

C410 Circuit Description

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1. Introduction

The model C410 is a 40 channel (902 MHz - 928 MHz) cordless telephone.

This unit is made up of two parts:

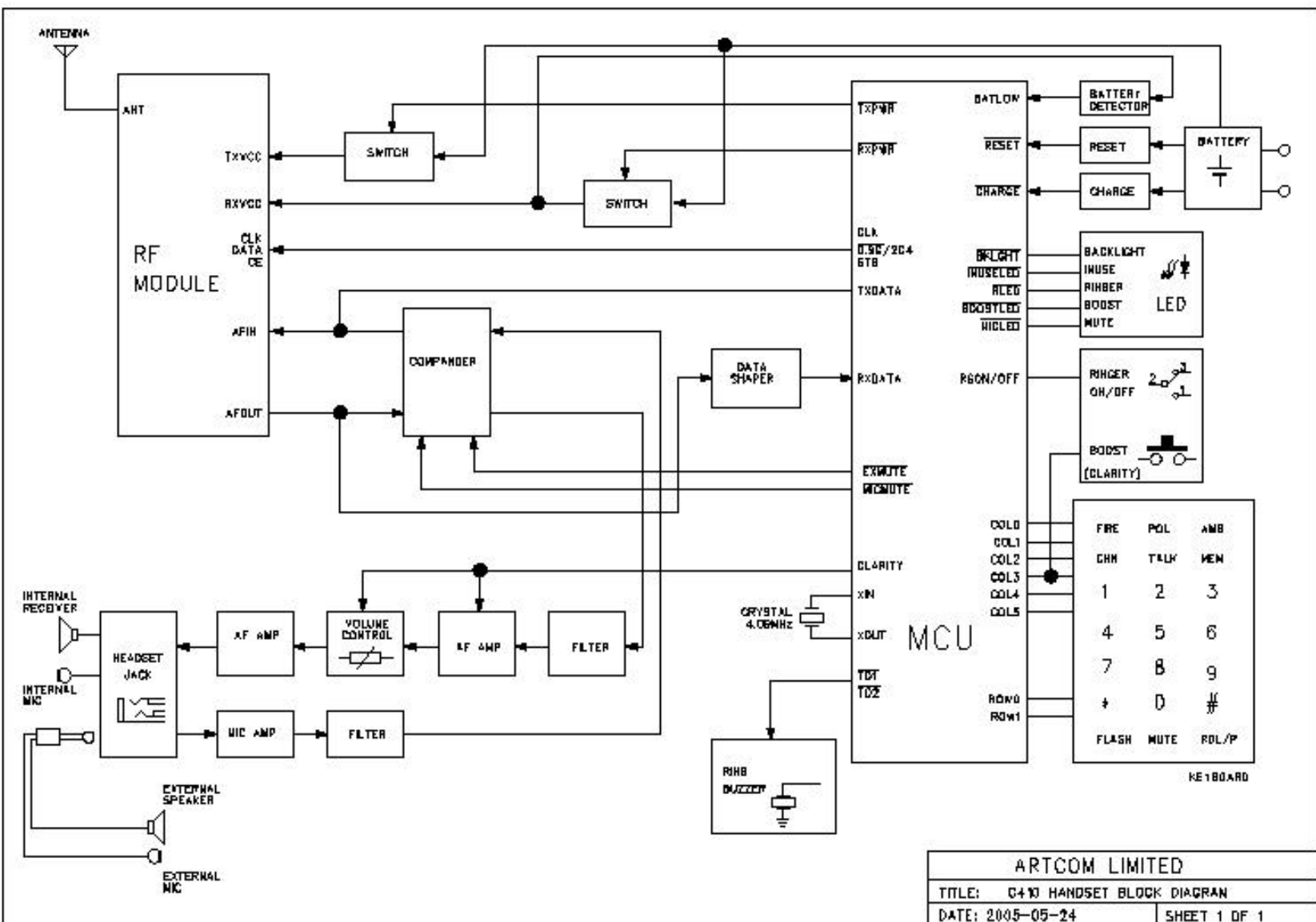
- a. A Handset unit.
- b. A Base unit.

