

## **TELEFIELD LTD**

**MODEL : FF688**

**DATE : Apr 23, 1999**

### **CIRCUIT DESCRIPTION**

#### **BASE UNIT (RF Part)**

##### **1.0 Power Supply**

The regulation circuit (U303) generates DC 5V and then pass through a diode(D387) to power all RF and audio circuit. The RF transmit power is controlled by the electronic switch (Q204). The transmit power is off when TALK OFF.

##### **1.1 RF Transmit Circuit**

The Voltage Controlled Oscillator VCO (Q205) generates the required frequency (43-46MHz, it also act as a modulator. Digital data from base unit MCU (IC301) for remote unit and base unit communication is feed into the modulator through a resistor network. Audio signal from tel. line are feed into the modulator through the buffer amplifier of the Combo chip TB31224 (U201).

##### **1.2 RF Receiver Circuit**

The LNA (Q201) together with the duplexer and the tune circuit (IFT201) amplify the wanted RF signal while suppress the unwanted RF signal. This RF signal together with the RF signal from the Local Oscillator of the Combo chip TB31224 (U201) are feed into the Mixer of the Combo chip TB31224 (U201), the Mixer is work at non-linear conditions such that a series of mixed frequencies of the incoming RF signal are generated. The 10.7MHz ceramic filter (CF201) filtered out the wanted Intermediate Frequency (IF). This IF is demodulated by the narrow band FM receiver of the Combo chip TB31224 (U201) to get the wanted audio signal.

##### **1.3 Frequency Synthesizer**

Frequency synthesize of the RF Transmit frequency and the LO frequency is done by the Phase Locked Loop of the Combo chip TB31224 (U201).

The PLL divide the transmit frequency by a factor "n" with a reference 5kHz frequency (generated from the 10.24 MHz reference frequency), any phase difference between these two frequencies will produce a net DC output at Pin47 of the Combo chip TB31224 (U201). This DC signal is feed at the varator diode (VD202 and VD203) to its capacitance in a way that will decrease the phase error unit zero. That is, the transmit frequency is locked.

Change channel is easily done by vary the factor "n" which is controlled by the MCU (IC301) through the 3 input port CLK, DATA and STB (Pin 6, 7, and 8) of the Combo chip TB31224 (U201).

LO frequency synthesize is done in the same way.

##### **1.4 Telephone Line Interface**

The telephone line input ( Tip / Ring ) is connected to the hybrid transformer and couple to the Secondary coil. The circuit is also protected by a slow blow fuse (FUSE) and the varistor. (MOV381) The Line seizure is performed by the transistor (Q341) to turn on the Reed relay. Transistor switching is controlled by the LSEIZE (Pin 3) of the base MCU(U301).

##### **1.5 Ringer Detection Circuit**

When the ring signal come from the telephone line, it is detected by the RINGIN port of the MCU (U301) through the Photo Coupler IC (U302).

### 1.6 Charge Detection Circuit

When the battery is under charging, It turn on the transistor (Q353) ,and the low level is detected by the CHG port (Pin 1) of the MCU (U301) . During charging, the CHARGE LED will be lit up.

### 1.7 Data Recovery

The function of the D-COMP-IN and DATA-OUT (Pin23 and Pin24) of the Combo chip TB31224 (U201) is to shape the recovered digital code signal to clean square pulse chain with correct duty cycle which can be recognized by the base MCU.

### 1.8 Compressor Circuit

The compressor of the Combo chip TB31224 (U201) will take a signal with an 80 dB dynamic range ( 100uV to 1.0 mVrms). and reduce that to a 40 dB dynamic range by attenuating strong signals, while amplifying low level signals .

### 1.9 Expander

The expander of the Combo chip TB31224 (U201) does the opposite in that the 40dB signal is increased to a dynamic range of 80 dB by amplifying strong signals and attenuating low level signals.

