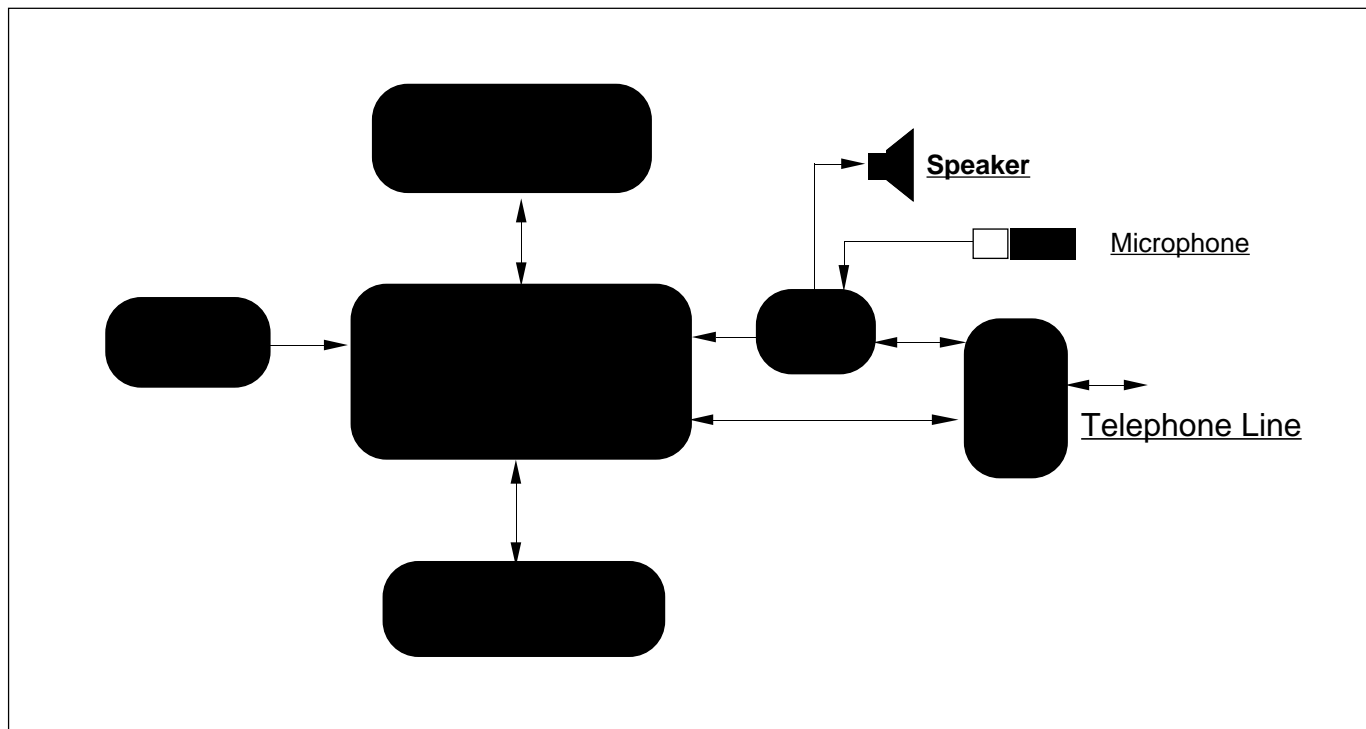## 1.0 GENERAL DESCRIPTIONS

The MX93011A is an engine chip for Digital-Answering-Machine(DAM) .

