

C4205 Circuit Description

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1. Introduction

The model C4205 is a 40 channel (2.4GHz) cordless telephone.

This unit is made up of two parts:

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

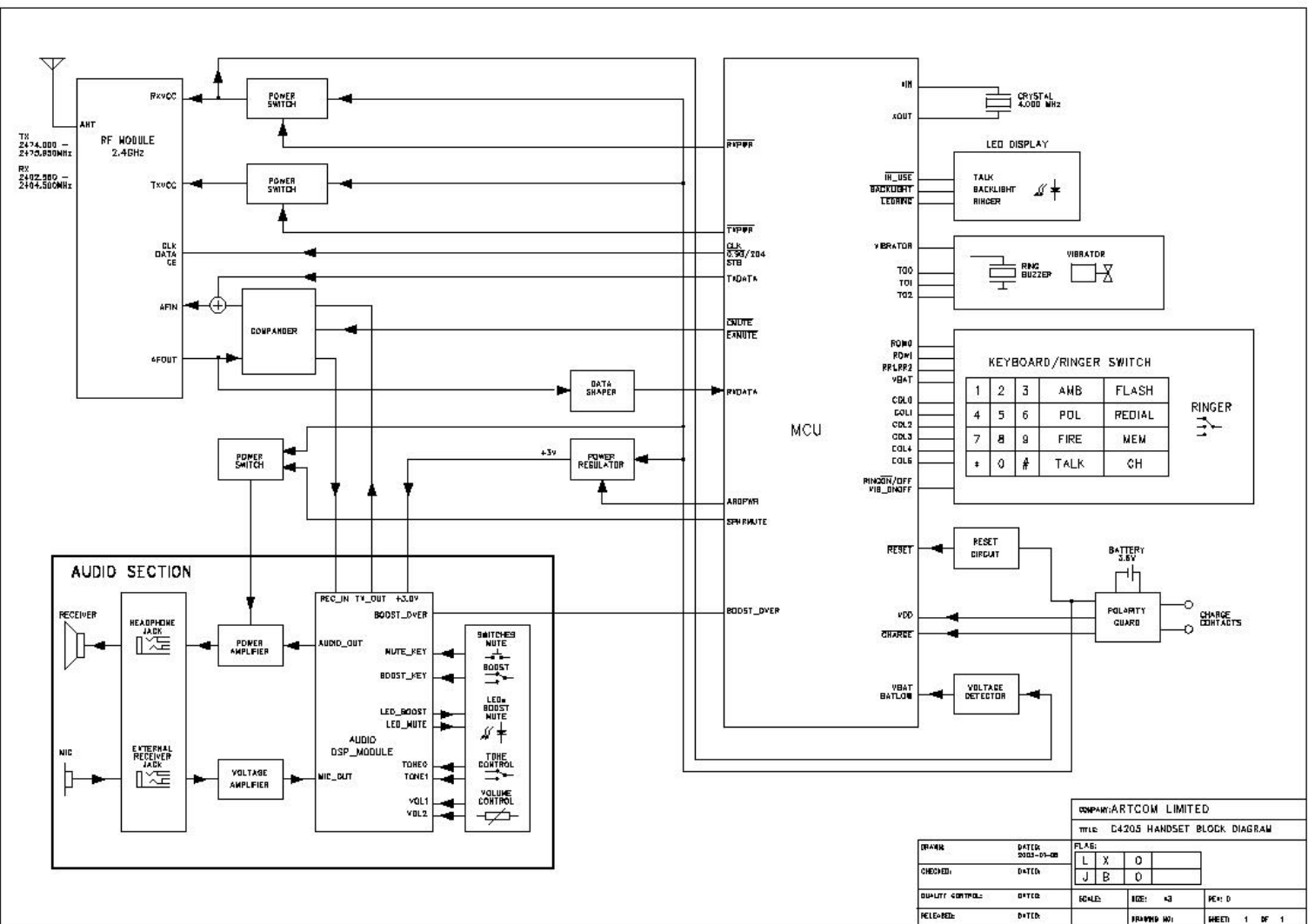
2. Functional Blocks of the Handset

The block diagram of C4205 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 Compander
- 2.5 Data Shaper
- 2.6 Charge and Control
- 2.7 Low Battery Detector
- 2.8 Buzzer
- 2.9 Audio Circuit

3. Handset Unit Circuit Block Description

C4205 Handset Unit Block Diagram



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
- RDL/P – redials the last number or provides a pause during dialing.