2. Functional Blocks of the Handset

The block diagram of C410 handset unit is as shown below. It is made up of the following parts:

- 2.1 Keyboard Matrix, Switches and Function LED
- 2.2 MCU and MCU Interface
- 2.3 RF Module
- 2.4 Comander
- 2.5 Data Shaper
- 2.6 Charge and Control
- 2.7 Low Battery Detector
- 2.8 Buzzer
- 2.9 Audio Circuit

C410 Handset Unit Block Diagram



3. **Handset Unit Circuit Block Description**

3.1 Keyboard Matrix, Switches and Function LED

The keyboard consists of the following keys:

- FIRE – one touch memory key
- POL – one touch memory key
- AMB – one touch memory key
- CHN – for changing RF carrier frequency
- TALK – for On/Off hook control
- MEM – for memory program and dialing
- 1, 2, 3, 4, 5, 6, 7, 8, 9, *, 0, # – numeric keys
- FLASH – provides timed On/Off hook function
- MUTE – turns Off/On the handset microphone
- RDL/P – redials the last number or provides a pause during dialing.

The keyboard is connected to Pins 19 to 26 the MCU (U2).

The switches consist of the followings:

- BOOST CLARITY POWER – for On/Off the receiver amplifier gain
- RINGER ON/OFF – turns On/Off the ringer buzzer

They are connected to pins 24 and 21 of MCU.

The function LEDs consist of the followings:

- MICMUTE (LED2 - Red) – Located under the “MUTE” key. On/Off when microphone is Off/On
- INUSE (LED17 – Green; LED6 and LED18 - Red) – Located under the “TALK” key and the handset antenna. On/Off when telephone is Off-hook/On-hook
- BOOST (LED17 – RED) – Located under the “TALK” key. On/Off when the receiver amplifier extra gain is On/Off
- BACKLIGHT (LED3, LED5, LED7, LED8, LED9, LED10, LED11, LED12, LED13, LED14, LED15, LED16 – Green) – Located under the keyboard. On for a short time when any key is pressed
- RINGER (LED6 and LED18 - Red) – Located in the handset antenna. Flashes when the telephone line rings

These LEDs are controlled by pins 7, 9, 10, 11 and 12 of MCU.

3.2 MCU and MCU Interface

The controller of the handset is U2. It controls the functions of the handset through the keyboard interface and signals from the base unit. The data to and from the base goes through pin 31 (data from base) and pin 34 (data to base).

3.3 RF Module

For operation and frequency see RF module section.

It receives the PLL data through pins 5, 6, 7 from MCU pins 1, 43 and 44.

The antenna located at the top of the unit and is permanent attached to RF module through a copper wire.

3.4 Compander

A compander U5 is used for improving the S/N of transmit and receive audio signals.

3.5 Data Shaper

The information which sent from base unit is recovered by the amplifier Q7 and Q9.

3.6 Charge and Control

D5, D7, D9, D10, D6, D11, Q5 and ZD1 provide polarity and over-voltage protection during battery charging. The charge signal is detected by pin 29 of the MCU.

When the handset is put into the base cradle, a negative pulse is sent to pin 14 of the MCU.

3.7 Low Battery Detector

The battery voltage is detected by U4D and the signal is sent to pin 4 of MCU.

3.8 Buzzer

Q2 is the buzzer signal amplifier and driven by the MCU pins 2, 32, 33.

3.9 Audio Circuit

Speech signal is picked up by the internal microphone M1 and sent to the telephone line through amplifier U4C, the compander U5 and the RF module.