- It provides functional modules, including speech compression/decompression, silence management, telephone line signal processing, internal-ROM voice prompt, ARAM management, etc.
- By using this chip, users do not need external microprocessors and can effectively reduce the system overall cost.
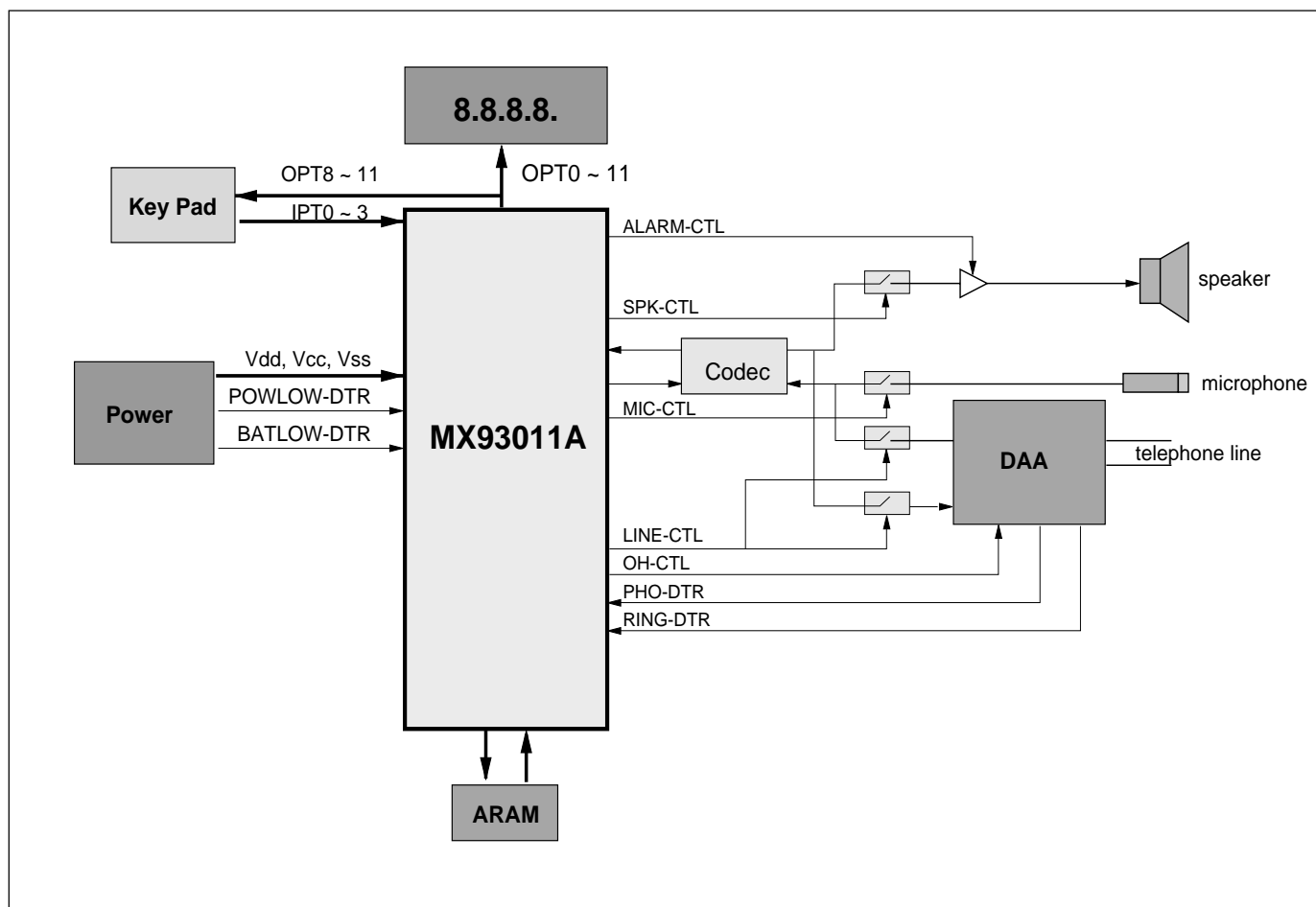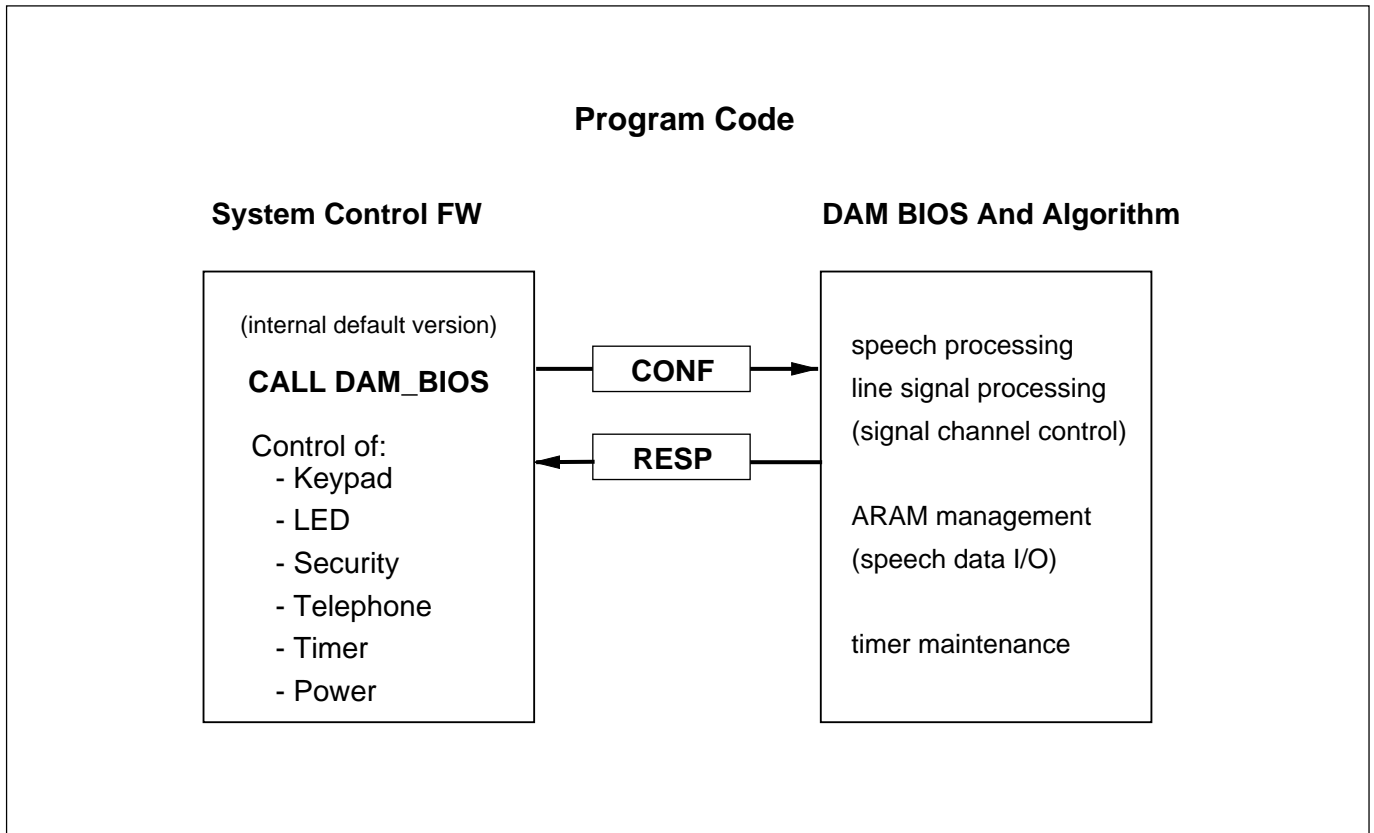
2.0 FEATURES

- High-quality speech compression/decompression algorithm for message recording/playback. 20 minutes of recording time for one 16M bits DRAM.
- Low (4.8kbps) compression rate with silence management technique for voice prompt making
- Maximum 8 personal mailboxes support (separate maximum 63 messages).
- DTMF generation and detection with near-end echo cancellation.
- Internal/external voice prompt ROM support.
- Mask-in control code, external uP is not required.
- DAM BIOS modes provide speech, timer, and telephone service.
- Support standard sample program for customer development.
- On-chip maskable ROM space for voice prompt use.(up to 50 seconds)
- Provide single low crystal solution (FLL).

3.0 BLOCK DIAGRAM

3.1 D.A.M. HARDWARE BLOCK DIAGRAM

3.2 FIRMWARE FUNCTIONAL BLOCK

Program Code

System Control FW

DAM BIOS And Algorithm

(internal default version)

CALL DAM_BIOS

Control of:
- Keypad
- LED
- Security
- Telephone
- Timer
- Power

CONF ⟶

RESP ⟵

speech processing
line signal processing
(signal channel control)

ARAM management
(speech data I/O)

timer maintenance

4.0 PIN CONFIGURATIONS

Top pins (80 to 51): ED10, ED9, ED8, ED7, ED6, ED5, ED4, ED3, ED2, ED1, GND, VDD, ED0, HOLD\, HOLDA\, EDCE\, EPCE\, ERD\, EWR\, EAD0, EAD1, EAD2, EAD3, EAD4, EAD5, EAD6, FLLEN\, GND, EAD7, EAD8

Left pins:
- ED11 — 81
- ED12 — 82
- ED13 — 83
- VDD — 84
- GND — 85
- ED14 — 86
- ED15 — 87
- X1 — 88
- X2 — 89
- CAS\ — 90
- DRD\ — 91
- DWR\ — 92
- RAS\ — 93
- POPT15 — 94
- POPT14 — 95
- RST\ — 96
- EROM — 97
- POPT13 — 98
- OPT12 — 99
- OPT11 — 100

MX93011A

Right pins:
- 50 — EAD9
- 49 — EAD10
- 48 — EAD11
- 47 — EAD12
- 46 — EAD13
- 45 — EAD14
- 44 — GND
- 43 — VDD
- 42 — EAD15
- 41 — NMI\
- 40 — INT1\
- 39 — OPT18
- 38 — CDR0
- 37 — OPT17
- 36 — CMCK
- 35 — CFS
- 34 — CDX0
- 33 — OPT16
- 32 — BIO0
- 31 — BIO1