The keyboard is connected to Pins 19 to 26 the MCU (U3).

- MUTE – turns Off/On the handset microphone

The MUTE key is connected to the DSP_MODULE board.

The switches consist of the followings:

- BOOST CLARITY POWER – for On/Off the receiver amplifier gain.
This is connected to the DSP_MODULE board.
- RINGER ON/VIBRATOR/OFF – turns On/Off the ringer buzzer and the vibrator. This is connected to pins 21 and 38 of MCU.

The function LEDs consist of the followings:

- MICMUTE (LED317 - Red) – Located under the “MUTE” key. On/Off when microphone is Off/On
- INUSE (LED316 – Green; LED301 - Red) – Located under the “TALK” key and the handset antenna. On/Off when telephone is Off-hook/On-hook
- BOOST (LED316 – RED) – Located under the “TALK” key. On/Off when the receiver amplifier extra gain is On/Off
- BACKLIGHT (LED304 – LED315 – Orange) – Located under the keyboard. On for a short time when any key is pressed
- RINGER (LED301 - Red) – Located in the handset antenna. Flashes when the telephone line rings

These LEDs are controlled by pins 9, 11, 12 of MCU and the DSP_MODULE board.

3.2 MCU and MCU Interface

The controller of the handset is U1. The frequency of the crystal used is 4 MHz. 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 4, 5, 6 from MCU pins 44, 43, and 1.

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 U201 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 Q201 and Q202.

3.6 Charge and Control

ZD201, Q207, D212, D213, D214, D215, D218, D219 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 U6B and Q1. The signal is sent to pin 4 of MCU.

3.8 Buzzer and Vibrator

Q204 is the buzzer signal amplifier and driven by the MCU pins 2, 32, 33.

Q301 is the switch to turn on the vibrator. It receives its control signal from pin 39 of the MCU.

3.9 Audio Circuit

Speech signal is picked up by the internal microphone MIC1 and sent to the gain

control module U8 (DSP_MODULE) and sent to telephone line through the compander U201 and the RF module.

The incoming speech is received through the RF module, the compander, the gain control module U8 (DSP_MODULE) and amplifier U2.

When BOOST is On, extra gain is inserted in this audio path.

The headset jack is for external speaker and microphone.

The neckloop jack is for an external hearing aid device.

U7 provides regulated +3.0V for U8 and is controlled by U1 pin 41.

The power to the power amplifier U2 is supplied by Q15 which is controlled by U1 pin 3.

3.10 DSP_Module

The DSP_Module controls the gain and frequency response of the speech signal.

The brain of its operation is a TI DSP controller (U6) which provides the following functions:

- a. controls the CODEC (U2);
- b. scan the Timer (U5);
- c. scan the Tone switch (SW4);
- d. scan the “BOOST” switch (SW3);
- e. scan the “MUTE” key;
- f. scan the setting of the Volume (VR1); and
- g. on/off the “BOOST” and “MUTE” LEDs.

This DSP runs with a crystal of clock frequency 24.576 MHz (X1).

The EEPROM (U7) provides the main program storage for U6.

The timer IC (U5) is used to measure the setting of the Volume control.

The handset microphone signal is picked up by the DSP_Module pin 1, Op Amp (U1) and then pin 2 of the CODEC (U2). The processed signal is sent out from CODEC (U2) pin 15, Op Amp (U3), and the DSP_Module pin 34.