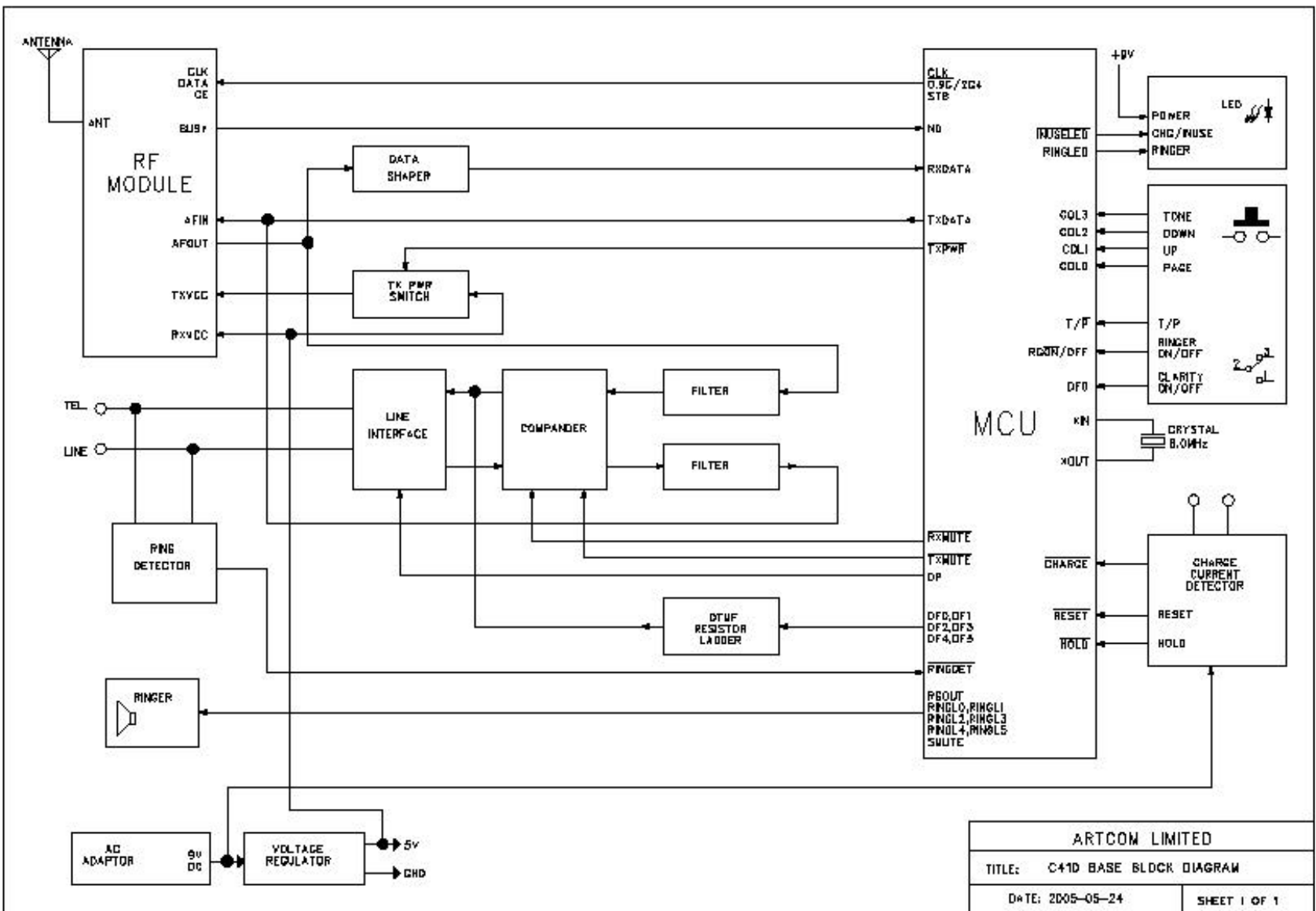
The incoming speech is received through the RF module, the compander, the amplifier U4A and U3. When BOOST is On, extra gain is inserted in this audio path.

