# 3028 Circuit Description

## 1. Introduction

The model 3028 is a 40 channel (2.40255-2.47595GHz ) Caller ID cordless speaker telephone. The whole unit is divided into two main parts as follow :

a. A remote Handset.
b. A Base unit.

## 2. Functional Blocks of the Remote Handset

2.1 Keyboard matrix and function LED
2.2 LCD
2.3 MCU and MCU interface
2.4 Antenna and RF module
2.5 Compander
2.6 Data shaper
2.7 Charge detector
2.8 Low battery detector
2.9 Buzzer amplifier

## 3. Circuit Block Description

**3.1 Keyboard matrix and function LED**
Pin 46 to pin48, pin 50 to pin 51, pin54 to pin55, pin57 to pin68 of the MU1 form a keyboard. The new call LED is controled by the pin 73 of MU1.

**3.2 LCD**
MLCD1 is controlled by the MU1 pin 1 to pin 32 and pin 99 to pin 128

**3.3 MCU and MCU interface**
The handset and the base is link up by the pins(45,76 and 78 in HS and 43,76 and 78 in Base). Besides, the PLL of the RF Module is controlled by the pins 39 to pin 41 of the MCU1.

**3.4 Antenna and RF module**
ANT is the common point for transmitting and receiving through antenna. It is only a wire and is permanently soldered on the RF module.
MD1 is a RF module which consists of Duplexer, Power amplifier, Mixer & IF, RXVCO, TXVCO, VCC & TXVCC control, Synthesizer and DEMO Audio Output circuits.

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

### 3.4.1 Power Supply
### 3.4.2 PLL and MCU Interface
### 3.4.3 RF Transmitter
### 3.4.4 RF Receiver
### 3.5.5 Audio Detector

3.4.1 Power Supply
**The RF transmitter receives power from TXVCC. TXVCC is enabled only during TALK mode.The RF receiver receives power from RXVCC. RXVCC is enabled only during TALK or stand-by mode when wake up.**

**3.4.2 PLL and MCU Interface**

**The frequencies of the RF transmitter and RF local oscillator are controlled by 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. The local frequencies to TX and RX are generated and locked at 825MHz and 798MHz respectively.**

**3.4.3 RF Transmitter**

**The RF transmitter oscillator frequency 825MHz is controlled by the PLL through Vt. The PLL samples the RF frequency through fin. The audio input signal AFIN is fed to this RF oscillator through the FM modulator.**

**Fundamental frequency 825MHz is multiplied to 2475MHz and bypass through band pass filter formed by Q7, ML5, C5, C37 and ML4. The filtered 2475MHz is then injected into TX power amplifier Q6** and related passive components. The enlarged 2475MHz rf signal is then input into the 2475MHz TX_FILTER, DF1. The transmitted rf signal is then injected into the ANTENNA and radiated out into air.

**3.4.4 RF Receiver**

**Received rf signal is collected from ANTENNA and passed through 2403MHz filter DF2. The filtered 2403MHz rf signal will then be injected into the LNA Q3 and be enlarged. The amplified 2403MHz signal is then input into the MIXER which is formed by Q4 and related passive components.**

Q2 and VD2 with related resistors and capacitors network form the RXVCO **which is fed and locked by the PLL U1. The fundamental 798MHz frequency is multiplied to 2393MHz and bypass the BPF formed by C28, ML11, C26, C25, ML13 and C 50 to the receiver mixer.**

The receiver local oscillator frequency is controlled by the PLL through Vt. The PLL samples the local oscillator RF frequency through fin.

**The mixer collects the input from LNA and 2393MHz signal from BPF and then output the IF 10.7MHz into Q5.**

3.4.**5 Audio Detector**

**Amplified IF from Q5 is passed into 10.7MHz filter CF1,amplifer Q8 ,10.7MHz filter CF3 and then injected into the IF demodulated IC U4. Detected audio will then be recovered and output at the AFOUT pin of the RF module.**

**3.5 Compander**

A compander U1 is used for improving the S/N of the transmit and receive audio signal.

**3.6 Data shaper**

The information which sending from base unit, is recovered by the amplifier Q1,MQ4 and MQ5.

**3.7 Charge detector**

MD2 to MD6, MZD1, MR22, MR23,MC9 form a charge detector to direct the charging signal to the MCU pin 34.

**3.8 Low battery detector**

A battery low detector is built-in by the Q2 which detects the battery dropping and sends a signal to pin 36 of MU1.

**3.9 Buzzer amplifier**

Q4 is a buzzer amplifier driven directly by the MU1 pin 75.