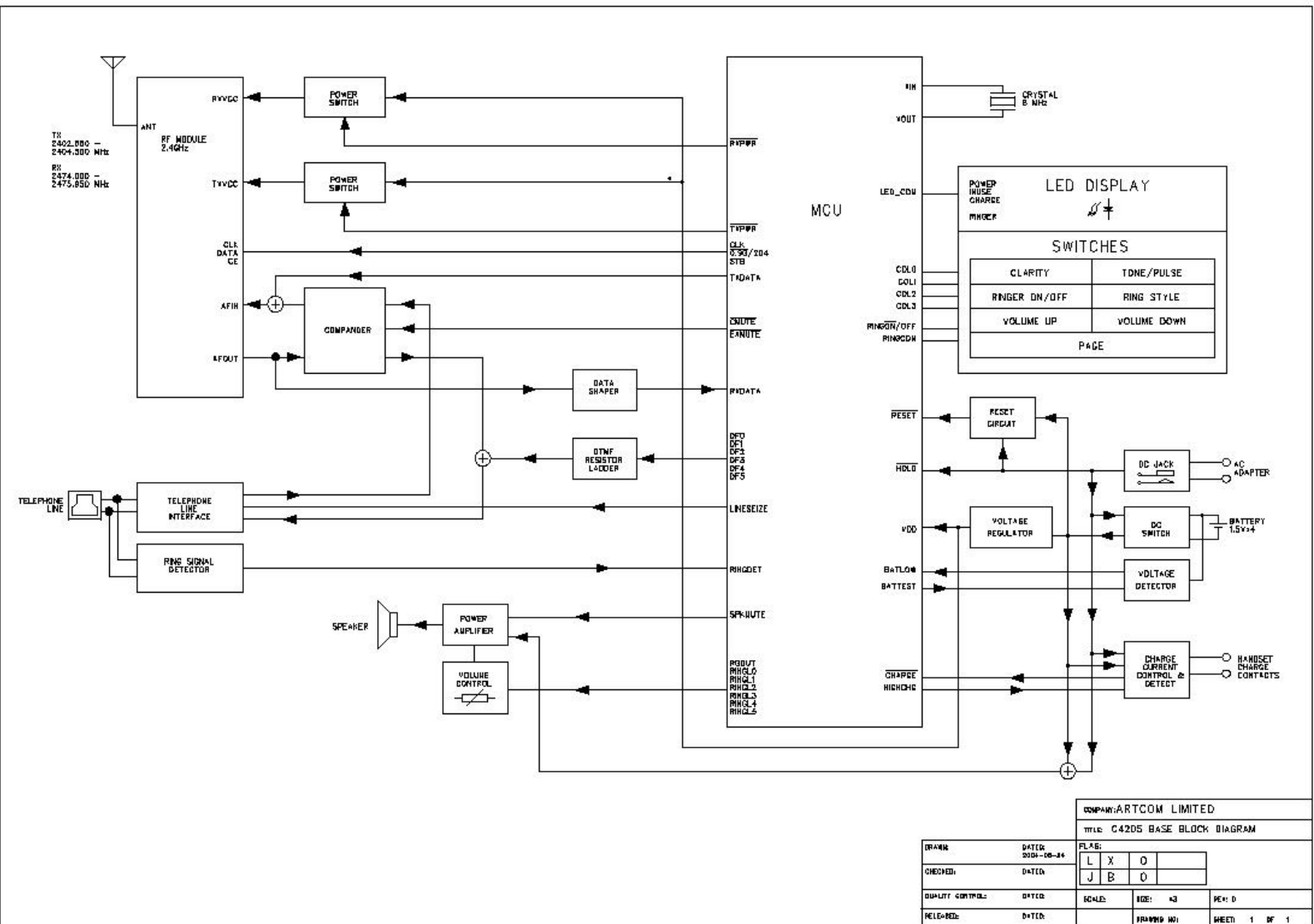
The audio signal from telephone line is picked up by the DSP_Module pin 2, CODEC (U2) pin 3. The processed signal is sent out from CODEC (U2) pin 16, and the DSP_Module pin 35. The gain is depending on the VOLUME setting. When BOOST mode is “On”, the DSP will add extra gain in the receive path depending on the signal frequency and amplitude. At the same time, it adjusts the microphone gain depending on the incoming speech level.

