Circuit Description of Digital Cordless Telephone (43-3519)

The 43-3519 Digital Cordless telephone with caller ID is 2400MHz band(ISM BAND) Digital Cordless Telephone and Time Division Duplex (TDD) System.
It performs Transmission and reception through the TDD ANTENNA of the RF module.

BASE Station and Handset unit

1.1 Power supply and Regulator circuit (Base station)

- AC/DC adapter converts 120V AC/60Hz to DC 9V 300mA and supplies 9VDC to the base unit.
- Regulated voltage used U100(KIA7805) and through D101, D102

1.1.1 Power supply and Regulator circuit (Handset unit)

Supply the Battery 3.6V 600mAh Ni-Mh and voltage regulator U100(3.0V output)

1.2 Park Detect and Battery Charger

- When the handset is parked, the charge signal is connected between the battery charger circuit (Q100, Q101 and Q102) and the handset battery.
  Current will flow to charge the battery and turn on the Q103 TR ON.
  Q103 will set the PARK(Pin 25) signal low, which will inform the base station that the handset is parked.
  trickle charged Ni-Mh is use, the Nominal charge current must be close to but less than 0.1C.
  Nominal charge current should be 55-60mA for 600mA battery.

1.3 Speech circuit (Base Station)

1.3.1 S800(Poly switch),VAR800(Varistor) is for surge protection and there are RF interference protection components L800, L801, and C800.

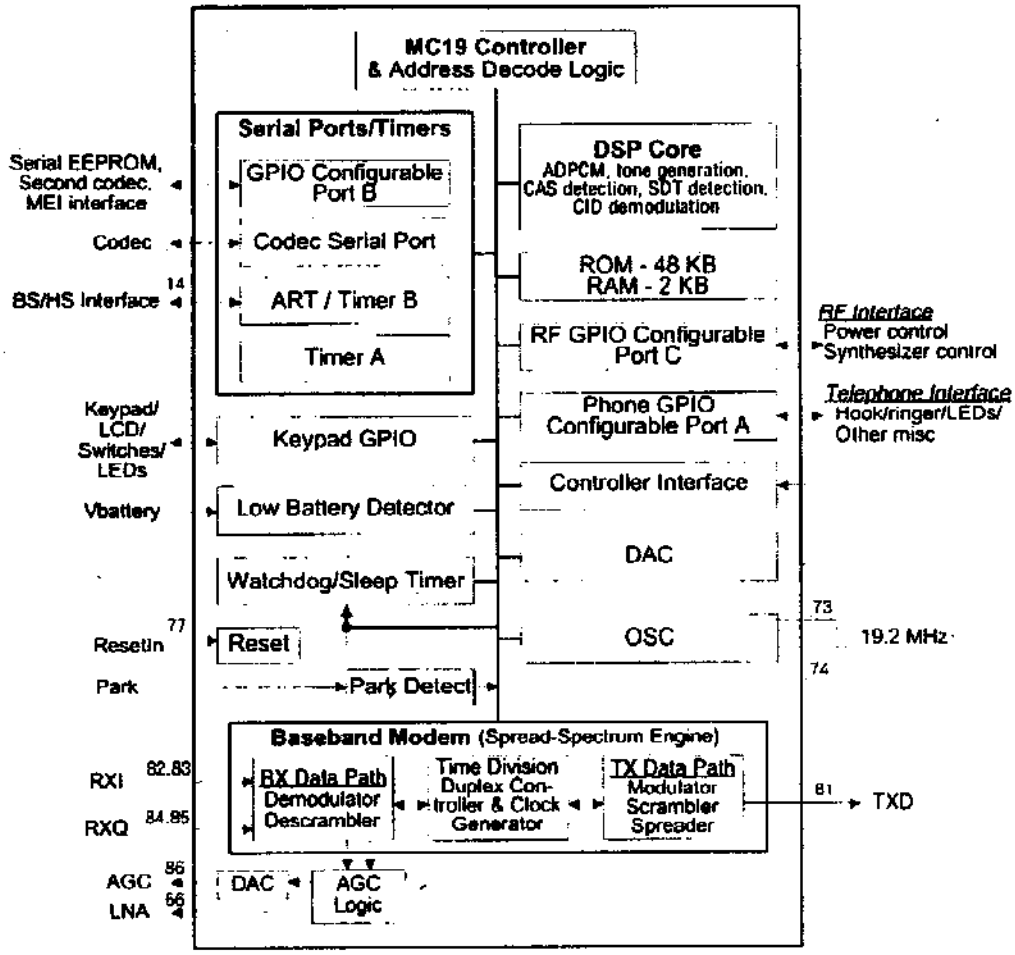
1.3.2 IC800, C801, R600 and R801 are for ringer circuitry.
When the base unit receives a ring signal, a pulse on pin 4 of U800 inputs pin 4 of U300.