The headset jack is for external speaker and microphone.

4. Functional Blocks of the Base unit

The block diagram of C410 base unit is as shown below. It is made up of the following parts:

- 4.1 Power Supply
- 4.2 MCU and MCU Interface
- 4.3 RF Module
- 4.4 Compander
- 4.5 Data Shaper
- 4.6 Charge and Control
- 4.7 Telephone Line Interface
- 4.8 Ring Signal Detector
- 4.9 Base Ringer
- 4.10 Keyboard Matrix, Switches and Function LED



5. Base Unit Circuit Block Description

5.1 Power Supply

The base unit is powered by an AC adapter (9V dc).

The voltage regulator (BU3) regulates the input DC to 5V. This provides power to every part of the unit.

5.2 MCU and MCU Interface

The controller of the base is U1 and controls the function of the unit.

It communicates with the handset through the RF module. PLL data to the RF module BMD1 is sent through pins 1, 43 and 44. The data between Handset and Base is via the pin 31 (data from handset) and pin 34 (data to handset) through the RF module. The transmitter power is controlled by the signal from pin 35 of MCU.

The MCU monitors ring signal from telephone line through the telephone line interface at pin 29. MCU pins 19 to 24 provide DTMF signal through a resistor ladder connected at these pins. The keyboard interface is provided by pins 8 to 12.

5.3 RF Module

For operation and frequency see RF module section..

It receives the PLL data through pins 5, 6, 7 from MCU pins 1, 43 and 44.

The antenna (~130mm total length) partly located inside the plastic rod at the side the unit is permanent attached to RF module.

5.4 Compander

The compander BU2 is used for improving the S/N of the transmit and receive audio signal.

5.5 Data Shaper

The information sent from handset unit is recovered by the amplifier BQ4 and BQ5.

5.6 Charge and Control

BQ12 detects the handset charging current and sends signal to MCU pin 30.

BQ20 detects the 9V supply and sends a negative pulse to MCU pin 14.

5.7 Telephone Line Interface

BL1, BL2, BF1, BVAR1, BR32 and BC81 provide telephone line surge protection.

BQ3, BU6, BD24, BD25, BD26, BD27, BD3 provide telephone On/Off hook function. BD3, BR34 and BT1 line transformer are the audio interface to the telephone line. The transformer BT1 is also used for telephone line isolation.

5.8 Ring Signal Detector

BL1, BC57, BR31, BZD5, BZD6, BD2, BU5, BR32 and BL2 form the ring signal detector. The signal is sent to pin 29 of MCU.

5.9 Base Ringer

Base ringer sound output is provided by BU7 and speaker BSP1. MCU pin 2 provides the ringer output signal and the level is controlled by pins 38, 39, 36, 32, 27 and 28.

5.10 Keyboard Matrix, Switches and Function LEDs

The keyboard and switches consist of the followings:

- PAGE – for Base to page handset
- TONE – for changing Ringer sound frequency
- DOWN – for reducing Ringer sound output volume
- UP – for increasing Ringer output sound volume
- RINGER ON/OFF – turns On/Off the ringer buzzer
- CLARITY ON/OFF – turns On/Off handset receiver extra gain
- T/P – for selecting Tone or Pulse mode dialing

They are connected to pins 3, 8 – 12 and 19 of MCU (BU1).

The visual ringing signal is provided by LEDs BKLED1, BKLED2 and BKLED5 (Red) and located under the red lens. They are controlled by pin 5 of MCU and transistor BQ4.

BLED1 (Green) is used for indicating “INUSE” when the telephone is in use or “CHARGING” when handset is in cradle.