4. Functional Blocks of the Base unit

The block diagram of C4205 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

C4205 Base Unit Block Diagram



5. Base Unit Circuit Block Description

5.1 Power Supply

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

The voltage regulator (BU4) regulates the input DC to 6V. This provides power to every part of the unit.

When there is no AC power, BQ13 and BQ15 are turned on to connected the backup batteries to power the base. The backup up batteries voltage is checked periodically by BU2-A and this signal is connected to pin 5 of the MCU.

5.2 MCU and MCU Interface

The controller of the base is BUX and controls the function of the unit. The frequency of the crystal used is 8 MHz.

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 pins 26 and 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 9 to 12.

5.3 RF Module

For operation and frequency see RF module section..

It receives the PLL data through pins 4, 5, 6 from MCU pins 1, 43 and 44.

The antenna located inside the plastic cabinet is permanent attached to RF module.

5.4 Compander

The compander BU1 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 BQ2 and BQ3.

5.6 Charge and Control

BU2-B detects the handset charging current and sends signal to MCU pin 30. MCU pin 37 detects the 9V supply. MCU pin 1 detects both the 9V supply and the batteries.

5.7 Telephone Line Interface

BL3, BL4, BF1 and BVAR1 provide telephone line surge protection. BQ7, BD12, BD13, BD14, BD15, BC69, BU7 provide telephone On/Off hook function. BD2, BR118 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

BL3, BC68, BR116, BZD2, BZD3, BD11, BU6, BF1 and BL4 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 BU3 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, 9 – 12 and 19 of MCU (BU2).

The visual ringing signal is provided by LEDs BLED8 and BLED9 (Red) and located under the red lens. They are controlled by pin 12 of MCU.

BLED21 (Green) is used for indicating “INUSE” when the telephone is off-hook. This is controlled by pin 11 of MCU.

BLED31 (Red) is used to indicate “CHARGING” when handset is in cradle. This is controlled by BU2-B.

BLED12 (Red) and BLED11 (Green) indicate base power conditions. They are

controlled by MCU pin 9 and pin 10.