Bottom pins (1 to 30): OPT10, OPT9, OPT8, OPT7, OPT6, OPT5, OPT4, OPT3, OPT2, OPT1, OPT0, X32I, X32O, XFI, IPT7, IPT6, IPT5, IPT4, IPT3, IPT2, IPT1, IPT0, VDD, GND, BIO7, BIO6, BIO5, BIO4, BIO3, BIO2

5.0 PIN DESCRIPTIONS

POWER/CLOCK/CONTROL PINS:

SYMBOL	PIN TYPE	PIN NUMBER	DESCRIPTION
VDD		23, 43, 69, 84	5V power source
GND		24, 44, 53, 70, 85	Ground
X1/VDD		88	32.256MHZ Crystal input/CONNECT to VDD in single low X'tal mode
X2/GND		89	32.256MHZ Crystal output/CONNECT to VDD in single low X'tal mode
RST\	IS	96	Power-on Reset .
XF\	OA	14	External flag if UPMODX=1. This pin can be directly written by one DSP instruction. Default inactive (5V output).
HOLD\	IS	67	Hold DSP clock down and release bus
HOLDA\	OA/Z	66	Ack to HOLD\ signal
EROM	IS	97	Disable internal ROM; use external ROM only.
NMI\	IS	41	Non maskable interrupt pin.
INT1\	IS	40	Interrupt pin
X32O		13	32.768KHZ Crystal output.
X32I		12	32.768KHZ Crystal input.
FLLEN\	IS	54	1: Dual X'tal Mode. 0: Single low X'tal Mode.

MEMORY INTERFACE PINS :

SYMBOL	PIN TYPE	PIN NUMBER	DESCRIPTION
EAD0-EAD15	OA/Z	61-55, 52-45, 42	DSP IO/RAM/ROM external address bus. EAD0-EAD14 are for DRAM address.
ED0-ED15	IT/OA/ZR	68, 71-83, 86-87	DSP IO/RAM/ROM/DRAM external data bus. With Soft latch feed back current is 250uA.
EDCE\	OA/Z	65	External data chip enable.
EPCE\	OA/Z	64	External program chip enable.
ERD\	OA/Z	63	SRAM/ROM/IO external read.
EWR\	OA/Z	62	SRAM/ROM/IO external write.
CAS\	OA	90	DRAM column address select.
RAS\	OA	93	DRAM row address select.
DRD\	OA	91	DRAM read.
DWR\	OA	92	DRAM write.

CODEC INTERFACE PINS:

SYMBOL	PIN TYPE	PIN NUMBER	DESCRIPTION
CFS	OA	35	Codec frame sync, 8 KHz. (9.6KHz) Output low in power down mode.
CMCK	OA	36	Codec master clock, 1.536 MHz. Output low in power down mode.
CDX0	OA	34	Codec data transmit
CDR0	IS	38	Codec data receive

OPT : Output port

SYMBOL	PIN TYPE	PIN NUMBER	DESCRIPTION
OPT0-OPT15	OB	11-1,100-98 95,94	Output to pin, all output values are registered and may be read back when read by 'IN' instruction.
OPT16-OPT18	IT/OA/ZR	33,37,39	Output to pin, when UPMODX=1

BIO : Bi-direction I/O

SYMBOL	PIN TYPE	PIN NUMBER	DESCRIPTION
BIO7-BIO0	IT/OA	25-32	Input/output port when UPMODX=1. Direction is controlled by BIO15-BIO8, (see BIOR).

IPT : Input port

SYMBOL	PIN TYPE	PIN NUMBER	DESCRIPTION
IPT4-IPT7	IS	18-15	Input port.
IPT0-IPT3	ISH	22-19	Input port with internal pull high resister(R=30k ohm)

NOTE:

IT TTL level input

IS CMOS level schmidt trigger input (hysteresis:2V~3V)

ISH CMOS level Schmidt trigger input with internal pull high resistor(~30k ohm)

OA 8mA drive level output

OB 16mA drive level output

Z high impedance state

ZR high impedance state with soft latch

PIN TYPE SUMMARY :

INPUT :   CMOS level schmidt trigger INPUT:
                   IPT7~IPT4,CDR0,INT1\.NMI\,FLLEN\,HOLD\,RST\,EROM
         CMOS level schmidt trigger INPUT with internal pull high resister:
                   IPT3~IPT0

OUTPUT: 8mA drive level output:
                   XF\,CDX0,CFS, CMCK,RAS\,CAS\,DRD\,DWR\
         8mA drive level output/ high impedance state
                   EAD15~EAD0,HOLDA\,EPCE\,EDCE\,ERD\,EWR\
         16mA drive level output :
                   OPT15~OPT0

BI-DIRECTION:
         TTL level input/8mA OUTPUT /high impedance state
                   BIO7~BIO0
         TTL level input/8mA OUTPUT/high impedance state/soft latch
                   ED15~ED0 , OPT18~OPT16

MULTIPLEX PINS

PIN NUMBER	PIN NAME	UPMODX=1 (non_up mode)	PIN NAME	UPMODX=0(up mode)
25~32	BIO(7:0)	Input/output port	HDB(7:0)	Host data bus
39	OPT18	Output port	HILO	High low data select
37	OPT17	Output port	HRD\	Host read
33	OPT16	Output port	HWR\	Host write
14	XF\	External flag	ACK\	Acknowledge to host

NOTE UPMODX:up mode select bit in CONTROL register,"0" is its power on reset value.

PIN NUMBER	PIN NAME	FLLEN\=1(Dual x'tal)	PIN NAME	FLLEN\=0(single x'tal)
88	x1	32.256MHz crystal input	VDD	Power VDD
89	x2	32.256MHz crystal output	GND	Power ground

NOTE FLLEN\:pin 54.

6.0 FUNCTIONAL DESCRIPTIONS

DAM BIOS

 Macronix DAM BIOS provides DSP embedded functional modules, including speech compression/decompression, telephone line signal processing, ROM voice prompt, ARAM management and time keeping.
DAM BIOS service is requested via a DAM BIOS call with CONF (16 bits) parameter, and answered in RESP (16 bits) word.
DAM BIOS supports 13 modes of service and responses useful to operational information about timing, ARAM utilization, detected DTMF.(see DAM BIOS format)

ARAM MANAGEMENT

ARAM types and specifications supported by MXIC 93011A E1 version :
1. ARAM type :
   - 64K x 16
   - 128K x 8, 128K x 16
   - 256K x 4, 256K x 8, 256K x 16
   - 512K x 2, 512K x 4, 512K x 8, 512K x 16
   - 1M x 1, 1M x 2, 1M x 4, 1M x 8, 1M x 16
   - 2M x 1, 2M x 2, 2M x 4, 2M x 8, 2M x 16
   - 4M x 1, 4M x 2, 4M x 4, 4M x 8, 4M x 16
   - 8M x 1, 8M x 2, 8M x 4, 8M x 8, 8M x 16