1.3.3 When there is an audio signal on telephone line, the audio signal through U200A applies pin 37 of U300 (Baseband chipset IC)for convert analog signal to digital signal.
When converted signal outputs from pin 81 of U300 TXDAC and send to the RF Module.

1.3.4 Receive signal from handset is detected by RF module then De-modulation by the U300 Pin 82(RXIP), 83(RXIN), 84(RXQP), 85(RXQN) reserved audio signal output to keep proper level. The audio level is adjusted by U200 and . upplies to telephon line.

1.3.5 U300 Baseband Chip ASIC Block Diagram Figure 1

Figure 1 - U300 BASEBAND ASIC

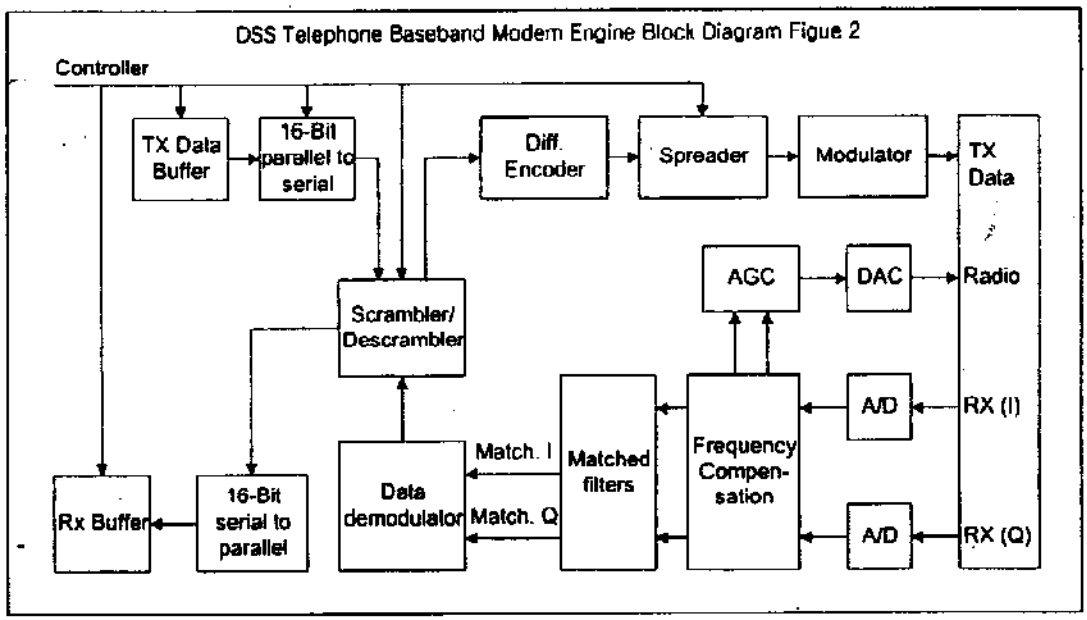


The Partitioning of the U300 Baseband ASIC logic blocks is show in Figure 1. Detailed information on Each of these block follows.

1.3.5.1 Microcontroller

The microcontroller is the 65C02 based MC19 CPU.

1.3.5.2 Baseband Modem – A block diagram of the baseband Modem is shown in Figure 2.



- ***Transmit/Receiver Data Paths.*** The transmit data path is comprised of a parallel-to serial converter , scrambler, differential encoder, spreader and modulator. The receive data path is comprised of analog to digital converters, a matched filter with frequency compensation, data demodulator, descrambler and serial to parallel converter.

- ***Scrambler / Descrambler.*** A 16 bit code ramdomizes the voice and supervisory data for Transmission and reception. More than 64K scramble codes are available form the 16 bit maximal Length pseudo noise sequence generator.

- ***Spread Spectrum Spreader.*** Each transmitted bit is multiplied with a 12 chip spreading code.

- ***Differential Encoder.*** Data is differentially encoded.

- ***Modulation.*** BPSK modulation is used.

- ***Receiver A/D Converters.*** Baseband I/Q signal from the radio are sampled at 2.4GHz and Converted to digital with 3 bit flash A/D converters.