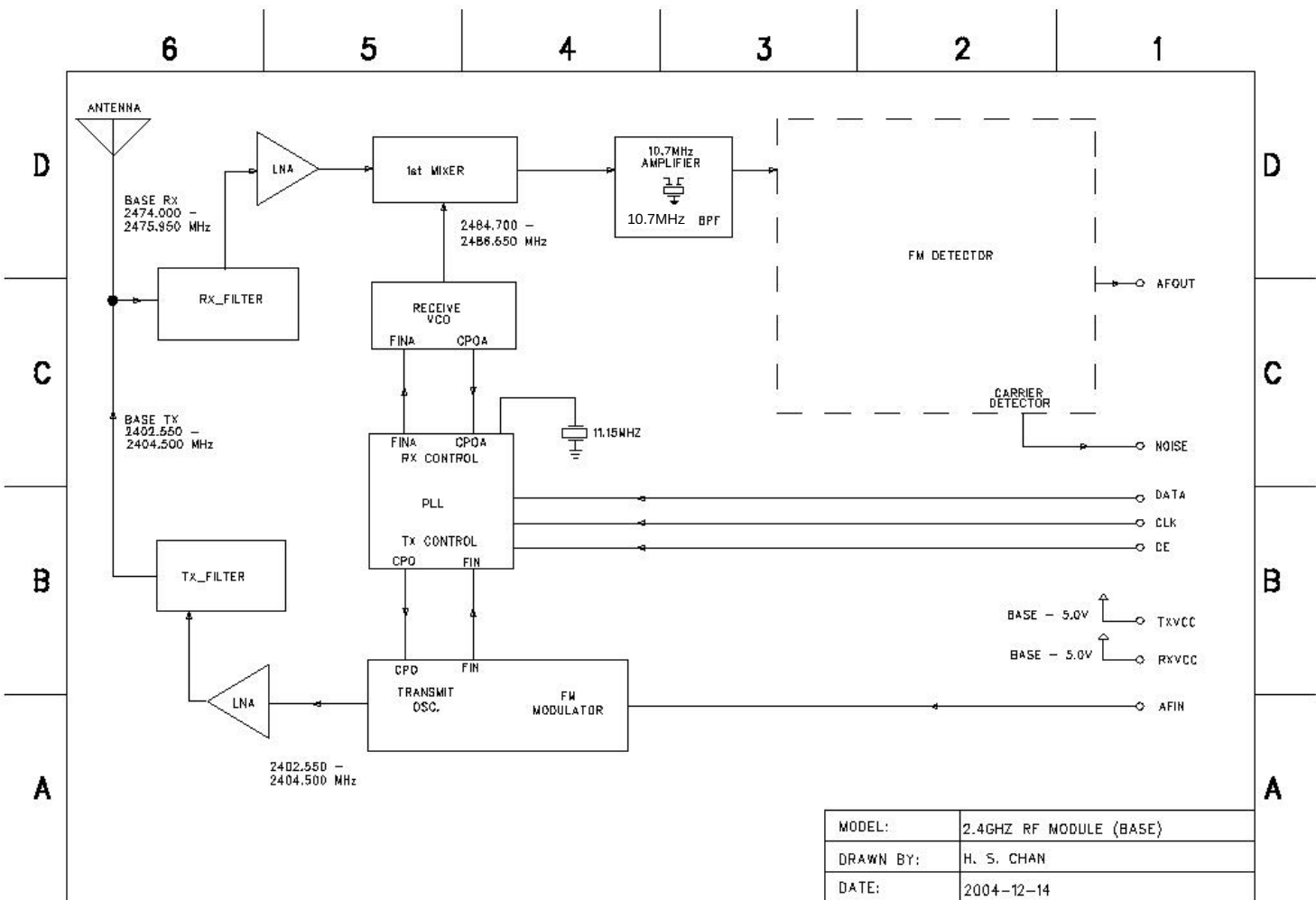
- Green – when the base is powered by AC adapter and good batteries.
- Red – when the base is powered by AC adapter only.
- Blinking Red/Green – when the base is powered AC adapter with bad batteries.
- Blinking Red – when the base is powered by good batteries only.
- Flashing Red – when the base is powered by batteries and the battery voltage is low.