## **REMOTE UNIT**

### 2.1 Power Supply

The power is supplied by a 3.6 Volt battery. The RF transmitted power is controlled by the electronic switch(Q3). On the other hand, the power of receiver part is controlled by the VCC2 (PIN 41) of the Combo IC (IC1). The voltage regulator (IC3) provide a stable power to the MCU(IC2).

### 2.2 RF Transmit Circuit

The Voltage Controlled Oscillator VCO (Q5) generates the required frequency (49MHz), it also act as a modulator. Digital data from handset MCU (IC2) for remote unit and base unit communication is feed into the modulator through a resistor network. Audio signal from the TAD or tel. line are feed into the modulator through the compressor of the Combo chip TB31224 (IC1).

### 2.3 RF Receiver Circuit

The LNA (Q1) together with the duplexer and the tune circuit (T1) amplify the wanted RF signal while suppress the unwanted RF signal. This RF signal together with the RF signal from the Local Oscillator of the Combo chip TB31224 (IC1) are feed into the Mixer of the Combo chip TB31224 (IC1), the Mixer is work at non-linear conditions such that a series of mixed frequencies of the incoming RF signal are generated. The 10.7MHz ceramic filter (F1) filtered out the wanted Intermediate Frequency (IF). This IF is demodulated by the narrow band FM receiver of the Combo chip TB31224 (IC1) to get the wanted audio signal.

### 2.4 Frequency Synthesizer

Frequency synthesize of the Transmit frequency and the LO frequency is done by the Phase Locked Loop of the Combo chip TB31224 (IC1).

The PLL divide the transmit frequency by a factor "n" with a reference 5kHz frequency (generated from the 10.24 reference frequency), any phase difference between these two frequencies will produce a net DC output at TX-OUT (Pin47) of the Combo chip TB31224 (IC1). This DC signal is

feed at the varactor diode (D11) to its capacitance in a way that will decrease the phase error unit zero. That is, the transmit frequency is locked.

Change channel is easily done by vary the factor "n" which is controlled by the MCU through the 3 input port CLK, DATA and STB (Pin6, 7, and 8) of the Combo chip TB31224 (IC1).

LO frequency synthesizer is done in the same way.

#### 2.5 Charge Detection Circuit

When the handset put into the cradle, the handset MCU CHG-IN (Pin23) pull low and it reset the MCU.

#### 2.6 Data Recovery

The function of the D-COMP-IN and DATA-OUT (Pin23 and Pin24) of the Combo chip TB31224 (IC1) is to shape the recovered digital code signal to clean square pulse chain with correct duty cycle which can be recognized by the handset MCU.

#### 2.7 Compressor Circuit

The compressor of the Combo chip TB31224 (IC1) will take a signal with an 80 dB dynamic range (100uV to 1.0 mVrms). and reduce that to a 40 dB dynamic range by attenuating strong signal, while amplifying low level signals.

#### 2.8 Expander

The expander of the Combo chip TB31224 (IC1) does the opposite in that the 40dB signal is increased to dynamic range of 80 dB by amplifying strong signals and attenuating low level signals.

#### 2.9 LCD Display

The MCU is also drive the LCD display through its ports SEG00-SEG51 and COM0-COM11.

### **BASE UNIT (SPEAKER PHONE PART)**

#### 3.1 Transmission

In speakerphone mode or intercom mode, the electrical signal come from the Mic will be filtered and amplified through the MCI (Pin11) of the U401 (T65118), and then send to the Tx Attenuator (TXI for input, TXO for output) which is controlled by the comparison of the Tx level with the Rx level. After attenuation, the signal is sent to the Hybrid Amplifiers (HTI for input, HTO for output) of the U401. In speakerphone mode, the output of the transmission signal will be sent to line through analogue switch U409C. In intercom mode, the output of the transmission signal will be sent to line through analogue switch U409D.