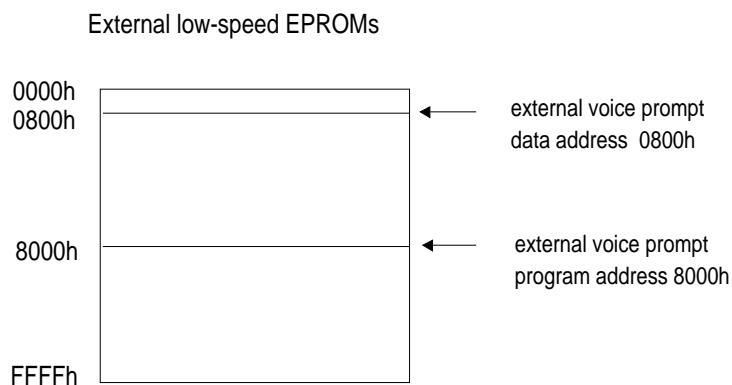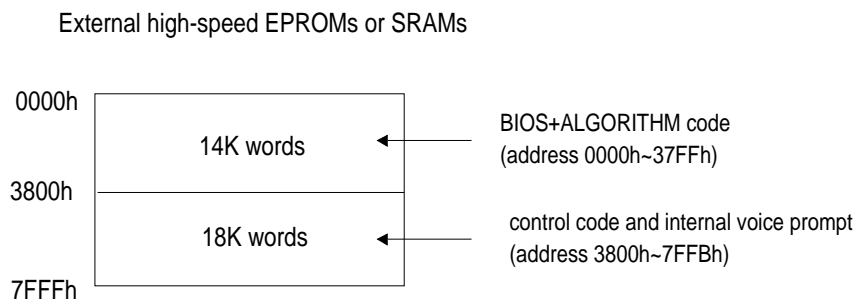2.4M bits & larger density ARAM specifications :
   - ARAM speed is not less than 120 ns.
   - ARAM refresh use CAS-BEFORE-RAS mode.
   - The number of column address line is greater than or equal to 4.
   - There are no any failed bit in first 16 rows.
   - ARAM is separated to 16384 clusters, one bit of one cluster being failed will be a bad cluster.
   - DC/AC characteristics are the same as those of standard DRAM.
                 - Maximum input/output leakage current is 2 uA.
   - Maximum stand-by current is 2mA.
   - Failed bits in each row are less 5%.

Control code and voice prompt configuration :

There are three configurations for customer development or production.

Configuration 1 :

In this configuration, the BIOS+ALGORITHM and control codes are all running in the external high-speed EPROMs or SRAMs. DSP pin97 EROM must set to high.
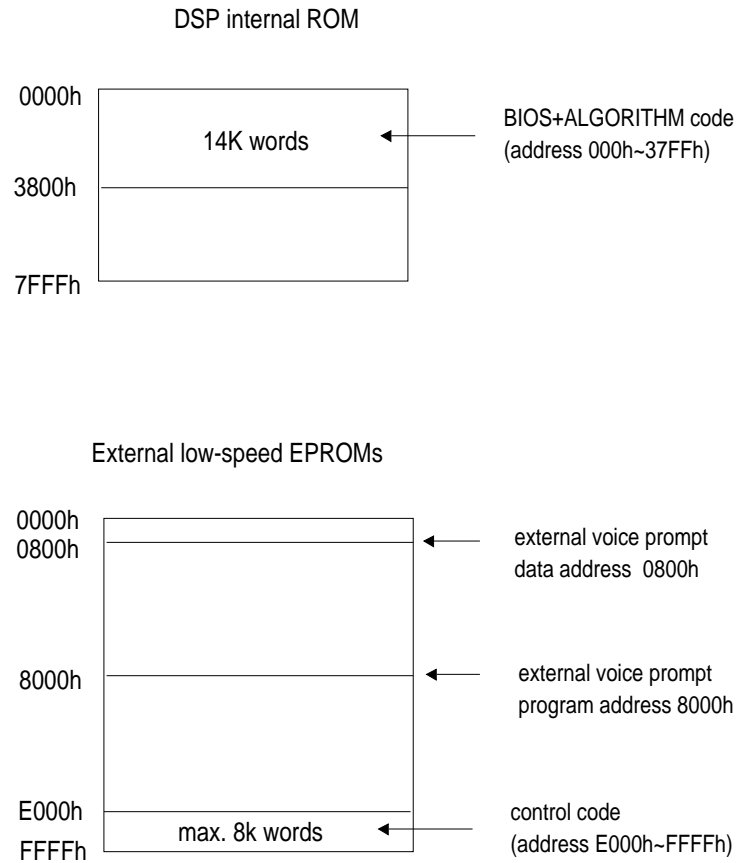
External high-speed EPROMs or SRAMs

```
0000h  ┌──────────────────────┐
       │                      │ ◄──  BIOS+ALGORITHM code
       │      14K words       │      (address 0000h~37FFh)
3800h  ├──────────────────────┤
       │                      │      control code and internal voice prompt
       │      18K words       │ ◄──  (address 3800h~7FFBh)
       │                      │
7FFFh  └──────────────────────┘
```

External low-speed EPROMs

```
0000h  ┌──────────────────────┐
0800h  ├──────────────────────┤ ◄──  external voice prompt
       │                      │      data address  0800h
       │                      │
       │                      │
8000h  ├──────────────────────┤ ◄──  external voice prompt
       │                      │       program address 8000h
       │                      │
       │                      │
FFFFh  └──────────────────────┘
```

This configuration is mainly used in the development stage and the speed of high-speed EPROMs or SRAMs must be less than 25ns.
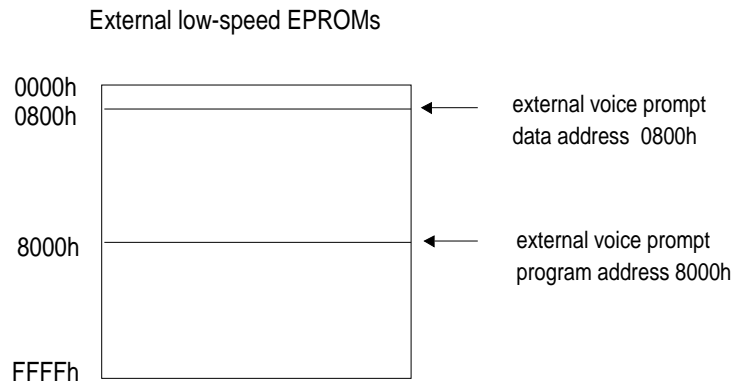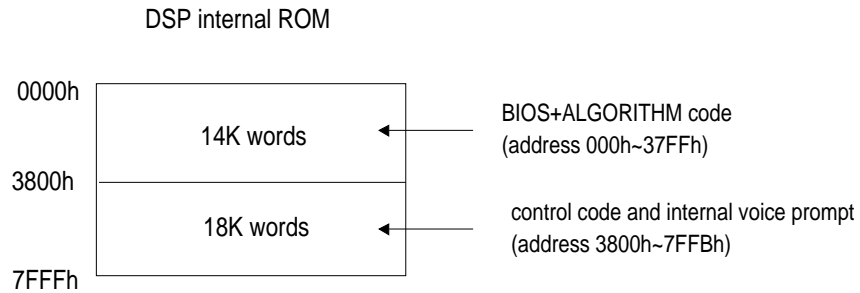
Configuration 2 :

In this configuration, the BIOS+ALGORITHM code is running in the DSP internal ROM and
the control code running in the external low-speed EPROMs.
DSP pin97 EROM must set to low.

