1. Introduction

The model FF714 is a 25 channel (43-49MHz) cordless telephone with digital answering machine. The whole unit is divided into three main parts as follows:

    a. A remote handset.
    b. A base unit.
    c. A digital answering machine.

2. Functional Blocks of the Remote Handset

- Keyboard matrix and function LED
- MCU and MCU interface
- Antenna and Duplexer
- Receiver amplifier
- Demodulator
- Audio amplifier and Compander
- Transmitter and receiver PLL frequency synthesiser
- Data shaper
- Transmitter amplifier
- Transmitter oscillator and modulator
- Charge detector
- Low battery detector
- Buzzer amplifier

3. Circuit Block Description

3.1 Keyboard matrix and Function LED
Pin 7 to pin 14 of the MCU form a keyboard and the talk LED KLED3 function is controlled by the Pin 22 of the MCU.

3.2 MCU and MCU interface
The handset and the base is link up by the pins (26, 18 and 25, 28).

3.3 Antenna and Duplexer

ANT is the common point for transmitting and receiving signal through antenna. DP2 is the transmitting duplexer and DP2 is the receiving duplexer which rejects the transmitting signal to interfere the receiver.

3.4 Receiver amplifier
Q1 and IFT1 is a tuned RF amplifier which amplifies the 43 to 46 MHz incoming RF signal and rejects the unwanted signal at other frequencies.

3.5 Demodulator

U1 MC13135DW is a double conversion receiver demodulator IC which produce two IF signals and demodulate the FM signal into baseband audio. In addition, it produce a RSSI signal to monitor the condition of receiving carrier signal.

3.6 Audio Amplifier and compander

U3C and Q5, U3D are the receive and transmit audio amplifier respectively. BU4 MM1100XF is a compander IC which performs audio compression for transmitted signal via pin12, pin8 and expand received audio signal at pin1, pin4.

3.7 Transmitter and receiver PLL frequency synthesiser

R45, C33, R44, C32 and R49, C39, R48, C37, R47 are the receive and transmit PLL loop filters respectively.

3.8 Transmitter amplifier

Q9, L2, C52, C53 and Q8, IFT5 form a tuned transmitter amplifier which amplifies the outgoing 48-49MHz RF signal.

3.9 Datashaper

C19, R22, C20, and U3B form a datashaper which send the information from BASE to the MCU pin18 (RXDAT).

3.10 Transmitter oscillator and modulator

Q10, IFT4, C57, C58, C40, C61, VD2 form a PLL tune oscillator which oscillates at the FCC assigned channel frequencies. VD3 performs as a FM modulator.

3.11 Charge detector

KZD1, KD4, KR11, KR14 form a charge detector to direct the charging signal to the MCU.

3.12 Low battery detector

U3A is the battery low detector which detect the low battery signal from pin 10 of MCU.

3.13 Buzzer amplifier

KQ1 is a buzzer amplifier driven directly by the MCU pin28.

4. Functional Blocks of the Base unit

- Power supply
- MCU and MCU interface
- Antenna and Duplexer
- Demodulator
- Receiver amplifier
- Audio amplifier and Compander
- Data shaper and noise detector
- Transmitter amplifier

- PLL loop filter
- Charge detector
- Audio analogue switch
- Line audio interface
- Parallel phone detector
- Ring detector

5. Circuit Block Description

5.1 Power supply

BD13, BD14, BD15, BD16 and BU10 7806 regulate the input AC 9V to DC 6V which provides dc power to every part of the circuit.

5.2 MCU and MCU interface

The heart of the base is the CU1 COPC880 (MCU) which communicates with the (PLL) MC145162DW through pin 3, 4, and 26 and the digital answering machine via pin 18, 19, and 20. Audio paths are selected by pins 17, 18, 19 and 20 through the analogue switch BU6 and BU7 CD4053. Generating DTMF by MU2 260SRA (DSPIC) through audio switch. Transmitter is controlled by the signal TXEN which output from MCU via pin 35. The communication between Handset and Base via the pin 22 and pin 24 through the RF link.

5.3 Antenna and Duplexer

BANT1 is the transmit and receive signal antenna.
BDUP1 and BDUP2, form a duplexer which rejects the transmitter signal to interfere the receiver.

5.4 Demodulator

MC13135DW (BU1) demodulator which using double conversion scheme produce two IF signals to demodulates the FM signal into base baseband audio. In addition, it has audio path amplifier, tuning cap for PLL frequency synthesiser, and RSSI (pin 12). BU3B pin 1 is for carrier detection.

5.5 Receiver amplifier

BQ1 and BIFT1 is a tuned RF amplifier which amplifies the 49 MHz incoming RF signal and rejects the unwanted signal at the other frequencies.

5.6 Datashaper and noise detector

BU3A is a datashaper detector to monitor the receiving carrier state for the condition of changed channel. BU3A form a carrier detector by monitoring the RSSI level output from BU1 (pin 12).