#### 3.2 Receiving

In speakerphone mode, the receiving signal is come from the line through analogue switch U409B. In intercom mode, the receiving signal is come from the line through analogue switch U409A. The receiving signal is then filtered by the Filter (FI for input, FO for output) of the U401 and then send to the Rx Attenuator (RXI for input, RXO for output) which is controlled by the comparison of the Tx level with the Rx level. After attenuation, the receiving signal is sent to power amplifier U3 through buffer Q404.

### 3.3 Attenuator control

The Tx and Rx attenuators are complementary in function. When one is at maximum gain (+6dB), the other is at maximum attenuation (-46dB), and vice versa. They are never both fully on or both fully off. The sum of their gains remains constant. Their purpose is to control the transmit and receive path to provide the half-duplex operation required in a speakerphone.

## **BASE UNIT (CALLER ID PART)**

### 4.1 Caller ID detection

The MX602A (U304) is a FSK detector, it will morning the signal from line (Tip and Ring), after ring if CID FSK signal is detected, it will demodulate the signal and send the digital data to RF MCU (U301). After processing, RF MCU will send the CID data to remote unit through RF link.

### 4.2 Caller ID CW detection

In talk mode, the MX602A (U304) is still morning the signal from the line. If a CAS signal is detected, it will send a detect signal to RF MCU (U301) through DET (Pin 13). RF MCU (U301) will sent a ACK signal to the line to activate the line to send FSK Caller ID data. After receiving the signal, the RF MCU (U301) process the decoded data form MX602A (U304) and then send to remote unit through RF link for display.

## **BASE UNIT (TAD PART)**

### 5.1 Power Supply & Low Battery Detection

The power voltage supplies to all the TAD audio circuitry is regulated by Q103 and the output voltage is 6.8V. The power voltage supplies to all the TAD digital circuit is regulated by Q102 and the output voltage is 4V.

The circuit is backed up by one 9V alkaline battery, the battery is disconnected from the supply when the ac mains is presented and detected by the transistor Q104. When there is a power failure, D103 and D104 are turned ON and the 9V is regulated down to 4V by Q102 & DZ1 (4.7V zener) which together form a voltage regulator. The back up voltage will only supplied to the digital part circuit which will back up all messages stored in the ARAM.

If the 9V battery voltage output becomes low, a high signal will come from Pin 1 of U5 and send to the Batt\_Low port of the TAD MPU.

### 5.2 MPU & MPU Interface

The heart of this circuit block is a MPU for TAD, U7 SV9601. Its functions are as follows:-

- Low Battery detection (see section 5.1)
- TAD MPU & Cordless MCU I/O port (see section 5.3)
- Line In/Out path, record/play path control (see section 5.4)
- VOX detection (see section 5.4.1)

- Function key interface (see section 5.4.2)
- LED display interface (section 5.4.3)
- DTMF Decoder (section 5.4.4)
- Voice chip interface (see section 5.5)
- DAY/TIME stamp and Voice Wizard (section 5.8)

### 5.3 Digital I/O port

- MPU (TAD part) & Cordless MCU interface port consists of the following:
  - : SCK (SERIAL CLOCK port) to U6 PIN53
  - : SI (SERIAL INPUT port) to U6 PIN52
  - : SO (SERIAL OUTPUT port) from U6 PIN50
  - : TAD\_RDY (MPU READY port) from U6 PIN49
  - : RING DETECTION to U6 PIN36

### 5.4 Paths Control

The TAD MPU will provide control for the following paths through suitable controls (namely the Mic. enable U6 PIN98, speaker enable U6 PIN97 to the desired analogue switches for the corresponding paths. The controls can be divided into the following areas:-

- OGM recording

The microphone Mic1 is enabled, the Speaker/ Line In/Line Out is disabled.

- OGM/ICM Play back

Speaker/Line Out enabled, Line In/Mic disabled.

- ICM recording

Speaker/Line In enabled. Mic./Line Out disabled.