DSP internal ROM

```
0000h  ┌──────────────────────┐
       │                      │ ◄──  BIOS+ALGORITHM code
       │      14K words       │      (address 000h~37FFh)
3800h  ├──────────────────────┤
       │                      │
       │                      │
7FFFh  └──────────────────────┘
```

External low-speed EPROMs

```
0000h  ┌──────────────────────┐
0800h  ├──────────────────────┤ ◄──  external voice prompt
       │                      │      data address  0800h
       │                      │
       │                      │
8000h  ├──────────────────────┤ ◄──   external voice prompt
       │                      │       program address 8000h
       │                      │
       │                      │
E000h  ├──────────────────────┤       control code
       │     max. 8k words    │ ◄──   (address E000h~FFFFh)
FFFFh  └──────────────────────┘
```

This configuration can be used in the development stage or for production. The control code must start with two words
1234h and 5678h.

Configuration 3 :

In this configuration, the BIOS+ALGORITHM and control codes are all running in the DSP internal ROM.
DSP pin97 EROM must set to low.

DSP internal ROM

0000h		
	14K words	← BIOS+ALGORITHM code (address 000h~37FFh)
3800h		
	18K words	← control code and internal voice prompt (address 3800h~7FFBh)
7FFFh		

External low-speed EPROMs

0000h		
0800h		← external voice prompt data address 0800h
8000h		← external voice prompt program address 8000h
FFFFh		

This configuration is used for production.

To set the voice prompt type, see DAM BIOS. Mode 7 (Set current Time/Voice Prompt/Silence Threshold)

Message Recording and Storage

The MX93011A provides a high quality speech compression technique to permit around 20 minutes of speech storage in each 16M bit of DRAM device.

The chip supports up to 63 variable length incoming and outgoing messages that are labeled as Msg ID 1 to 63. Although ICM could range from Msg 1 to 63, Msg IDs 63 to 57 are the only places for outgoing messages (OGM) storage so that the deletion and recovery of old OGM are easier to maintain. The Msg IDs of incoming messages are labeled chronologically and rearranged automatically after recording or deleting. ICM with Msg ID 1 is the oldest recorded incoming message.

During recording, the MX93011A also monitors the telephone line signal to detect the presence of DTMF, Call Progress Tone and Continuous Tone and responses to the control program. The control program can stop recording, and delete the last n*400ms/200ms from the memory using a Record command with assigned Tail Cut factor.

The MX93011A can generate a desired tone during recording voice message, which allows the application such as two-way recording. During recording, Record Pause function is provided.

The recording voice signal, received through the CODEC input, is transmitted back to the CODEC output by the MX93011A.

Outgoing Message (OGM) Record

The MX93011A provides flexible recording ways for outgoing message. The control program can select to delete the old OGM before a new one is recorded or to abort the new OGM record without losing the old OGM.

New/Old Message

For the control program to manipulate incoming messages more handily, the MX93011A keeps an internal record of the ICM to identify the new/old status of messages.
Before playback, the status of ICM is considered as "new". All incoming messages that have been played could change their status to "old" by issuing Real Del bit on PLAY command. After Real Del is issued, all new/old ICM Msg IDs will be rearranged. The functions, Play-New

or Delete-All-Old messages, are provided by the MX93011A in the command set.

Message Playback

Random access for playback of any new message or message with specified Msg ID is supported by the MX93011A. During playback, the MX93011A also monitors the telephone line signals, and Play Pause function is provided. The MX93011A is able to fast-forward the playback of a recorded message, and the playing speed will be up to 33%.

Message Deletion

The MX93011A provides two ways to delete recorded ICMs. One is the two-step method -- the combination of Del Mark and Real Del on Play command, and the other is the immediate method -- Delete command. The two-step method enables the control program to handle the deletion more flexibly, while the immediate method deletes a specified message directly.

Voice Prompt

For high-quality Voice Prompt playback, the MX93011A utilizes the built-in speech decoder and an internal ROM or/and external EPROM/ROM to store the vocabulary. The storage size of internal voice prompt is about 13K words (minimum 44 seconds). The chip also supports up to a 62-Kword external EPROM/ROM that allows minimum 3.44 minutes of voice prompt storage. The combination of internal (lower part) and external (upper part) voice prompt is allowed. The vocabulary supports up to 255 phrases. Given a phrase number in the Voice Prompt command from the control program, the MX93011A outputs the corresponding utterances to the Codec interface. The starting address of voice prompt data could be located at data address 0800hex, or program address 8000hex.
During playback of the voice prompt, the MX93011A monitors the telephone line signals.

Time Keeping

There is a timer clock in the MX93011A. The control program can issue Set Time and Get Time commands to get time services. The clock also supports system to stamp time to the recorded incoming messages.

DTMF Detection

For remote control operation of the answering machine, the MX93011A monitors the incoming telephone line signal to detect the presence of DTMF signal.

Tone Generation

Up to double tones can be generated by the MX93011A. The levels and frequencies are programmable by the control program.

Call Progress Tone Detection

The MX93011A supports the detection of call progress tones within the band of 300-640 Hz for the incoming telephone line signal. The tone detector is implemented with a bandpass filter. Indication of the presence of call progress tones is responded to the control program, and could be used to terminate recording.

Near End Echo Cancellation

The MX93011A implements a near end echo canceller in software to enhance the detection of DTMF and Call Progress Tone during Playback and Voice Prompt mode.

Vox Detection (Digital Voice Activated Recording)

The speech detection is implemented in the DAM chip to indicate whether the recording signal level is above the Vox threshold. If the control program sets the Vox Record bit on Initial command, the recording of the speech would start when the voice activity is detected. The control program has to set Vox threshold by issuing command mode 13. Hexadecimal numbers for Vox threshold are listed in Table 6.

Query and Report

The MX93011A is capable of reporting to the control program about the query of the current status, such as the number of recorded messages, the number of new messages, the number of old messages, the available recording time of ARAM, the time of recorded message, and the ARAM good/bad check.

Personal Mail

The MX93011A supports up to 8 mailboxes that may be used for personal mail application. Each mailbox has its own ICM/MEMO Msg ID. Before recording, playing or deleting messages, the control program should set the corresponding mailbox number first with Personal Mail command.

