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COMMUNICATIONS

C389

CDMA MOBILE PHONE

Technical Operational Description

Summarize

Hisense C399 handset is applied for CDMA 1X network, With Qualcomm MSM6000 chip and ZERO-IF technic C399 has high integrity, high quality of RF and longer idle period . To adopt FLASH , SRAM chip , bar shape , 4K colorful and 128X96 pixels LCD , fixed outer antenna and disassemble battery makes it bright and clear.

CDMA2000 1X key technic

CDMA2000 1X adopts SRI expend frequency speed and DMSS(direct multi-carrier spread spectrum) (1.2288Mbits/s chip rate in forward and backward channel), so it is smoothly compatible with IS-95(A/B).

Because CDMA2000 1X adopt backward correlative demodulation, fast forward power control, transmiting division, Turbo coding technic, its capability is higher than IS-95 and about twice than that of IS-95(A/B) for common voice service under the same condition.

1、Forward fast power control technic

CDMA2000 1X adopts Forward fast power control technic. Mobile station will measure Eb/Nt received from traffic channel, compares it with threshold and then transmit indication to base station for adjusting base station transmiting power, the power control speed is up to 800b/s.

Due to using Forward rapid power control, the base station transmiting power is lowered, total interfere pulse is decreased, accordingly mobile station signal-to-noise is also decreased and finally the system capability is increased.

2、Forward fast paging channel technic

This technic has two usage:

1) Choosing Paging or sleeping state

Because base station transmits indecation to mobile station through fast paging channel to decide the mobile station in monitoring paging channel state or low consumption sleeping state, the mobile station need not constantly monitor forward paging channel for a long time, accordingly the mobile station active time is decreased and consumption is saved.

2) Changing configuration

Base station transmits recent several minutes system parameter message through forward fast paging channel, makes the mobile station handle these message correspondingly.

3、Forward linking transmitting division technic

CDMA2000 1X adopts directly expanding frequency division technic in two way:

1). Orthogonal division method is to separate data stream firstly and then expand frequency for the two data stream with different Orthogonal

Walsh Code and transmit them through two transmiting antenna.

2). Another is air-space expand division

This method uses two space separated antenna to transmit interweaved data and the same original Walsh code channel. Using forward link transmiting division technic may decease transmit power, anti Rally fading and increase system capacity.

4、Reverse correlative demodulation

Base station uses backward pilot channel to transmit expanding frequency signal to capture the signal of mobile station, and then realizes correlative demodulation with RAKE receiver, improves the backward link capability compared with IS-95 which adoptes no-correlative demodulation, decreased the mobile station transmiting power, increases system capacity.

5. Continued backward air interface waveshape

In backward linking, data adopts continued pilot frequency to make data waveshape continued in channel, this method may decrease the interference of outer electromagnetism, improves seaching capability, supports forward power fast control and continued monitor of backward power control

6. Flexible frame length

Differing from IS-95, CDMA2000-1X supports multi frame length of 5ms, 10ms, 20ms, 40ms, 80ms and 160ms, different channels support different frame length separately. The forward basic channel , forward dedicated control channel , backward basic channel, backward dedicated control channel adoptes 5ms or 20ms fram length, forward supplement channel, backward supplement channel adoptes 20ms、40ms or 80ms frame length，voice channel adoptes 20ms frame length. Short frame may reduce time delay, but demodulation capability is lower. Long frame may lower the demand for transmiting power.

Technical description and capability parameter

1. CDMA1X mobile phone accords with following standard

YDC **015**-2002 《CDMA2000 digital cellular mobile communication network device criterion：mobile station》

YDC **023**-2002 《CDMA2000 digital cellular mobile communication network test criterion: mobile station》

YDC **024**-2002 《cdma2000 1X mobile station device test criterion：protocol coherence test》

YD 1169.1-2001《the first part of 800MHz CDMA digital cellular mobile communication system electromagnetism compatibility requirement and test method：mobile station and its accessory device》

YD/T965-1998《security requirement and test method of telecom terminal device》

GB/T2434.8-1995 《Electrician and Electron Product Basic Environment Test Regulation Test Ed：Free Falling》

GB 9254-1998《Wireless Interference Limitation and test method of information technic

device》

2.General description:

2.1 Intended Environment

Store temperature :-30 to +60℃

Working temperature :-20 to +50℃

2.2 Industrial design

Size: 101.9x47.1x17.1mm

Weight: 72.5g。

2.3 Electronic device speciality

(1) Continuum conversation time test condition: according to CDG 35 and charpter 2.1, setting

Standard battery: longer than 3.5 hours

Continuum idle time test condition: according to CDG 35 and charpter 2.2.2c setting

Standard battery: longer than 220 hours

Charging time: ≤150 minutes.Battery rating Voltage :3.8V.

