Circuit Description for AT5110

This is a 2.4GHz WDCT cordless telephone with type 2 caller ID & call waiting and a wireless headset. Radio transmitter with GFSK and Frequency Hopping technology provides greater mobility to the user within approximately 300 meters radius around the base.

Following paragraphs describe the detail of major building blocks.

1. Ringer Detection

a. Base

The incoming ring signal is attenuated by C204, D213, D208, R203, R237 and Q211. The signal is fed to the micro-controller (MCU) U100. When the ringer switch is set to on position, the MCU sends the digital coded data to the handset via the RF link.

b. Handset

When the digital coded data is received, it will be decoded from the MCU U301. The ring will output at the speaker. The audio amplifier U400 drives the speaker J400 for the ring signal.

c. Headset

When the digital coded data is received, it will be decoded from the MCU U301. The ring will directly output from the MCU. The user can hear the ring signal at the receiver.

2. Surge protection

The surge absorber V201 is mounted in the Base unit. It designs to protect the EUT under the transient voltage 330V condition. In general, it is common to have induced the surges at the telephone line due to lightening. The surge absorber V201 can absorb the power to protect the others line interface components.

3. Line control

When the handset or headset is pressed the "talk" key, the line control is done by MCU. It turns on transistor Q209 at the base. Then the telephone line power feeds to the line interface circuit through the transistors Q206 and Q205. It also turns on the internal voice path.

4. Power Control

a. Base unit

The main power comes from AC/AC adaptor, which provides 9VDC to the unit across the bridge. Inside the unit there are two different voltages available

for the different modules. 3.9V non-backup voltage is supplied to the RF power amplifier. The MCU and line interface related circuit are supplied with non-backup regulated 3.3V voltage.

b. Handset

Three cells of Ni-MH battery (3.6V) provide the power to the handset. In order to keep power consumption to minimum, the radio receiver turns on and off periodically by MCU and Q303, Q304. The MCU is supplied with regulated 1.8V and 2.5V by U301.

c. Headset

The Lithium Ion Polymer battery (3.6V) provides the power to the headset. In order to keep power consumption to minimum, the radio receiver turns on and off periodically by MCU and Q303, Q304. The MCU is supplied with regulated 1.8V and 2.5V by U301.

5. RF system specification

This radio system uses the ISM band from 2400MHz to 2483.5MHz. The modulation is a standard GFSK, with 0.864MHz channel bandwidth and the data is transmitted at a bit rate of 576 kbit/s. It ensures that all transmissions are hopped equally over all the transmission channels in our RF system, implemented by the frequency hopping spread spectrum technique. A regular TDMA is used. The frame structure is repeated every 10ms, corresponding to 5760-bit duration, and will not be greater than 0.4 seconds on any frequency. It is in accordance with the FCC rules. This frame is divided into 4 uplink slots lasting 5ms, and 4 downlink slots. So the system is either receiving or transmitting at any given time. Although the system hopper contains "Duplicated bearer data" mode (DBD), however, the DBD mode is disabled in our product. Moreover, the frequency substitution is also utilized with the frequency-hopping scheme in our products.

a. Receiver

The receiver of the radio chipset incorporates a LNA, a mixer, channel filters, amplifier stage with RSSI indicator, demodulator and data slicer.

The channel filter in the receiver path is based on the Low-IF architecture. It is equivalent to a band-pass filter around to 864kHz IF frequency combined with image rejection architecture. It can be used to further reduce the receiver's susceptibility to out-of-band signals. Due to this IF frequency, the LO frequency should be 864kHz above the wanted RF frequency.

The data slicer converts the demodulated analog data to NRZ (binary) format.

One pin diode D1 works as the T/R switch (Transmit / Receive Switch), which selects between the reception and transmission paths.

In our radio system, it can support two antennas. Another pin diode D2 is performing the antenna selection. It is controlled by the signal supplied by base-band controller for the implementation of antenna diversity.

The PCB printed band-pass filter is used between T/R switch and the antenna switch. It is used to remove partially the unwanted signals occurring outside the 2.4G ISM band, and to reduce undesired emissions during transmission.

b. Transmitter

The transmitter of the radio chipset utilizes GFSK architecture. The VCO oscillates at twice the ISM 2.4GHz band, then pass through the integrated frequency divider and divide the signal to desired RF frequency in the 2400 to 2483.5MHz range. The VCO is directly modulated with GFSK filtered data. The transmitted power is typically 3dBm.

An external silicon power amplifier is used. It consists of 3 cascaded gain stages. In Base unit, the PA amplifies the typical 3dBm at its input to EIRP of 20dBm at the antenna output ports including overall loss. In handset unit, because the antenna matching circuit is different, the EIRP is 18dBm with 3dBi antenna gain including overall loss. The external power amplifier connects to the transmitter of the radio chipset with appropriate impedance matching and harmonics filtering components.

The same RF signal path as mentioned in the receiver, the external power amplifier also connects with T/R switch, PCB printed band-pass filter and the antenna switch. They have the same function as described in the receiver's section.

c. Voltage Controlled Oscillator (VCO) and Synthesizer path

The fully integrated VCO operates at twice the ISM 2.4GHz band frequency. A frequency divider by two is connected to the VCO block. It will provide to the rest of the chip the correct frequency signal with the adequate amplitude. The output of the prescaler is used to drive the synthesizer main divider and this output can also be switched to either the transmitter or the receiver LO output buffer of the radio chipset.

The main divider is clocked by the RF signal from the prescaler at frequencies from 2400 to 2483 MHz. The reference divider is clocked by a 13.824MHz crystal. It must be aligned better than +/- 2 ppm for frequency accuracy.

The Phase-Lock Loop (PLL) tunes the VCO to a given channel based on control signal of 3-line serial bus. These control signals are come from the base-band controller. The minimum PLL locking time is 300 us.

d. Antenna

The antennas utilized in the base, handset and headset are quarter-wave monopole. Since quarter-wave monopole is small in size and the antenna wire is

mounted over the ground plane, the antenna gain is -1 dBi for this configuration. In the base unit, it contains two antennas for antenna diversity. In the handset and headset unit, it contains only one antenna.

e. Shield Can

The radio module is fully covered with a suitable shield can in order to minimize the interference to other equipment or device.

Range of frequencies at each Tx /Rx path:

While transmitting or receiving: TX/RX	Wanted Freq. (MHz)	VCO Freq. (MHz)	LO Freq. (MHz)
TX	2401.056 (Ch 0)	4802.112	2401.056
RX	2401.056	4803.840	2401.920 (IF=864kHz)
TX	2441.664 (Ch 47)	4883.328	2441.664
RX	2441.664	4885.056	2442.528 (IF=864kHz)
TX	2482.272 (Ch 94)	4964.544	2482.272
RX	2482.272	4966.272	2483.136 (IF=864kHz)

Note: There are 95 frequency channels: channel 0, channel 47 and channel 94 are listed above for the indication of the range of frequencies, i.e. lower channel, middle channel and upper channel. It also provides the annotation of all frequency utilization in the system on RF block diagram. The transmitting and receiving frequencies are also within the frequency band 2401.056MHz to 2482.272MHz. Since the channel filter is a low-IF architecture, the IF frequency is 864kHz.