRANSMITTER

- 1) Power Output : High (4W), Low (2W)
- 2) Frequency Stability : Better than +/- 2.5ppm within operating temperature
- 3) Hum & Harmonic : < -40dB (with 300Hz to 3KHz audio filter)
- 4) Spurious & Harmonics : < -36dBm
- 5) Audio Distortion : Less than 5% (1KHz tone 6 0% modulation)
- 6) Audio Response @6dB/oct : -10.5 / 0 / +9.5dB (pre-emphasized)

C. RECEIVER

- 1) Sensitivity (20dB SINAD) : < 1uVemf



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|---------------------------------|-----------------|
| 2) Selectivity | : < -60dB/-70dB |
| 3) Inter-modulation | : < -65dB |
| 4) Spurious and image rejection | : < -70dB |
| 5) Maximum Audio Output | : More than 1W |
| (6) Audio Distortion | : less than 5% |