Standard battery rating volume: 750mAh。

LCD: 4K color and 128 x 96 dot.

Key beep volum:choice.

Key beep volum:choice.

DTMF tone: 75±5dBA; Error tone: 70±5dBA; Other key beep tone: 70±5dBA

(2) A、Outer I/F interface speciality

input impedance (transmiting signal end) 5KΩ

output impedance (recieving signal end) 600 5KΩ

B、Accessory headset and microphone interface speciality:

input impedance (transmiting signal end) bigger than 2.2KΩ-20%

2.4 General technical requirement:

2.4.1 Minimun CDMA Receiver standard

2.4.1.1 Receiver Frequency range:: 869MHz～894MHz。

2.4.1.2 Receiver sensitivity and dynamic range

Minimun standard :conducted sensitivity FER≤0.5%(Îor=-105dBm/1.23MHz, Pilot Ec/Ior= －7dB, Trffic Ec/Ior=－15.6dB)。

Dynamic range :FER≤0.5% (Îor =－105.0～-25.0dBm/1.23MHz, Pilot Ec/Ior =－7dB, Trffic Ec/Ior=－15.6dB)

2.4.1.3 Single Tone Desensitization

Single tone desensitization is a measure of a receiver ability to receive a CDMA signal at its assigned channel frequency in the presence of a single tone spaced at a given frequency offset from the center frequency of the assigned channel. The receiver desensitization performance is measured by the frame error rate (FER).

Given frequency offset ±900kHz、power－30dBm,Îor＝－101dBm/1.23MHz, Pilot Ec/Ior= －7dB,Traffic Ec/Ior＝－15.6dB)The FER in each test shall not exceed 1.0% with 95% confidence。

2.4.1.4 Intermodulation Spurious Response Attenuation

The intermodulation spurious response attenuation is a measure of a receiver' s ability to receive a CDMA signal on its assigned channel frequency in the presence of two interfering CW tones. These tones are separated from the assigned channel frequency and are separated from each other such that the third order mixing of the two interfering CW tones can occur in the non-linear elements of the receiver, producing an interfering signal in the band of the desired CDMA signal. The receiver performance is measured by the frame error rate (FER).

One given CW(continuous wave) offset±900kHz, another given signal offset±1700kHz, tone power -43dBm, The FER in each test shall not exceed 1.0% with 95% confidence (Îor＝－101dBm/1.23MHz, Pilot Ec/Ior＝－7dB, Traffic Ec/Ior＝－15.6dB)。

One given CW(continuous wave) offset±900kHz, another given signal offset±1700kHz, tone power -32dBm, The FER in each test shall not exceed 1.0% with 95% confidence(Îor＝－90dBm/1.23MHz,Pilot Ec/Ior＝－7dB,Traffic Ec/Ior＝－15.6dB)

One given CW(continuous wave) offset±900kHz, another given signal offset ±1700kHz, tone power -21dBm, The FER in each test shall not exceed 1.0% with 95% confidence (Îor＝－79dBm/1.23MHz, Pilot Ec/Ior＝－7dB, Traffic Ec/Ior＝－15.6dB)

2.4.1.5 Conducted spurious transmitting

Conducted spurious emissions are spurious emissions generated or amplified in a receiver that appear at the mobile station antenna connector.

The conducted spurious emissions for a mobile station shall be:

1. Less than -76 dBm for band classes 0 Band measured in a 1 MHz resolution bandwidth at the mobile station antenna connector, for frequencies within the mobile station receive band associated with each band class that the mobile station supports.
2. Less than -61 dBm, measured in a 1 MHz resolution bandwidth at the mobile station antenna connector, for frequencies within the mobile station transmit band
   (see 3.1) associated with each band class that the mobile station supports.
3. Less than -47 dBm for band classes 0, measured in a 30 kHz resolution bandwidth at the mobile station antenna connector (see 3.1), for all other frequencies. Less than . 47 dBm for Band Class 6, measured in a 1 MHz resolution bandwidth at the mobile station antenna connector (see 3.1), for all other

frequencies in the range from 1 GHz to 12.75 GHz.