Power Down

With the power of backup batteries, the MX93011A is capable of keeping messages and data stored in the ARAM during power failure. In power down mode, the MX93011A will run at a lower clock rate to reduce power consumption and keep refreshing the ARAM.

Crystal Connection

The MX93011A allows two ways of crystal connections:

1.Normal approach : use both high crystal (32.256 MHz) and low crystal(32768Hz).

To enable this mode, the FLLEN\ (54) pin must be connected to VDD. In this mode, the DSP hgih clock is generated from the high crystal directly. And the low crystal is mainly used in Power Down mode. For the pin connection, refer to Appendix 1.

2.FLL (Frequency-Locked-Loop) approach : use only low crystal (32768 Hz)

To enable this mode, the FLLEN\ (54) pin and X2 (89) pin must be connected to ground and the X1 (88) pin to VDD. In this mode,the low crystal is to generate all the DSP system clocks and the high crystal can be saved to reduce the overall system cost. For the pin connection, refer to Appendix 1.

7.0 OPERATIONAL DESCRIPTION

INITIAL PROCEDURE

When the system is powered up, the RST\ pulse will

INTERNAL RAM

The MX93011A has internal RAM 2048 words. But only Address 0 to 127 (in data page 0, total 128 locations)are allocated for customer program usage. Other locations are reserved for the DAM BIOS and algorithm programs.

ROM

The MX93011A can support ROM space up to 64K words and there are 32K words in the internal ROM. The first 14K words of internal ROM are used by the DAM BIOS and alogorithm programs. The other 18K words are reserved for the customer program and voice prompt.

INTERRUPT

The MX93011A supports interrupts such as NMI, Single Step, Interrupt 1, Codec Interrupt, System Timer Interrupt and Trap Vector. All interrupts have entry points in the customer program and end up with RET instructions. In general cases, only System Timer Interrupt and Interrupt 1 require the customer maintenance.

POWER LOW

There are two solutions to save power consumption when power low happens:

Software hold mode :
The control program can enter Software Hold Mode by setting bit 10 of CTLR register (I/O register 7). When enabling Software Hold Mode, the MX93011A will halt until it is awaked by an interrupt.

Power down mode :
In this mode, the high crystal (32.256 MHz) will be disabled and the low crystal (32768 Hz) is used as the chip clock source.

The control program can enter Power Down Mode by setting bit 11 of CTLR register. At the same time, bit 3 of CTLR reqister must also be cleared to use the low crystal as the system timer source. When enabling Power Down Mode, the system timer tick will be 1/32 second. To leave Power Down Mode, the steps are
1.Clear bit 11 of CTLR register to 0, then
2.Wait until bit 5 of CTLR register changes to 0. (the high crystal re-oscillates completely).
3.Finally, set bit 3 of CTLR register to 1 to use the high crystal as the system timer souce.

8.0 MODES OF OPERATION

The MX93011A supports 13 modes of operation, that are listed as follows:

BIOS Mode	Mode Name
1	Record
2	Play
3	Message Status
4	DTMF Generator
5	Line Monitor
6	Delete Message
7	Set Current Time /Voice Prompt/ Silence Threshold
8	Get Current Time
9	Initial & Test Memory
10	Get Record Message Information
11	Voice Prompt
12	Voice Activity
13	Personal Mail

Record

When Record command is received from the control program, the MX93011A performs speech compression, stores the message into ARAM, and monitors telephone line. If the Vox Record bit had been set to 1 on Initial & Test Memory command, recording of the speech will start upon the voice activity detected, else the MX93011A starts recording immediately after Record command is received.

Clearing Marked Record (bit 8-10) to 0, if it is recording ICM. When recording OGM, the control program should set Marked Record (bit 8-10) to desired number other than 0 as OGM ID.

Setting bit 5 (Annc Del) to 1 on Initial & Test Memory command, the control program can choose to delete the old OGM before a new one is recorded. If that bit is cleared to 0, the new OGM recording can be aborted without losing the old OGM by issuing Mark Fail (bit 11) on Record command.

During recording, the control program can pause the recording by setting Pause (bit 7) to 1 and resume recording by clearing that bit. Line Monitoring will continue during pause.

The control program can stop recording by setting Stop (bit 6) to 1, and delete the last n*400 ms/200ms from the memory by using a Record command with assigned Tail Cut factor (bit 0-5).

While system memory is full, the MX93011A will stop message recording, show the status in response word (bit 7, Mfull).

During Record mode, the control program can instruct the MX93011A to generate a tone by issuing the DTMF Generator command. Setting Stop bit on DTMF Generator command will stop tone generating.

The MX93011A will terminate Record mode when Stop bit on Record command is set to 1.

Note: The MX93011A supports up to 63 incoming and outgoing messages recording which are labeled as Msg ID 1-63. The Msg IDs of incoming message are labeled chronologically and rearranged automatically after recording. Although ICM could range from Msg ID 1 to 63, Msg IDs 63 to 57 are the only places for outgoing message storage. So, it is strongly suggested that the control program should keep an upper bound of the number of ICM. (For example, upper bound of ICM=63 - maximum OGM number that will be applied in user's specification.)

Play

When Play command is received from the control program, the MX93011A performs message playback and line monitoring. The Msg ID (bit 0-5) is set by the control program to specify which message to play. To playback

new message (non-played one), set Play New (bit 10) to 1, then the MX93011A will search to play the non-played message with specified Msg ID. During playing, the control program can pause playback by setting Pause (bit8) to 1 and resume playing from the same point by clearing that bit. Line Monitoring will continue during pause. To fast playback a recorded message, set Fast Play (bit 11) to 1 and the playing speed will be up to 33%.

To delete and stop the playing message, the control program can set Del Mark (bit 6) on Play command. After being tagged a "Del Mark", the marked message is not really deleted until a Real Del (bit 7) is set. The Real Del command not only deletes the messages that have been tagged a "Del Mark" but also changes the status of those ICMs that have been played to old. The ICMs that have not been played before are regarded as "new". After Real Del is issued, all new/old ICM Msg IDs will be rearranged.

For the control program, it is used to issue the Real Del after the user terminates the manner of playback.

The response word contains the information of tones detected from the line, playing time spent (bit 8-15) and End of play flag (bit 6), which indicates the end of the current message. When the Play-End bit is 1, the MX93011A stops playback .

The MX93011A will terminate Play mode when Stop bit, Del Mark bit or Real Del bit is set to 1 on Play command.

Message status

In this mode, there are five request codes for the control program to get message information:
1. Get the number of recorded messages (request code=0)
2. Get the number of new messages (request code=1)
3. Get the number of old messages (request code=2)
4. Get the available recording time with unit of second (request code=3).
5. Get the DAM BIOS version (request code=4)

The result will be reported in the response word.