#### 5.4.1 VOX Detection

The voice signal is passed from C142 to the VOX compactor (U5B) from amplifier (U3 PIN15). The compactor will take the reference voltage as derived using the potential divider R142, R141. If signal level is lower than this level, the compactor will output a high signal to TAD MPU. Conversely, it will output a low signal to the TAD MPU (U6). The TAD MPU will use this signal to determine when to drop the line.

#### 5.4.2 Function Key Interface

The MPU (U6) will accept input and perform corresponding functions from the following function keys:-

- ON/OFF/ ANNOUNCE ONLY (SW105)

This key input will inform the MPU to turn the unit into or out of the Answer Ready mode and also inform the MPU that OGM record or Play shall be performed and the desired paths shall be controlled.

- STOP (SW101)

The MPU will perform the stop function when this particular key input is sensed.

- PLAY/SKIP/MEMO (SW103)

This key will inform the MPU to play the ICM message, skip the message or record a Memo.

- GREETING/REPEAT (SW106)

When this key input is sensed, the MPU will play the OGM or repeat the message being played.

- MESSAGE CALL BACK (SW108)

When this key input is sensed, the MPU will play the CID number and if it is press again, the MPU will seize the line and dial back the CID number.

- HELP 1 (SW109)

When this key input is sensed, the MPU will play the voice manual help guide.

- HELP 2 (SW110)

When this key input is sensed, the MPU will stop play the voice manual help guide.

#### 5.4.3 LED Display interface

The LED display is controlled by MPU (U6) PIN83. The LED display will display the following:-

- POWER INDICATE

- Battery Low

The LED display will flash rapidly to indicate that the battery is low.

The 7-Segment LED display is controlled by Pin63 - Pin70 of the MCU (U6).

- The number of incoming message will be displayed on the 7-Segment LED.

#### 5.4.4 DTMF Decoder

DTMF signal is detected by MS8870 (U9). A valid DTMF tone will sent to TAD MCU (U6) TOE (PIN51), Q1 (PIN72), Q2 (PIN73), Q3 (PIN74), and Q4 (PIN75).

### 5.5 Voice Recording/Reproducing IC & Interface

The OGM/ICM message is stored in the one ARAMs (U7, S4004SB1 4M x 4) via the TAD MCU SV9601 (U6). The voice signal is input to the ADI terminal of the voltage compactor (U5D, PIN9), the voice data DIN (U6 Pin106) will always try to generate a signal equal to the signal present at ADI. The TAD MCU constantly check the O/P of the compactor (U5D, PIN8) to know the signal information.

The ARAMs' interface is also performed by the TAD MCU (U6) with its internal refresh counter providing refresh cycles to the ARAMs.

### 5.6 Automatic Level Control

The signal to the TAD MCU is controlled by the ALC circuit. The signal from the KA221307 ADI (U3, PIN15) is fed to the ALC-IN (U3, PIN14) and then accounts for the decade time of ALC loop. The voltage output is ALC-OUT (U3, PIN3), and when signal is higher than approx. 0.5V, it will start to conduct and mute the signal to ADI and a ALC loop is formed.

### 5.7 Amplifier

The heart of the block is the power amplifier inside the KA22130 (U3). Signal passes from DAO, after its level is adjusted by variable resistor R162A (20K), is passed to the PW-IN (U3, PIN13) of the amplifier via resistor R139. The amplified signal is then coupled to the speaker through C127 (220U 10V).

### 5.8 Day/Time Stamp and Voice Wizard

The voice of the seven days, the 24 hours and voice help guide are pre-stored in the ROM IC (U10). The current day/time clock can be manually set through handset remote. The time of ICM messages will be stamped and it can be played associated with the ICM messages. The EPROM's interface is also performed by the TAD MCU (U6).

## **SECURITY CODE GENERATION**

When the handset was put on cradle for a while, a 16bit random security code is generated on the base MCU and it will be transmitted from base to handset through CH8. A beep will sound from the handset buzzer to confirm the successful security code transformation.