2.4.2 Minimun CDMA Transmitter standard:

2.4.2.1 Frequency converage:824MHz－849MHz。

Accuracy: $F_o=F_f-45MHz\pm300Hz$

Note: F_o is the carrier frequency of reverse link and F_f is the carrier frequency of forward link channel.

2.4.2.2 Minimun standard of Demodulation:

Time reference:

The mobile station time reference is derived from the earliest arriving multipath component being used for demodulation. When receiving the Forward Traffic Channel, the mobile station time reference shall be used as the transmit time of the Reverse Traffic Channel. This test checks the accuracy of the mobile station time reference in static conditions as well as the mobile station time reference slew rate in dynamic conditions.

The mobile station time reference in steady state conditions shall be within ±1 μs of the time of occurrence, as measured at the mobile station antenna connector, of the earliest arriving multi path component being used for demodulation.

Waveform quality:

The waveform quality factor, shall be greater than 0.944 (excess power is less than 0.25dB).

Code domain power:

Code domain power is the power in each code channel of a CDMA Channel. The CDMA time reference used in the code domain power test is derived from the Pilot Channel and is used as the reference for demodulation of all other code channels.

The code domain power in each inactive code channel shall be 23 dB or more below the total output power measured on both the I and Q data channel combined.

2.4.2.3 RF output power requirement

A、Range of Open-Loop output power:

Mobile Phone estimates its even Open-Loop output power from its even input power. Formula of estimating is as follows (not using the correction of access attempt and Closed-Loop power control and set INIT_PWR = 0):

Even output power (dBm) ＝－Even input power (dBm) －73＋NOM_PWR (dB)。

Mobile Phone’s Even output power is between the above formula ±6dB

Range of Open-Loop Transmission power:

-48 dBm±9.5 dBm （Ior=-25 dBm）

-8 dBm±9.5 dBm （Ior=-65 dBm）

20 dBm±9.5 dBm （Ior=-93.5 dBm）

B、 Response time of Open-Loop power control:

When there is a hop change in the even input power, the Mobile Phone's Even output power will change accordingly because of the Open-Loop power control.

After the even input power changes, the Mobile Phone's Even output power will change in the reverse direction between the two limits:

(a) Toplimit:

for<t<24ms:max[1.2Pint/24],Pint/24]+2.0dB]+1.5dB,fort 24ms:max[1.2Pin+0.5dB]+1.5dB;

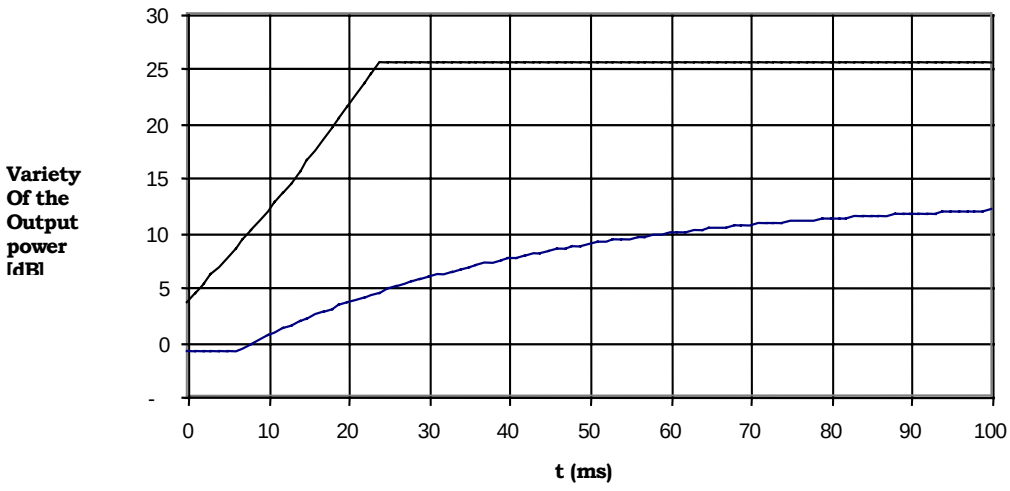
(b) Low limit:

fort>0:max[0.8Pin1-$e^{(1.25-t)}$/36]-2.0dB,0]-1dB;

In the formula ,t is measured in millisecond ,and Pin is measured in dB, max[x,y]is the largest between x and y.

Chart 1 is the top limit and low limit when Pin=20dB

The absolute value of variety of the even output power caused by Open-Loop power control should be the monotone augment function of the time .If the varieties of the even output power are composed of discrete increments ,the individual increment caused by Open-Loop power control will not exceed 1.2dB.