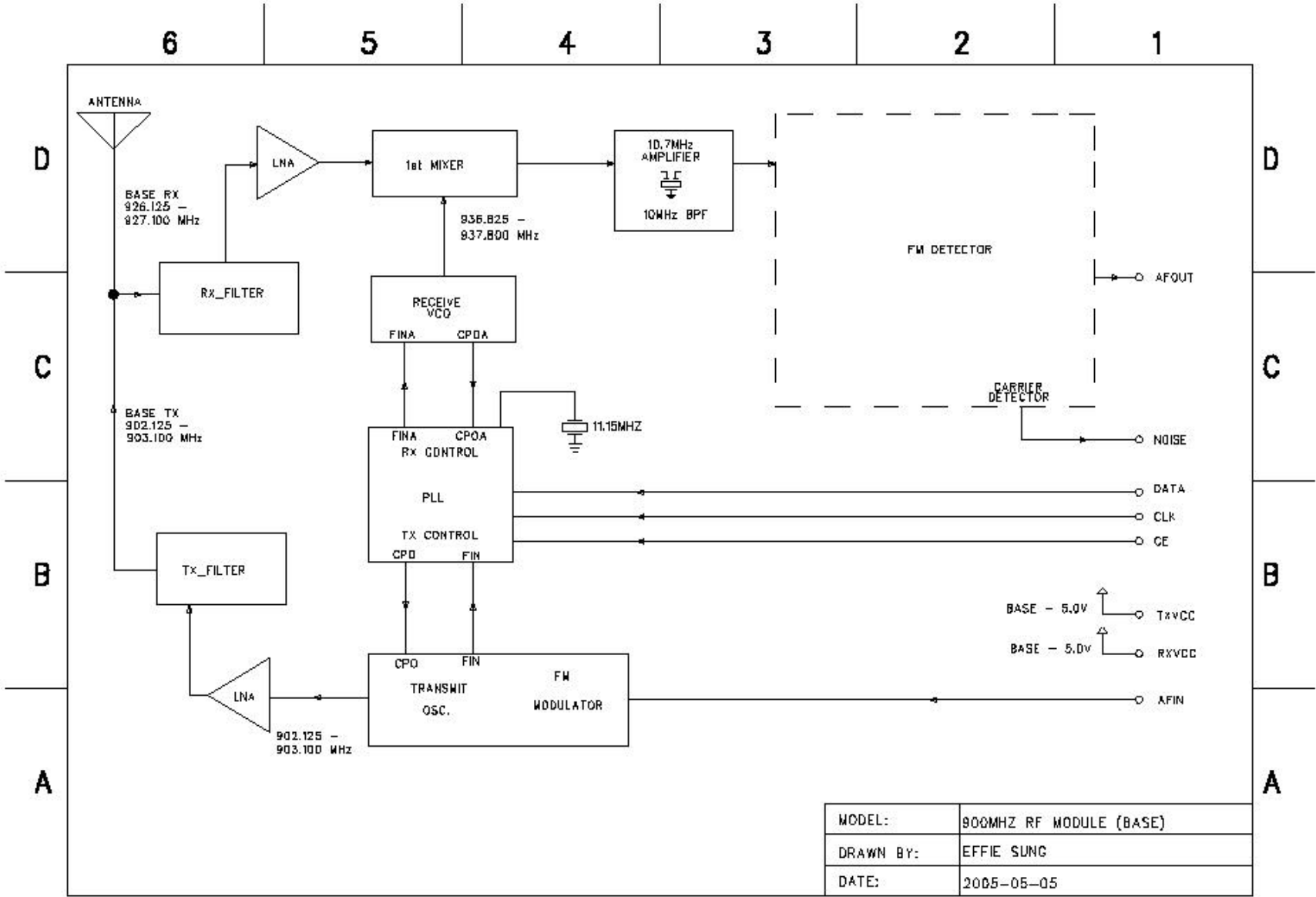
BLED2 (Red) is on when the base unit is powered by the AC adapter.