5.7 Transmitter amplifier

BQ6, BL6, BC30, BQ4 and BIFT3 form a tuned transmitter amplifier which amplifies the outgoing 43 to 46MHz RF signal. BQ5 and BC29 form the band switch to equalise the transmit power in two different band.

5.8 Audio amplifier and compander

BU4 (MM1100XF), BU3C and BU3D are the compander and audio amplifiers. BU3D also work as a premphasis filter. The audio muting is controlled by the MCU pin 36 by switching off the transistors BQ10 and BQ11.

5.9 Transmitter oscillator and modulator

BQ8, BC43, BC41, BC37, BC38 and BVD2, BIFT5 form a PLL tuned oscillator which oscillates at the FCC assigned channel frequencies.
BVD1 and BC33 performs as a FM modulator.

5.10 PLL loop filter

BR7-9, BC3, BC4 and BR18-20, BC22, BC24 are the receiving and transmitting PLL loop filter respectively.

5.11 Charge detector

CQ2 is a charge detector to direct the charging signal to the MCU pin23.

5.12 Audio analogue switch

BU6 and BU7 (CD40523) are for the audio path selection that is controlled by the MCU pin 18, 19 and 20.

5.13 Line audio interface

BQ14, BR90, BR92-93, BC74-75 and BT1 line transformer are the audio interface to the telephone line. The transformer is also for telephone line isolation.

5.14 Parallel phone detector

BQ15, BD6-9, BU8 (TLP521-1) form a detector to monitor   the parallel

5.15 Ring detector

BR99, BC83, BZ1-2, BU9 (TLP-521-1) form a ring detector to direct the ring signal to the digital TAD module.

6. Functional Blocks of the digital answering machine

- Power supply and Battery Back up part
- DSP and MCU interface
- Digital Audio Record and Play part
- Function key and Led part
- DTMF detect and VOX part
- Audio Amplifier
- Day/Time Stamp

7. Circuit Block Description

7.1 Power supply and Low Battery Detection

There are two different voltage supplying for CODEC TP3054 (MU3), +5V and -5V.
The transistor CQ4 (9014) is switching on when the power down. CQ3 (9015) and CQ5 are also going on if there is battery applying on the 9V adapter. Then the external battery can be used.

7.2 MCU and MCU interface

The heart of this circuit block is a CU1 (MCU). Its functions are as follow:
- Low battery detection (section 7.1)
- DSP and Cordless MCU I/O port (section 7.3)
- Audio path control interface (section 7.4)
- Function key interface (section 7.5)
- Led display interface (section 7.6)

7.3 Digital I/O part

MCU and DSP interface port consists of the following:
- MWCLK (SERIAL CLOCK Port) to MU2 pin 50
- MWDIN (SERIAL DATA INPUT Port) to MU2 pin 49
- MWDOUT (SERIAL DATA OUTPUT port) from MU2 pin 55
- MWRDY (MCU READY PORT) from MU2 pin 56

7.4 Paths Control

ICM, OGM recording, Cordless, Remote audio path are controlled by MCU CU1 through analogue switch CD4053 (BU6 and BU7)

The CU1 MCU will accept input and perform corresponding functions from the following function keys:

7.51 ANSWER   (CSW7)

This key input will inform the DSP to turn the unit into or out of the Answer Ready mode.

Do not release the key, it will inform the DSP that OGM record. Play shall be performed after release the key and the desired paths shall be controlled.

7.52 STOP/ERASE   (CSW3)

This key will perform stop/erase function when this particular key input is sensed.

7.53 TIME/REPEAT   (CSW5)

When this key input is sensed, the DSP will repeat the message being played, or play the current time and day through CODEC and audio path.

7.54 GREETING   (CSW6)

Press this key and do not release, it inform the DSP to be recording self speaking.

7.56 PLAY/SKIP/MEMO   (CSW9)

This key will inform the DSP to play the ICM message or skip the message, or inform MEMO record.

7.6 LED Display interface

The LED display is controlled by CU1 (MCU) pins 29, 30,32 and 33. The LED display will display the following:

-POWER / LOW BATTERY Indicate

-IN USE/CHG.

-PLAY/SKIP/MEMO

-TAD ON/OFF

7.7 DTMF Detector and VOX part.

DTMF signal from telephone line BQ14 (9014) and BT1 (line transformer), send to CODEC.

DTMF signal and VOX level detected by DSP

7.8 Amplifier

The heart of the block is the power amplifier CU4 (LM386). Signal passes from the analogue switch BU7 (CD4053) pin 14 after level adjusted by variable resistor CVR1 is passed to the input CU4 pin 2 of the amplifier via coupling capacitor CC17. The amplified signal is then coupled to the speaker through the capacitor CC14.

7.9 Day/Time Stamp

The voice of the seven days and the 24 hours are pre-stored in the DSP MU2. The current day/time clock can be manually set through the buttons TIME, ANSWER and REPEAT. The time of ICM messages will be stamped and it can be played associated with the ICM messages.