6. Functional Blocks of the RF Module

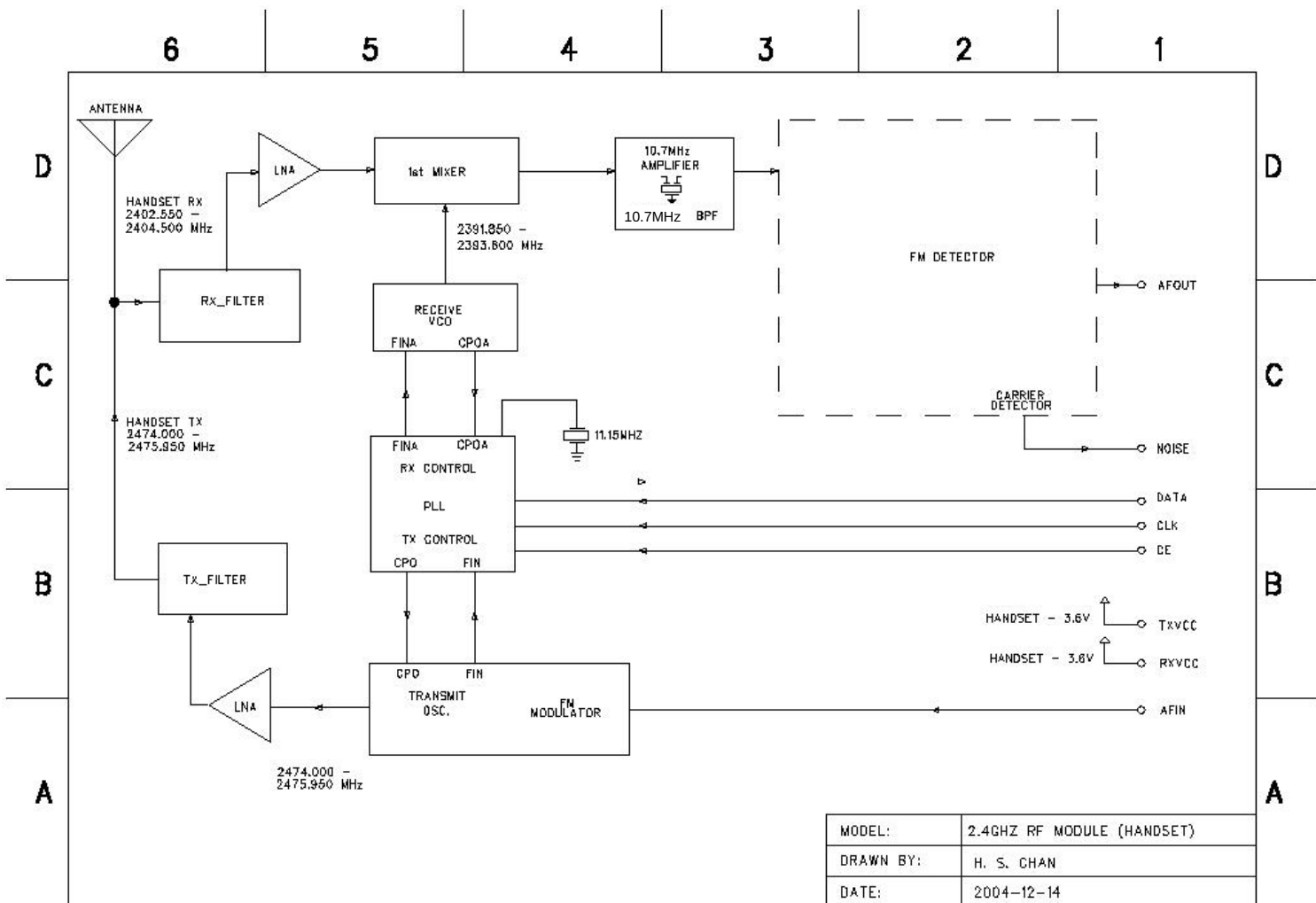
The block diagram of RF Module is as shown below. It is made up of the following parts:

- 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 (Q6, Q7, and Q1) 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 (Q3) 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 when there is AC power.

When running on backup batteries, it is on only while scanning for “TALK” signal from the handset.

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). It receives the frequency data through DATA, CLK and CE signal lines from the MCU. The basic clock frequency of the PLL is derived from an 11.15MHz crystal (X1) inside the RF module.

7.3 RF Transmitter

The RF transmitter frequency for the base is 2402.550 MHz – 2404.500 MHz and the handset is 2474.000 MHz – 2475.950 MHz.

The RF transmitter signal is derived from Q1. The transmit frequency is controlled by the signal pin CPO of the PLL IC (U1). The PLL samples the RF frequency through FIN. The audio input signal AFIN is fed to this RF oscillator through the FM modulator VD1.

The RF oscillator output is amplified through the LNA (Q6, Q7) and coupled to the RF antenna through the TX_FILTER (DF1).