6. Functional Blocks of the RF Module

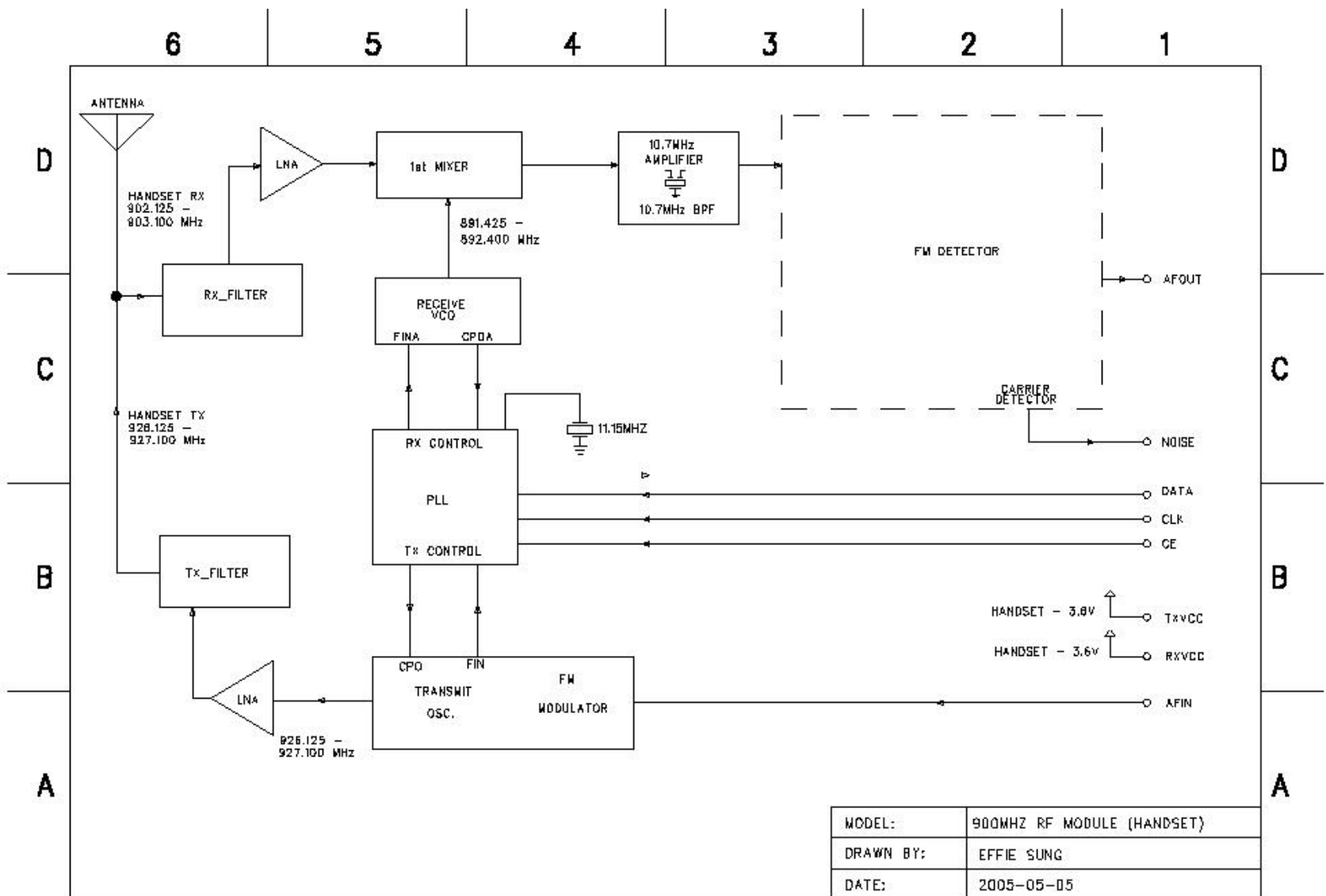
The block diagram of RF Module is as shown below. It is made up of the following parts:

- 6.1 Power Supply
- 6.2 PLL and MCU Interface
- 6.3 RF Transmitter
- 6.4 RF Receiver
- 6.5 Audio Detector

RF Module (Base) Block Diagram



RF Module (Handset) Block Diagram



7. RF Module Circuit Block Description

7.1 Power Supply

The RF transmitter receives power from TXVCC. This voltage is 5V for the base unit and 3.6V for the handset unit. For the base unit, TXVCC is enabled only during TALK or RINGING mode. For the handset unit, TXVCC is enabled only during TALK mode.