The top and low limits of the hop response in Open-Loop power control when Pin=20dB

C、 The minimal controlled output power:

The minimal controlled output power of the mobile phone is the ouput power measured beside the interface of the antenna when the Open-Loop and Closed-Loop power control both indicate the output power is minimal.

When the Open-Loop and Closed-Loop power control are both set to minimum , the even output power of the mobile phone centering the CDMA channel frequency should be under －50 dBm/1.23MHz

D、Maximal output power:

The maximal output power at the joint of the mobile phone’s antenna is higher than +23.0dBm, (Îor=-104dBm, Pilot Ec/Ior＝－7dB, Trffic Ec/Ior＝－7.4dB)。

E、Output power on idle:

For mobile phones with transmission frequency band between 824--849MHz, when the transmitter is shut off, the output noise power spectral density measured beside the mobile phone’s antenna with the Resolution of 1 MHz should be under －61dBm/MHz.

F、Gating output power:

For a given power control group with the same even output power, the even response time is shown in chart 2.

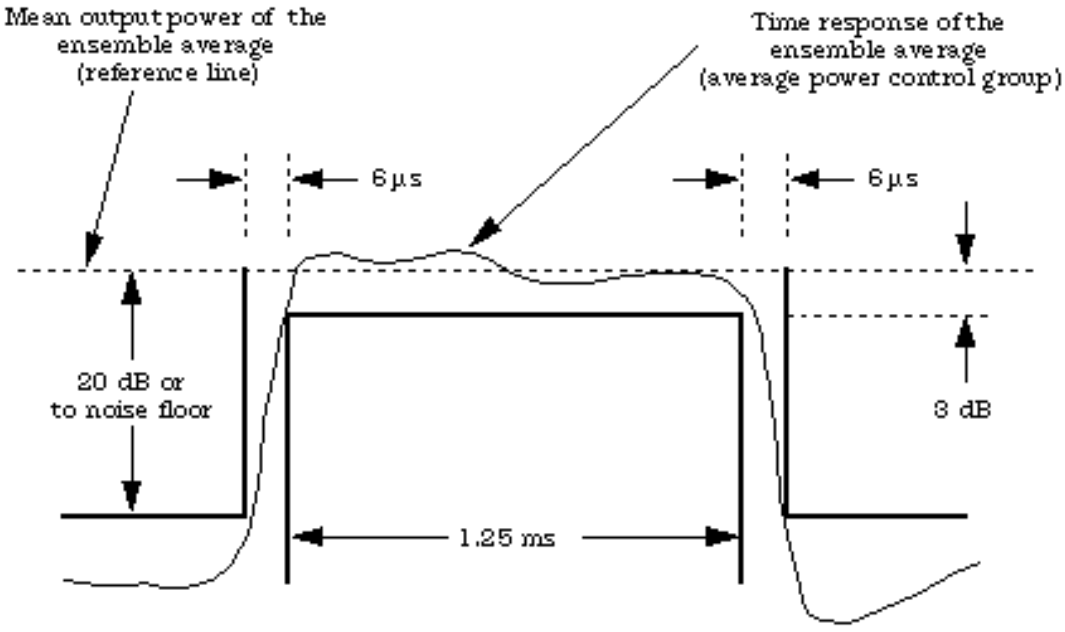


Figure 2 Transmission Envelope Mask (Average Gated-on Power Control Group)

G、close loop power control:

After receiving to closing loop power control bit effectively, The average output power of MS will reach within 0.3dB that is worth finally in 500ms at least .

close loop power control range: >-15dBm±24dB。

the response characteristic of the power control bit: < 2.5ms (9600bps),

the change rate of launch power average : <12.8～19.2dB/ms (9600bps)

Maximum Transmit Power :+23.0dBm -- +30dBm

2.4.2.4 Conducted spurious emission of Transmitter

A、when MS uses a assigned channel ,who can make radiation to other channels ,which is measured in antenna connector of the MS. If resolution of bandwidth is as follow, spurious emission Should accord with the value stipulated in the form.

form4: the restriction of spurious emission in transmitting

Center Freq offset Δf, expressed by | Δf |	bandwidth > 900kHz	bandwidth > 1.98MHz
Maximum spurious emission voltage	(a) -42 dBc/30kHz	(a) -54dBc/30kHz
< (a) or < (b) and < (c)	(b) -60dBm/30kHz (c) -54 dBm/1.23MHz	(b) -60dBm/30kHz (c) -54 dBm/1.23MHz

2.4.3 Field Test

All criterion contained in this document used for mobile telephone in CDMA network is Accord with the particular request of the operator.