# 4. Functional Blocks of the Base unit

4.1 Power supply
4.2 MCU and MCU interface
4.3 Calling line identifier
4.4 Antenna and RF module
4.5 Compander
4.6 Data shaper
4.7 Charge detector
4.8 Line audio interface
4.9 Ring detector
4.10 LCD function board
4.11 Carrier detector
4.12 Speakerphone

# 5. Circuit Block Description

**5.1 Power supply**
BU5 7805 regulate the input DC 9V to 5V which provides power to every part of the circuit.

**5.2 MCU and MCU interface**
The heart of the base is MCU BMU1 that communicates with the PLL of BMD1 through pins 39,40 and 41. Transmitter is controlled by the signal TX_DC which output from MCU via pin 44. MCU pin 95 is for generating DTMF signal. The communication between Handset and Base is via the pin 43, pin76 and pin 78 through the RF link.

**5.3 Calling line identifier**
MCU pin 87 to pin 88, when receiving caller ID data, MCU controls the LCD to display the correct information.

**5.4 Antenna and RF modulator**
ANT is antenna transmit and receive signal. BMD1 is a RF modulator which consist of Duplexer, Power amplifier, Mixer & IF, RXVCO, TXVCO, VCC & TXVCC control, Synthesizer and DEMO Audio Output circuits.
The block diagram of RF Module is as shown below. It is made up of the following parts:

## 5.4.1 Power Supply
## 5.4.2 PLL and MCU Interface
## 5.4.3 RF Transmitter
## 5.5.4 RF Receiver
## 5.5.5 Audio Detector

**5.4.1 Power Supply**

**The RF transmitter receives power from TXVCC. TXVCC is enabled only during TALK mode or Ring mode.The RF receiver receives power from RXVCC. RXVCC is enabled when BASE plug in DC adapter.**

**5.4.2 PLL and MCU Interface**

**The frequencies of the RF transmitter and RF local oscillator are controlled by 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. The local frequencies to TX and RX are generated and locked at 801MHz and 828MHz respectively.**

**5.4.3 RF Transmitter**

**The RF transmitter oscillator frequency 801MHz is controlled by the PLL through Vt. The PLL samples the RF frequency through fin. The audio input signal AFIN is fed to this RF oscillator through the FM modulator.**

**Fundamental frequency 801MHz is multiplied to 2403MHz and bypass through band pass filter formed by Q7, ML5, C5, C37 and ML4. The filtered 2403MHz is then injected into TX power amplifier Q6** and related passive components. The enlarged 2403MHz rf signal is then input into the 2403MHz TX_FILTER, DF1. The transmitted rf signal is then injected into the ANTENNA and radiated out into air.

**5.4.4 RF Receiver**

**Received rf signal is collected from ANTENNA and passed through 2475MHz filter DF2. The filtered 2475MHz rf signal will then be injected into the LNA Q3 and be enlarged. The amplified 2475MHz signal is then input into the MIXER which is formed by Q4 and related passive components. The mixer collects the input from LNA and 2485MHz signal from BPF and then output the IF 10.7MHz into Q5.**

Q2 and VD2 with related resistors and capacitors network form the RXVCO **which is fed and locked by the PLL U1. The fundamental 828MHz frequency is multiplied to 2485MHz and bypass the BPF formed by C28, ML11, C26, C25, ML13 and C 50 to the receiver mixer.**

The receiver local oscillator frequency is controlled by the PLL through Vt. The PLL samples the local oscillator RF frequency through fin.

5.4.**5 Audio Detector**

Amplified IF from Q5 is passed into 10.7MHz filter CF1,amplifer Q8 ,10.7MHz filter CF3 and then injected into the IF demodulated IC U4. Detected audio will then be recovered and output at the AFOUT pin of the RF module.

**5.5 Compander**

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

**5.6 Data shaper**

The information which sending from handset unit, is recovered by the amplifier BMQ2, BMQ3.

**5.7 Charge detector**

BMQ5 is a charge detector to direct the charging signal to the MCU pin 80.

**5.8 Line audio interface**

BR82, BC66, BD13 TO BD16, BD3, BU7, BR61 and BTR1 line transformer are the audio interface to the telephone line. The transformer is also used for telephone isolation.

**5.9 Ring detector**

BC67, BR77, BZD2, BZD3, BD7, BU6(LTV817) form a ring detector which feed the signal through pin 93 of MCU.

**5.10 LCD function board**

BMLCD1 is used for indicating information.

**5.11 Carrier detector**

The RF Module BMD1 pin 12 is an output pin of the carrier detector signal to MCU pin79.

**5.12 Speakerphone**

Speakerphone is mainly formed by BU3,BU4 and Base Keyboard.
BQ12,BQ10,BQ11 drives speaker ringing which is controled by MPU pin 75.
When use speakerphone, BU3 amplify signal from BMIC1 and send it to compander BU2, BU3 also amplify singnal from expander BU3 and drives speaker.