The RF receiver receives power from RXVCC. This voltage is 5V for the base unit and 3.6V for the handset unit. For the base unit, RXVCC is enabled all the time. For the handset unit, RXVCC is enabled only during TALK or scanning for ringing signal from the base unit.

7.2 PLL and MCU Interface

The frequencies of the RF transmitter and RF local oscillator are controlled by a PLL IC (U1). The MCU transmit PLL data through DATA, CLK and CE signal lines. The basic clock frequency of the PLL is derived from an 11.15MHz crystal inside the RF module.

7.3 RF Transmitter

The RF transmit frequency for the base is 902.125 MHz – 903.100 MHz and the handset is 926.125 MHz – 927.100 MHz.

The RF transmitter oscillator frequency is controlled by the PLL through CPO. The PLL samples the RF frequency through FIN. The audio input signal AFIN is fed to this RF oscillator through the FM modulator.

The RF oscillator output is amplified through the LNA (Q3) and coupled to the RF antenna through the TX_FILTER (DF2).

7.4 RF Receiver

The incoming RF signal is coupled from the antenna through RX_FILTER (DF1) to a LNA (Q1) where it is amplified and fed to the mixer (Q2). The receiver local oscillator frequency is controlled by the PLL through CPOA. The PLL samples the local oscillator RF frequency through FINA.

For the base unit, the local oscillator frequency is $(RF + 10.7\text{MHz})$.

For the handset unit, the local oscillator frequency is $(RF - 10.7\text{MHz})$.

7.5 Audio Detector

The audio detector (U2) receives the incoming signal from the amplifier (Q6) and 10.7MHz filter (CF1). The audio signal is recovered from a FM detector to AFOUT. The quality of the incoming RF signal is indicated by a logic output NOISE.

8. C410 Basic Operation

8.1 Setting the Ringers

The RINGER OFF/ON switches on the side of the handset and base set the ringers off/on.

Pressing the “UP” key on the base increases the ringer sound by one level while pressing the “DOWN” key reduces the sound by one level. There a total of six levels from maximum to minimum.

There are six types of ringer sound output. To change the tone, press the “TONE” key once.

The speaker will output a sample of two second with the latest selection of tone frequency and output level when any of these keys are pressed.

The relationship between the handset and base ringer sound outputs are as shown in the following table.

Charge State	Ringer Switch		Base		Handset	
	Base	Handset	Sound	LED	Sound	LED
Off	Off	Off	Off	On	Off	On
Off	Off	On	Off	On	On	On
Off	On	On	On	On	On	On
Off	On	Off	On	On	Off	On
On	Off	Off	Off	On	Off	On
On	Off	On	On	On	Off	On
On	On	On	On	On	Off	On
On	On	Off	On	On	Off	On

8.2 Setting the Dialing Mode

The Tone/Pulse switch set the telephone dialing mode, “Tone” for DTMF dialing and “Pulse” for rotary dialing.

8.3 Making and Receiving Calls

To make a call, take the handset from the base cradle and press the “TALK” key. The base “CHARGE/INUSE” LED comes on. After hearing dial tone from the receiver, dial the desired numbers. Press “RED/P” to redial the last dialed number.

To answer a call, take the handset from the base cradle and talk to the caller. If

the handset is not in the base cradle, press the “TALK” key. The base “CHARGE/INUSE” LED comes on.