- ***Freguency Compensation.*** Freguency compensation circuit allow use of high PPM crystals.

- ***Data Demodulation.*** Matched filter outputs are differentially demodulated using dot product detection.

- ***Matched filters.*** The spreading code is removed from the received digitized I/Q signals with Matched filters.

- ***AGC.(Pin 86)*** The signal energy is comparared to a programmable threshold and scaled with programmable gain. The digital AGC value is output to the radio by an 8 bit D/A converter.

- *ID Detector.(Pin 24)* A 16bit code program a 32 bit ID word which is used during acquisition to Vwrify the RF link and initialize from timing.

- *RF Control Functions.* The U300 Baseband ASIC four GPIOs (Pin 68,69,70,71) are for the RF synthesize serial Interface.
  In addition, the 9.6MHz REFOSC (Pin 72) signal is used as the synthesizer reference clock.
  Furthermore, two GPIOs (Pin 90, 92) are used to control the RF power amplifier output level,
  One GPIO (Pin 66) is used to control the LNA gain setting and two dedicated signals are used to Control switching of the RF transmit and Receive modes.(Pin 67, 89)

- *External Interface Functions.*

  . **General Purpose I/O Pins, Keypad/Switch/LCD display interface, Asychronous receiver/ Transmitter (ART), Park Dectector. ect..**
  . **Serial EEPROM interface.** The U300 Baseband ASIC supports the use of industry standard microwire or I+C serial EEPROM.
  . **Ringer/Buzzer interface.** The U300 Baseband ASIC provides several otions for generating ringer tones.
  . **LED Indicator Interface.** The U300 Baseband ASIC Provides the LED indicators. (Phone, Page/Intercom, Charge, Out of range/Low battery)

1.3.6 Telephone line interface for CID

The U300 Baseband ASIC chip is capable of Types 1, 2 Caller ID. The CID signal comes from the PSTN to U801C and LINEIN(Pin 37) on the U300 Codec, Converted to a digital signal and than goes to the U300 internal Audio Coprocessor. For Types 2 , because the phone is off-hook, a path already exists from the PATN signal to LINEIN on the U300 Codec. However, for Type 1 CID, the phone is on-hook.

1.3.7 Switches (Base Station only)

The switch input are available using the KEYPAD control pins to scan the switches and GPIOC0(Pin 5) to detect a closed switch, using a method similar to the keypad matrix scanning.
The base station circuit interface for the RINGER ON/OFF switch (Not Used)
and the TONE/PULSE switch.

1.3.8 LCD Interface (Handset only)

The liquid crystal display logic provides to interface the U300 to an LCD display. The controller uses the KEYPAD pins for 8 bit serial data bus, LCDDATA(Pin 96), and two GPIO pins for The LCD Control signal as pin 93 – LCDCLOCK and pin 94 – LCDRESET.

1.3.9 KEYPAD (Handset only)

The keypad is controlled by 14 pins (8 bidirectional control and 6 read inputs).

1.3.10 Asynchronous Receiver / Transmitter (ART) – Pin 24(ART IN) , Pin 26 (ART OUT)

This block can be configured as either as Asynchronous Receiver Transmitter (ART) or as a Standard time the logic controls the two-pin asynchronous serial port of the ASIC.
It can be used for base/handset communication and for the tester interface, and parallel to serial Conversion on data characters received from the controller.

1.3.11 **Audio Coprocessor.** The Audio coprocessor is to the microcontroller via the data bus and Memorymapped resisters. It runs at 19.2MHz crystal frequency and consists of :

- *ADPCM Codec.* Compresses 14 bit linear samples to 4 bits at an 8ksps rate,
  Using the ITU 726 32kbps ADPCM audio compression algrithum.

- ***Dual tone generator.*** Three programmable signal generator that produce either alerting tones or That conform to DTMF signaling specifications.

- ***CAS tone detector.*** Detector the CID CAS tone while system is off-hook.
- ***SDT tone detector.*** Detects the stutter dial tone (SDT) which indicatters a voice message has been stored in the PSTN memory storage.

- ***FSK detector and demodulator.*** Detects and demodulates the FSK signal sent form the PSTN For CID.

1.3.12 19.2 MHz Crystall Oscillator (U300-Pin 73, Pin 74)

This oscillator is used to generator the system reference clock. This oscillator needs to generate An accurate clock frequency from a crystal source. Normal operation is at 19.2MHz. The audio coprocesor uses this 19.2MHz clock. This clock is divided by 2 to generate a 9,6MHz reference clock for the rest of the system.