DTMF Generator

In this mode, up to double tones can be generated by the MX93011A. The tone levels and frequencies are programmable and controlled by the control program. The DTMF Generator command defines the output gains in bit

0-3 for the 1st tone, and bit 4-7 for the 2nd tone. Each tone can be programmed from 3 dB (gain code 0000) to -25 dB (gain code 1110) with 2 dB resolution. The frequencies are defined in the variables BUF1 and BUF2 with the following relationship:

frequency code=desired frequency (Hz) *8.19
$f(n)=32767*\cos(2*pi*f\_code*n/(8000*8.19))$
where f_code is the input frequency code, n is sequence index and 8000 is the sampling rate

For single tone, Codec outputs the signal s(n):
$$s(n)=gain*f(n)$$
For dual tone, Codec outputs the signal s(n):
$$s(n)=0.5*(gain1*f1(n)+gain2*f2(n))$$

To generate a single tone, the gain code of the other tone should be set to 1111. The MX93011A starts tone generation only after receiving the start command.

The MX93011A will terminate DTMF Generator when Stop bit is set to 1 on DTMF Generator command.

Line Monitor

In this mode the MX93011A monitors the telephone line signal for the detection of DTMF, Call Progress Tone, Vox, and/or Continuous Tone. The MX93011A keeps monitoring the line until Stop bit is set to 1.

The MX93011A returns to the control program a response word that reflects the flag of Call Progress Tone, Vox, Continuous Tone and the index of DTMF signal that has been detected:

INDEX	DTMF CODE
0000	No Tone
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7
1000	8
1001	9
1010	*
1011	0
1100	#

The MX93011A will terminate Line Monitor mode when Stop bit is set to 1 on Line Monitor command.

Delete Message

This mode provides an immediate way to delete messages as follows:

1.To delete a specified message, set its Msg ID in bit 0-5 and clear bit 11, 10 and 7 to zero.

2.To delete all old ICM, set Del-All-Old (bit 7) to 1 and clear bit 11, 10 to zero. (Bit 0-5 is ignored)

3.To delete a specified new ICM, set Del-New-Msg (bit 10) to 1, give the New Msg ID in bit 0-5, clear bit 11, 7 to zero.

4.To erase the "Del Mark" from a specified ICM ("Del Mark" is a tag set on Play command for deletion), set Del-Mark-Clr (bit 11) to 1, give the Msg ID in bit 0-5 and clear bit 10, 7 to zero.

Set Current Time/Voice Prompt/Silence Threshold

In this mode the control program can set the current time to the timer clock of the MX93011A. The time information includes second, minute, hour and week. The timer in the MX93011A will be used to stamp time and data to the recorded message.

1.To set second, put the data in bit 0-7 and use request code(bit 8-11) 0000.

2.To set minute, put the data in bit 0-7 and use request code(bit 8-11) 0001.

3.To set hour, put the data in bit 0-7 and use request code(bit 8-11) 0010.

4.To set week, put the data in bit 0-7 and use request code(bit 8-11) 0011.

5.To set voice prompt configuration, put the selection data in bit 0-1 and use request code(bit 8-11) 0110.

6.To set silence threshold level , put the data in bit 0-3 and use request code(bit 8-11) 0111.

Get Current Time

In this mode the control program can get the current time from the timer clock of the MX93011A. The time information includes second, minute, hour and week.

1.To get second, use request code (bit 8-11) 0000.

2.To get minute, use request code (bit 8-11) 0001.

3.To get hour, use request code (bit 8-11) 0010.

4.To get week, use request code (bit 8-11) 0011.

The requested data will be reported in the response word.

Initial & Test Memory

In this mode there are 7 functions for the control program to define:

1.ARAM Initialization

The control program can initialize the ARAM by setting Init ARAM (bit 0) to 1. At the same time, the initialization procedure can be set to normal (around 89 sec. for 1Mx16ARAM) or fast (around 17 sec. for 1Mx16 ARAM) by setting Fast ARAM Test (bit 2) to 0 or 1. This function is normally used after first power-up of the system. The control program must send this command to the MX93011A in order to format ARAM. The MX93011A performs ARAM formatting to determine the ARAM size (address space and bit width) and detect the good/bad memory unit of ARAM. The response word reported to the control program contains the information of ARAM bit size (bit 0-3), ARAM address size (bit 4-7) , ARAM good/bad status (bit 8) and ARAM good rate (bit 9~15). If the examination in the initialization shows that the ARAM quality meets the pre-defined specification, the MX93011A responses 1 in ARAM good/bad status bit. After initialization, all messages in the ARAM are lost.

2.ARAM Good/Bad Check

The MX93011A allows the control program to check the status of ARAM by setting the ARAM Check (bit 1) on this command. By checking the sum of ARAM management table, the MX93011A can identify the current ARAM status to be good or bad.

3.Line On/Off

The control program should set Line-On (bit 3) to 1 if the system is logged in from telephone line; and clear that bit to 0 if in local keypad operation. Failing to set this bit properly will degrade the performance of echo cancellation.

4. Vox On/Off Record

If the control program turns on the Vox Record function (by setting bit 4 to one) on this command, speech recording will start upon the voice activity detected, else recording will start immediately after Record command is issued.

5.OGM Deletion

By setting bit 5 (Annc Del) to 1 on this command, the control program can choose to delete the old OGM before recording a new one. If that bit is cleared to 0, the old OGM is not deleted until the new OGM recording is completed. With this option, the new OGM recording can be aborted without losing the old OGM by issuing Mark Fail (bit 11) on Record command.

6.New/Old Select

By setting New/Old Select (bit 6), the control program can decide which condition a new message will be changed to an old one. There are two options. When this bit is set to 1, the new message that has been played (even not played end) is regarded as an old message. If this bit is set to 0, the new message that has been played end is regarded as old one.

7.Tail Cut Unit

By setting Tail Cut Unit (bit 7) to 1, the control program can choose the tail cut unit length to be 200ms. If this bit is cleared to 0, the unit length is 400ms.

Get Record Message Information

In this mode, there are nine request codes for the control program to get the related information about a specified message.

Given the Msg ID (bit 0-5) and New-Msg flag (bit 7), the MX93011A can provide message recording time, recording length, attribute and "Del Mark" status according to the Request Code (bit 8-11) as follows:

1. Get the recording time -- second. (Request Code = 0000)

2. Get the recording time -- minute. (Request Code = 0001)

3. Get the recording time -- hour. (Request Code = 0010)

4. Get the recording time -- week. (Request Code = 0011)

5. Get the recording length (sec). (Request Code = 0100)

6. Get the timer status. (Request Code = 0101)
The response word is 1 if the MX93011A timer has been set before with Set Current Time command. Otherwise, the response word is 0.