To finish the call, put the handset back into the cradle and the “CHARGE/INUSE” LED comes on. Or press the “TALK” key again. The base “CHARGE/INUSE” LED goes off.

8.4 CLARITY Function

Pressing the “BOOST” switch on the handset toggles the receiver gain amplification. When BOOST is On/Off, the LED under the “TALK” key comes on (orange)/goes off (green) and receiver sound output level increases/decreases by a fixed level. Adjust the “VOLUME” control for fine adjustment.

The “BOOST ON/OFF” switch on the base forces the handset to start with “BOOST” to be initially On/Off when talking to the telephone line.

8.5 PAGE Function

The base can locate the handset by pressing the “PAGE” key once.

8.6 MEMORY Function

To store a number in memory

- Press “MEM” key. The Antenna and “TALK” key flashes.
- Dial the desired number (16 digits max). To insert a Pause, press “RED/P” key once.
- Press “MEM” key again
- Press a memory location (0 – 9) or one of the three emergency icons.
The handset will give a long beep and the indicators go off.

Repeat the above procedure for other locations.

To dial memory number

- Press “TALK” key. The Antenna and “TALK” key LEDs come on.
- Check for dial tone.
- Press one of the three emergency icons or press “MEM” key then the memory location (0 -9).
- For chain dialing, repeat the above step again with another memory location (0 – 9).
- If the memory location is empty, the handset will beep.

Repeat the above procedure for other locations.

8.7 MUTE Function

Pressing the “MUTE” key toggles the microphone Off/On. The LED under the “MUTE” key comes on (red) /goes off.

8.8 Changing RF Channel

Press “CHN” key to change the phone’s RF channel to eliminate interference.

9. RF Channels

CHANNEL	BASE		HANDSET	
	TX (MHz)	LOCAL (MHz)	TX (MHz)	LOCAL (MHz)
CH 01	902.125	936.825	926.125	891.425
CH 02	902.150	936.850	926.150	891.450
CH 03	902.175	936.875	926.175	891.475
CH 04	902.200	936.900	926.200	891.500
CH 05	902.225	936.925	926.225	891.525
CH 06	902.250	936.950	926.250	891.550
CH 07	902.275	936.975	926.275	891.575
CH 08	902.300	937.000	926.300	891.600
CH 09	902.325	937.025	926.325	891.625
CH 10	902.350	937.050	926.350	891.650
CH 11	902.375	937.075	926.375	891.675
CH 12	902.400	937.100	926.400	891.700
CH 13	902.425	937.125	926.425	891.725
CH 14	902.450	937.150	926.450	891.750
CH 15	902.475	937.175	926.475	891.775
CH 16	902.500	937.200	926.500	891.800
CH 17	902.525	937.225	926.525	891.825
CH 18	902.550	937.250	926.550	891.850
CH 19	902.575	937.275	926.575	891.875
CH 20	902.600	937.300	926.600	891.900
CH 21	902.625	937.325	926.625	891.925
CH 22	902.650	937.350	926.650	891.950
CH 23	902.675	937.375	926.675	891.975
CH 24	902.700	937.400	926.700	892.000
CH 25	902.725	937.425	926.725	892.025
CH 26	902.750	937.450	926.750	892.050
CH 27	902.775	937.475	926.775	892.075
CH 28	902.800	937.500	926.800	892.100
CH 29	902.825	937.525	926.825	892.125
CH 30	902.850	937.550	926.850	892.150
CH 31	902.875	937.575	926.875	892.175

CH 32	902.900	937.600	926.900	892.200
CH 33	902.925	937.625	926.925	892.225
CH 34	902.950	937.650	926.950	892.250
CH 35	902.975	937.675	926.975	892.275
CH 36	903.000	937.700	927.000	892.300
CH 37	903.025	937.725	927.025	892.325
CH 38	903.050	937.750	927.050	892.350
CH 39	903.075	937.775	927.075	892.375
CH 40	903.100	937.800	927.100	892.400