1.3.13 Low Battery Detector (U300 - Pin 80) - Handset Only

The Baseband ASIC (U300) Provides an analog to digital converter (ADC) input to allow the ASIC to monitor the battery voltage at the handset .

1.3.14 Power on Reset (U300-Pin 77)

The power on reset block uses a voltage detector to compare the RESETI (Pin 77) input Voltage with an on chip reference voltage to generate reset and the RESETOP output signal. The threshold for reset going active is 1.257V +/- 36mV, and for reset going inactive, is 1.35V +/- 36mV.

1.3.15 RX Data ADCs (U300-Pin 82, 83, 84, 85)

The U300 ASIC takes baseband In-phase and Quadrature (I/Q)analog samples from the RF Transceiver and processes them to demodulatote data. The basic functionality for the analog Calls is to quantize and sample the signal using a 3 bit ADC for the I/Q received signals. The inputs are differentially received.

1.3.16 AGC DAC (U300-Pin 86)

An 8 bit DAC is used the AGC control for the baseband amplifiers, in the RF transceiver, To control the amplitude level of the RX data input to the ASIC.

1.3.17 TX DAC Output (U300-Pin 81)

The TX data DAC output is used as the transmit data output to the RF transceiver. A DAC Is used to regulate the transmit output power level, when the power supply varies, to maintain Constant output power. The power has three levels : two levels for data modulation and a Thied level for maintaining DC level during the receive periods.

1.3.18 Audio Codec description

The Audio codec is a monolithic CMOS integrated circuit operation. It consists of an ADC encoder path and a DAC decoder path with digital filtering and analog signal processing Circuits to realize a complete ITU-G.714 compatible voice frequency liner coder/decoder. The word rate to and from the device is 8k words per second per channel.

- ***Encoder path description.*** There are two inputs to the encoder, MICIN(Pin 38,39-Handset) and LINEIN(Pin 37-Base station), which are biased at AGND.

The microphone input, MICIN(Pin38,39), is a differential input.
LINEIN(pin 37-base) is a Single ended input.
an electret microphone may be AC coupled(Handset -C204,c205) into MICIN and C213,C214,C215and R208,R213 is are near codec input filters, and R211,R212,C209 is are near microphone filter. and powered form the MICBIAS(Pin 40)source provided.

- ***Decoder Path Description.*** The codec provides two sets of analog output which may Independently enabled or disabled. SPKROP(Pin 46) and SPKRON (Pin 47) from a differential output capable of driving a 150 ohm resistive loaded.
The codec's SPKROP and SPKRON differential outputs will drive the telephone line interface directly and to drive DTMF tones.

1.4 RF module circuit

RF Module : RF 109(U400) Transceiver and RF 110(U700) RF Power Amplifier.