2.5 mechanical characteristic

2.5.1 libration : MS should maintenance stated mechanical capability and electric capability ,when MS suffer three sine librarion from quadrature direction orderly, acceleration of gravity of the sine liberation is 1,.5 g, Freq range is 5 ~ 500 Hz, the frequency variation rate is 0.1 times frequency/sec ,After make freq increasing monotonously, make freq decreasing monotonously.

2.5.2 Falling Test:

Hard floor 130cm higher than ground, falling freely, land once respectively in 6 different surfaces of MS : Hard floor 30cm higher than ground, falling freely, land 100 times respectively in six different surfaces of MS. It's normal if battery is out of the MS in the falling. Make a ultimate test: MS is 150cm higher than ground, repeat 10 times .

2.6 Environment Test

alternate test in high temperature and low temperature:

Power on state: -20～+60° C 96 hours

Power off state: -25～+60° C 96 hours

Changing rate of temperature: ±35° C/30 mins

Dust: < 0.1mg/m^3

Power Fluctuating: Power voltage 3.9V±10%。

2.7 Reliability

Mean time between failures(MTBF) : 15000 hour (Noumenonn of MS)

the operation principle of MS

1、the principle diagram of C399 cellular telephone (accessory 1)

2、RF circuit

2.1 RF circuit principle

2.1.1 the main function of RF circui :

the base band CDMA signal of MS' reverse channel is modulated by transmit circuit and transmitted from antenna side at 824MHz~849MHz ;the signal that received from antenna side and transmitted by BS at 869MHz~894MHz is demodulated by receive circuit, so we can get the base band CDMA signal of MS' forward channel; providing MS steady and controllable freq source at 19.2MHz.

2.1.2 RF circuit' s composing

It can be divided into 4 sub units according to the function: the antenna unit , frequency synthesizer unit , the receiving unit , the transmitting unit.

2.1.2.1 the antenna unit

It' s composed of antenna subassembly、antenna switch、duplexer.

antenna subassembly is transceiver device of wireless signal, which is made up of built-in antenna, match through high performance, remedy some shortcoming, such as: low efficiency, poor radiation directionality etc. but it' s SAR value is low.

antenna switch is used to test mechanical switch automatically, It lies in the RF channel, connects with the antenna in parallel ,so can decrease 0.5 d wasting in working process. It should put through the test cable in factory testing.

Duplexer separate receiving RF signal from tranmitting signal and decrease mutual affect. Tx port：824～849MHz insertion loss is 2.6 dB, channel decay from Tx to Rx is greater than 43dB; Rx Port：869～894MHz insertion loss is 4.0dB, channel loss from Rx to Tx is greater than 56dB.

2.1.2.2 Frequency Synthesis Unit

The MSM6000 flatform has High integration in the design of Frequency Synthesising and flexible design scheme . Main electrocircuits as below: VC-TCXO 19.2MHz、VCO、 filter loop、PM6000（LDO integrated for invariant voltage）

Frequency Synthesizer is controlled by MSM6000 with SBI(serial bus),one of the in-line equioments is TX RF-LO consist of TX PLL+ TX VCO , RF-LO（Local Oscillator）is direct modulated to RF(Radio Freqency) as the Local Oscillator of U/C (Up Converter) that belongs to transmit unit, amplified and cushioned to output; RX PLL ,the other in-line equipments,and RFR6002 、VCO circuit compose to Local Oscillator loop that block down convert RF signal to baseband signal in receiver part . VREG_TCXO from PM6000 and frequency of 19.2MHz which is the output of VC-TCX are separate into three parts,one is the reference signal of RFT6102,one is the reference signal of RFT6002,another part is cushioned and filtered to clock signal of MSM6000.

2.1.3 RF control

In MSM6000-CDMA signal processor,there are CDMA signal processing ,code/decode of the audio ,and 32 bit micro orocessor in it ,and

the software control all of the mobile phone .The control departments as below :wireless RF control ,the process of the Rx/TX signal among the base station ,link to the mobile phone , code/decode of the audio signal ,and so on.