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| CH | HANDSET | | BASE | |
|---|---|---|---|---|
| | TX | RX | TX | RX |
| 1 | 2,474,000,000 | 2,391,850,000 | 2,402,550,000 | 2,484,700,000 |
| 2 | 2,474,050,000 | 2,391,900,000 | 2,402,600,000 | 2,484,750,000 |
| 3 | 2,474,100,000 | 2,391,950,000 | 2,402,650,000 | 2,484,800,000 |
| 4 | 2,474,150,000 | 2,392,000,000 | 2,402,700,000 | 2,484,850,000 |
| 5 | 2,474,200,000 | 2,392,050,000 | 2,402,750,000 | 2,484,900,000 |
| 6 | 2,474,250,000 | 2,392,100,000 | 2,402,800,000 | 2,484,950,000 |
| 7 | 2,474,300,000 | 2,392,150,000 | 2,402,850,000 | 2,485,000,000 |
| 8 | 2,474,350,000 | 2,392,200,000 | 2,402,900,000 | 2,485,050,000 |
| 9 | 2,474,400,000 | 2,392,250,000 | 2,402,950,000 | 2,485,100,000 |
| 10 | 2,474,450,000 | 2,392,300,000 | 2,403,000,000 | 2,485,150,000 |
| 11 | 2,474,500,000 | 2,392,350,000 | 2,403,050,000 | 2,485,200,000 |
| 12 | 2,474,550,000 | 2,392,400,000 | 2,403,100,000 | 2,485,250,000 |
| 13 | 2,474,600,000 | 2,392,450,000 | 2,403,150,000 | 2,485,300,000 |
| 14 | 2,474,650,000 | 2,392,500,000 | 2,403,200,000 | 2,485,350,000 |
| 15 | 2,474,700,000 | 2,392,550,000 | 2,403,250,000 | 2,485,400,000 |
| 16 | 2,474,750,000 | 2,392,600,000 | 2,403,300,000 | 2,485,450,000 |
| 17 | 2,474,800,000 | 2,392,650,000 | 2,403,350,000 | 2,485,500,000 |
| 18 | 2,474,850,000 | 2,392,700,000 | 2,403,400,000 | 2,485,550,000 |
| 19 | 2.474,900,000 | 2,392,750,000 | 2,403,450,000 | 2,485,600,000 |
| 20 | 2,474,950,000 | 2,392,800,000 | 2,403,500,000 | 2,485,650,000 |
| 21 | 2,475,000,000 | 2,392,850,000 | 2,403,550,000 | 2,485,700,000 |
| 22 | 2,475,050,000 | 2,392,900,000 | 2,403,600,000 | 2,485,750,000 |
| 23 | 2,475,100,000 | 2,392,950,000 | 2,403,650,000 | 2,485,800,000 |
| 24 | 2,475,150,000 | 2,393,000,000 | 2,403,700,000 | 2,485,850,000 |
| 25 | 2,475,200,000 | 2,393,050,000 | 2,403,750,000 | 2,485,900,000 |
| 26 | 2,475,250,000 | 2,393,100,000 | 2,403,800,000 | 2,485,950,000 |
| 27 | 2,475,300,000 | 2,393,150,000 | 2,403,850,000 | 2,486,000,000 |
| 28 | 2,475,350,000 | 2,393,200,000 | 2,403,900,000 | 2,486,050,000 |
| 29 | 2,475,400,000 | 2,393,250,000 | 2,403,950,000 | 2,486,100,000 |
| 30 | 2,475,450,000 | 2,393,300,000 | 2,404,000,000 | 2,486,150,000 |
| 31 | 2,475,500,000 | 2,393,350,000 | 2,404,050,000 | 2,486,200,000 |
| 32 | 2,475,550,000 | 2,393,400,000 | 2,404,100,000 | 2,486,250,000 |
| 33 | 2,475,600,000 | 2,393,450,000 | 2,404,150,000 | 2,486,300,000 |
| 34 | 2,475,650,000 | 2,393,500,000 | 2,404,200,000 | 2,486,350,000 |
| 35 | 2,475,700,000 | 2,393,550,000 | 2,404,250,000 | 2,486,400,000 |
| 36 | 2,475,750,000 | 2,393,600,000 | 2,404,300,000 | 2,486,450,000 |
| 37 | 2,475,800,000 | 2,393,650,000 | 2,404,350,000 | 2,486,500,000 |
| 38 | 2,475,850,000 | 2,393,700,000 | 2,404,400,000 | 2,486,550,000 |
| 39 | 2,475,900,000 | 2,393,750,000 | 2,404,450,000 | 2,486,600,000 |
| 40 | 2,475,950,000 | 2,393,800,000 | 2,404,500,000 | 2,486,650,000 |