- RF Module Descriptions -

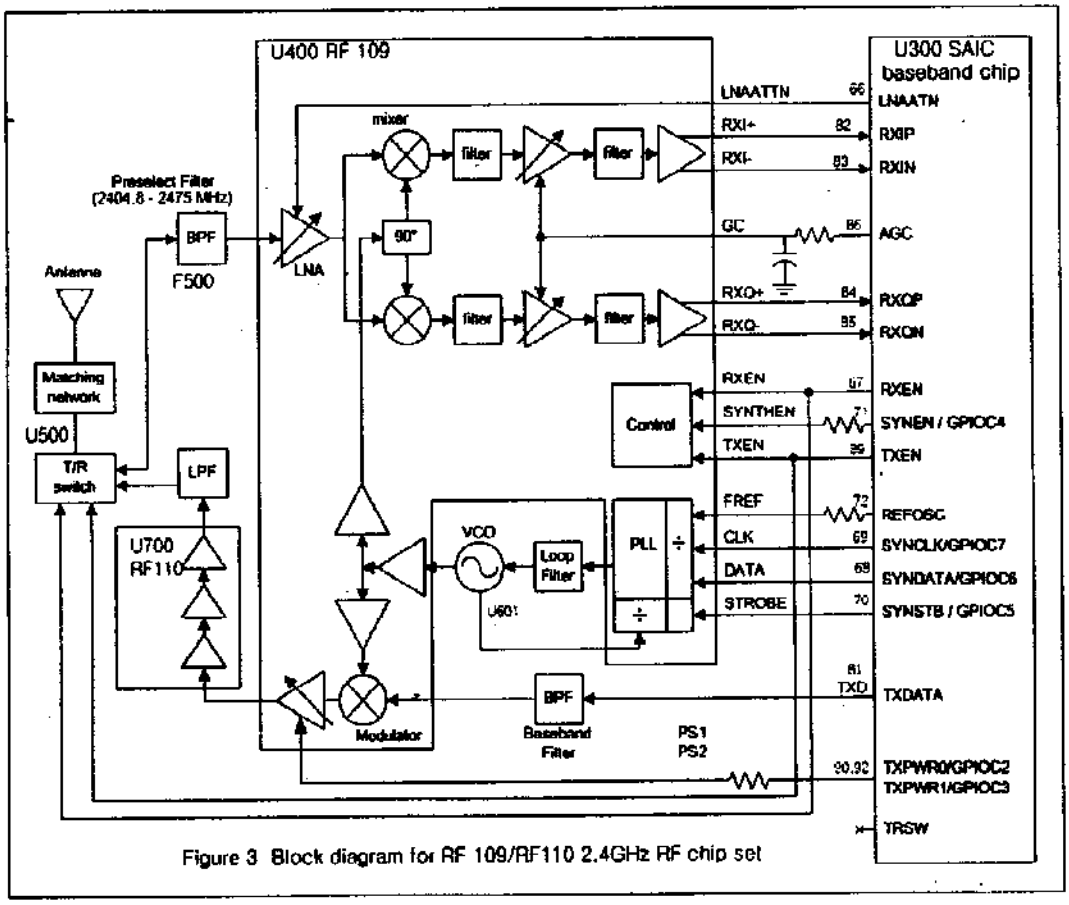


Figure 3 Block diagram for RF 109/RF110 2.4GHz RF chip set

The U400 and U700 is are 2.4GHz RF chip set, U300 Baseband chip to from a complete 2.4GHz ISM band DSS cordless telephone.
The U400 is a transceiver IC, and the U700 is a class AB Power amplifier.

1.4.1 Transmit Path. The baseband digital data input signal is shaped by an R402,C406,L400, C405 and C411 external B.P.F (baseband filter) from U400.
The shaping of the baseband data determines the spectral sharpe of the transmitted RF signal. For the 2.4GHz telephone system, the typical 3dB cutoff frequency is about 22KHz(highpass) and 820KHz (lowpass).

The U700 power amplifier (PA)inputs and outputs are differential RF signal. Impedance matching network a are between the PA output and the RF Lowpass filters.(C703,C702,C701,C700)
The U700 output with a phase difference of 180 degrees between the two branchs.
The differential output of the U700 are converted to a single ended signal, 50 ohm load, using the balun circuit.

The system is automatically selectable High power, Medium power, Low power output modes. Depending on the distance between base station and handset, the system automatically sets the desired power mode.

1.4.2 Receive Path The signal is received at the antenna and passes through the U500 Transmit/Receive switch and an RF bandpass filter(F500).
The filter should have a 3 dB passband range from 2404.8 to 2475 MHz.

The output of the bandpass filter is AC coupled to the LNA (Low Noise Amplifier) of the U400 Pin 11.
The U400 downconverts the RF signal into In phase and Quadrature baseband Signals. The differential I/Q baseband signal are DC coupled to the U300 ASIC Pin 82, 83,84 and 85 inputs.

1.4.3 Transmit / Receive Switch The transmit and receive function of the radio are enabled by RXEN(Pin67) and TXEN (Pin 89)control signals the U300 ASIC.

1.4.4 Lo Oscillator The LO signal oscillator by a programmable PLL frequency synthesizer in the U400 and an external 2.4GHz VCO to U601.

1.4.5 Antenna Part

1.5 Frequency Table

Channel	Frequency [MHz]	Channel	Frequency [MHz]
1	2404.8	21	2440.8
2	2406.6	22	2442.6
3	2408.4	23	2444.4
4	2410.2	24	2446.2
5	2412.0	25	2448.0
6	2413.8	26	2449.8
7	2415.6	27	2451.6
8	2417.4	28	2453.4

9	2419.2	29	2455.2
10	2421.0	30	2457.0
11	2422.8	31	2458.8
12	2424.6	32	2460.6
13	2426.4	33	2462.4
14	2428.2	34	2464.2
15	2430.0	35	2466.0
16	2431.8	36	2467.8
17	2433.6	37	2469.6
18	2435.4	38	2471.4
19	2437.2	39	2473.2
20	2439.0	40	2475.0