2.1.3.1 RF control part

2.1.3.1.1 frequency control

The frequency offset is detected by CDMA signal processor from the phase differ of the Rx signal-I and Q signal ,and is feed back to PIN1 of VC-TCXO to control the voltage ,the sensibility : 87.5 to 175Hz / V,(range :0.5 - 2.5V); phase noise: -100/-120/-130dBc/Hz offset:100/1K/10KHz。And so AFC bases on the BS frequency ,and keep the frequency offset in the range under the technique standard.

The RF channel switch is implemented through the first Local Oscillator formed by the frequency Synthesizer RFT6102 in-line controlled by MSM6000.the alternation is 30kHz between two channels. The frequency Synthesizer has the locked detecting circuit ,the loked status is output by LD ,and high voltage is available.

2.1.3.1.2 emissivity output control

In the transmit part, The alterable gain amplifier is used in IF (Intermediate Frequency) and RF (Radio Frequency) parts, in order to ensure the indispensable dynamic range to control the power .The power control include closed loop power control which bases on the signal from BS and control BIT and openning loop power control which bases on the signal intensity from BS.So the differ of the gain caused by temperature and frequency and the linearity of gain must be adjusted , note the offset gained beforehand into a list and the software will correct the differ from the list.At the same time ,limitation of maximum transmit power is controlled through HDET.

2.1.3.1.3 Rx gain control

In the openning loop power control,it is necessary to accurate measure the power of receive signal from BS ,the receive part is the similar as the transimit part ,the gain is corrected by the software from the list.LNA high gain, choice of attenuation mode, alterable gain control of RFR6000 (dynamic ranger>90dB).

MSM 6000(Mobile Station Modem)

MSM6000 performs all digital-processing functions of CDMA/FM/PCS cellular phone.

The MSM6000 is device that adds the mixed signal functions of an audio CODEC and transmit (Tx) Digital to Analog Converters. The subsystems within the MSM6000 include a CDMA processor, a Digital FM processor, a multi-standard Vocoder, an integrated CODEC with earpiece and microphone amplifiers, general-purpose ADC for system monitoring, an ARM7TDMI microprocessor, and a RS-232 serial interfaces supporting forward link MDR data communications of 14.4 Kbps.

The MSM6000 performs baseband digital signal processing and executes the subscriber

unit system software. It is the central interface device of the subscriber unit, providing interfaces and control signals to the RF and baseband section, control to the audio circuits, a glue-less memory interface, and the required user interfaces.

The subscriber unit system software is executed by an ARM7TDMI embedded microprocessor and controls most of the functionality of the subscriber unit. The user interface of the subscriber unit typically includes the keypad, LCD display, and ringer.

These are under the direct control of the MSM6000. As the subscriber changes modes of operation, the MSM6000 will power down unused circuits in order to dynamically minimize power consumption.

With the integrated microphone and earpiece amplifiers, the MSM6000 interfaces directly to the microphone and earpiece and greatly reduces the audio interface into a few passive components. The intergrated CODEC converts an analog audio signal, either differential or single-ended, from the microphone into digital signals for the MSM6000’s Vocoder. The integrated CODEC also converts digital audio data from the Vocoder into an analog signal, either differential or single-ended, for the earpiece. The internal Vocoder supports EVRC, QCLEP 13K Vocoders, along with implementing two echo cancellers, one for the earseal (ESEC) and an acoustic echo canceller (AEC) for carkit applications. The vocoder also supports digital FM(DFM), DTMF generation and detection, Advanced Noise Suppression, audio AGC control, and automatic volume control (AVC). The MSM6000 has an auxiliary Pulse Code Modulation(PCM) interface and programmable Tx and Rx 13-Tap compensation filters to support an auxiliary linear mu-Law CODEC. The MSM6000 is fabricated in an advanced submicron CMOS process. The device operates between 2.3 and 3.0 Volts for low power consumption increasing both standby and talk time.

Base band Circuit

Operation functions of peripheral memory devices of MSM

1) FLASH Memory

As a 32MBit-memory device it contains S/W and program for each device. You can change program by using of download program.

2) SRAM

Its capacity is 8MBit and in this memory stored are internal flag information, call processing data, and timer data from FLASH to SRAM by MCU.

3) KEY PAD

Store signal of SCAN 0-6 and four input port of MSM KEY 0-3 are used for key input and formed a key Matrix. Power key is not related to Matrix and 20 keys including this are available.

4) LCD Module

LCD display is 128 x 96 pixels monochrome in 18 characters
with 5 lines. And support double rate character. Controller is built in the module and all