7.4 RF Receiver

The incoming RF signal is coupled from the antenna through RX_FILTER (DF2) to a LNA (Q3) where it is amplified and fed to the 1st mixer (Q4). The frequency of the receiver local oscillator (Q2) is controlled by the signal pin CPOA of the PLL IC (U1). The PLL samples the local oscillator RF frequency through signal pin FINA.

For the base unit, the local oscillator frequency is (RF + 10.7MHz).

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

7.5 Audio Detector

The audio detector receives the incoming signal from the 10.7MHz filter and amplifier (Q5). The audio signal is recovered by a FM detector (U2) and sent to AFOUT. The quality of the incoming RF signal is indicated by logic output NOISE.

8. C4205 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 is 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

It is a 2-position switch for setting dialing mode.

T – TONE (DTMF)

P – PULSE (10pps, 40/60).

The dialing mode is determined while going from on-hook to off-hook.

8.3 Making and Receiving Calls

To make a call, take the handset from the base cradle and press the “TALK” key.

The base “INUSE” LED comes on. After hearing dial tone from the receiver, dial the desired numbers. Or, press “RDL/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 “INUSE” LED comes on.

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

RF CHANNEL	HANDSET (KHz)		BASE (KHz)	
	TX	RX	TX	RX
01	2,474,000	2,391,850	2,402,550	2,484,700
02	2,474,050	2,391,900	2,402,600	2,484,750
03	2,474,100	2,391,950	2,402,650	2,484,800
04	2,474,150	2,392,000	2,402,700	2,484,850
05	2,474,200	2,392,050	2,402,750	2,484,900
06	2,474,250	2,392,100	2,402,800	2,484,950
07	2,474,300	2,392,150	2,402,850	2,485,000
08	2,474,350	2,392,200	2,402,900	2,485,050
09	2,474,400	2,392,250	2,402,950	2,485,100
10	2,474,450	2,392,300	2,403,000	2,485,150
11	2,474,500	2,392,350	2,403,050	2,485,200
12	2,474,550	2,392,400	2,403,100	2,485,250
13	2,474,600	2,392,450	2,403,150	2,485,300
14	2,474,650	2,392,500	2,403,200	2,485,350
15	2,474,700	2,392,550	2,403,250	2,485,400
16	2,474,750	2,392,600	2,403,300	2,485,450
17	2,474,800	2,392,650	2,403,350	2,485,500
18	2,474,850	2,392,700	2,403,400	2,485,550
19	2,474,900	2,392,750	2,403,450	2,485,600
20	2,474,950	2,392,800	2,403,500	2,485,650
21	2,475,000	2,392,850	2,403,550	2,485,700
22	2,475,050	2,392,900	2,403,600	2,485,750
23	2,475,100	2,392,950	2,403,650	2,485,800
24	2,475,150	2,393,000	2,403,700	2,485,850
25	2,475,200	2,393,050	2,403,750	2,485,900
26	2,475,250	2,393,100	2,403,800	2,485,950
27	2,475,300	2,393,150	2,403,850	2,486,000
28	2,475,350	2,393,200	2,403,900	2,486,050
29	2,475,400	2,393,250	2,403,950	2,486,100
30	2,475,450	2,393,300	2,404,000	2,486,150
31	2,475,500	2,393,350	2,404,050	2,486,200
32	2,475,550	2,393,400	2,404,100	2,486,250
33	2,475,600	2,393,450	2,404,150	2,486,300
34	2,475,650	2,393,500	2,404,200	2,486,350
35	2,475,700	2,393,550	2,404,250	2,486,400
36	2,475,750	2,393,600	2,404,300	2,486,450
37	2,475,800	2,393,650	2,404,350	2,486,500
38	2,475,850	2,393,700	2,404,400	2,486,550
39	2,475,900	2,393,750	2,404,450	2,486,600
40	2,475,950	2,393,800	2,404,500	2,486,650