7. Get the message ICM/MEMO attribute. (Request Code = 0110) To show the specified message is of MEMO type (*response word =1) or ICM type (response word = 0)

8. Get the Del Mark status(Request Code = 0111). To check if the specified message has been tagged a Del Mark (response word = 1) or not (response word = 0)

9. Get the message new/old status. (Request code=1000) To check if the specified message has been tagged an Old Mark (response word=1) or not (reponse word=1). (A new message will be tagged an Old Mark when it has been played/played end and changes to old message as Real Del command is issued.)

All the results are reported in the response word.

Voice Prompt

In this mode the MX93011A plays back a speech segment that the corresponding phrase number is given in command bit 0-7. Up to 255 speech segments, previously stored in Voice Prompt ROM,are provided by the MX93011A and pronounced using the speech decompression algorithm. The control program can pause the playback by setting Pause (bit 8) to 1 or resume from pause by clearing Pause bit to 0. Fast forward playback of voice prompt is also provided by setting Fast Play (bit 11) to 1. During Voice Prompt mode, the MX93011A keeps monitoring the line signal and sends the results in response word to the control program.

The MX93011A will terminate Voice Prompt mode when Stop bit is set to 1 on Voice Prompt command.

Voice Activity

In this mode the contorl program can set the VOX threshold in bit 0-11. The Hexadecimal numbers for VOX level are listed in Table 6.

Personal Mail

Four functions are provided in this command as follows:

1. Set the personal mailbox number
In this mode the control program can select one out of eight mailboxes (setting in bit 0-2) for recording messages, playing recorded message and retrieving message time. Each mail box manages its own messages and Msg IDs.

2. Set the recording message attribute
Before recording a message, the control program can set the attribute of that message to be MEMO or ICM. Clear bit 3 to zero for recording a message as an ICM or set bit 3 to one for recording a message as a MEMO.
Make sure to set the desired mailbox before issuing the message related commands such as Record, Play, Delete Message and Get Record Message Information.

3. Set the output level
The control program can set the level difference between the output (playback) speech and the corresponding input (recorded-in) speech. By setting the OUTPUT LEVEL bit to 1, the output speech level is equal to the input speech level, and clearing this bit to 0, the output speech level is about 5dB less than the input speech level. The default status is the later.

4. Set the codec data format
The control program can select one of two codec data formats by setting the CODEC_FORMAT bit. When CODEC_FORMAT is set to 0, 8-bit u-law data format is selected, and set to 1, 16-bit linear data format is enabled. At present, MX93000 Codec family provide both u-law and linear formats, and the later is suggested because of the better speech quality. The default format is 8-bit u-law.

9.0 DAM BIOS SERVICE FORMAT AND PROTOCAL

Mode 1. RECORD MODE

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00

CONF:
0001	MARK Fail	Marked Record	Pause	Stop	Tail Cut

Tail Cut -- 0~63 units. One unit length can be 400ms or 200ms (set by DAM BIOS Mode 9).
Stop =1 stop recording
Pause =1 pause recording
　　　 =0 continue recording.
Marked Record --　000 -- record a general message.
　　　　　　　　　001 -- record OGM1 and store it in message 63.
　　　　　　　　　010 -- record OGM2 and store it in message 62.
　　　　　　　　　011 -- record OGM3 and store it in message 61.
　　　　　　　　　100 -- record OGM4 and store it in message 60.
　　　　　　　　　101 -- record OGM5 and store it in message 59.
　　　　　　　　　110 -- record OGM6 and store it in message 58.
　　　　　　　　　111 -- record OGM7 and store it in message 57.
MARK FAIL =1 give up and stop recording of the new OGMx and recover the original
OGMx. if BIOS Mode 9 ANNC DEL=1,this bit will be ignored.
When MARKED RECORD =0, do not set this bit.

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00

RESP:
Record Time (sec)	Mfull	VOX	Tone	Cont Tone	DTMF

DTMF -- the detected DTMF value during recording
Cont Tone =1 Continuous tone is found
Tone =1 call progress tone is found.
VOX =1 the input speech power level is under the VOX LEVEL (set by BIOS Mode 12).
Mfull =1 ARAMis full and no further recording is possible.
in this case, one more STOP command is needed to completely stop the recording action.
RECORD TIME -- recording time until now, 0~239 sec.
DTMF Reference Table

index	DTMF CODE
0000	NO TONE
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7
1000	8
1001	9
1010	*
1011	0
1100	#

Mode 2. PLAY MODE

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
CONF		00	10		fast play	Play New	Stop	Pause	Real Del	Del Mark				Msg ID		

Msg ID -- 1~63 can be assigned for playing.
Del Mark =1 stop playing and mark the current message with a "Del Mark".
This messages will not be deleted until the REAL DEL command is done.
Real Del =1 Delete the messages that have "Del Mark" and change the new messages
that have been played to be old messages.(in this case, the MSG ID field is ignored)
Pause =1 pause playing
      =0 continue playing
Stop =1 Stop playing
Play New =1 the MSG ID is related to new messages.
      =0 the MSG ID is related to total messages.
Fast play =1 play speed will be up to 33%.
      =0 normal play speed.

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
RESP				Play Time (sec)					0	Play End	Tone	0		DTMF		

DTMF, and TONE -- see RECORD MODE.
PLAY END = 1 the current message is played end.
PLAY TIME -- playing time until now, 0~239 sec.

Mode 3. MESSAGE STATUS MODE

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
CONF		0011					00000000							Request Code		

RESP	Data
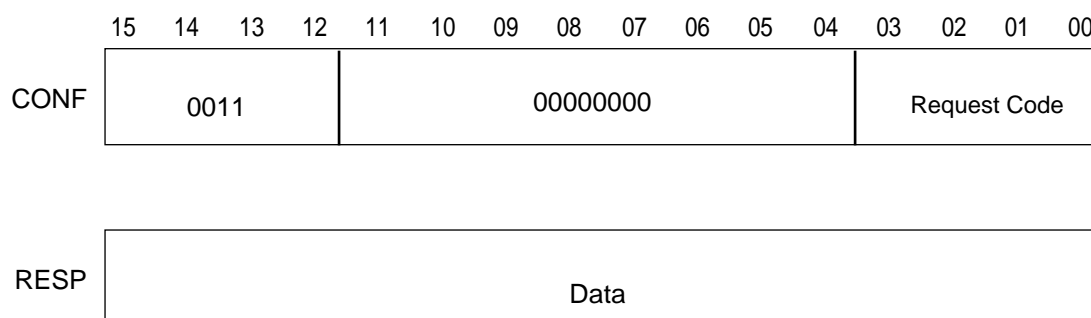
REQUEST CODE:

REQUEST CODE	STATUS	DATA
0000	number of recorded message	00 ~ 63
0001	number of new message	00 ~ 63
0010	number of old message	00 ~ 63
0011	available time	00 ~ 65535
0100	BIOS version	00E1h

Mode 4. DTMF GENERATOR MODE

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00

	15 14 13 12	11	10	09	08	07 06 05 04	03 02 01 00
CONF	0100	Start	Stop	0	0	Gain2	Gain1

BUF1	16-bit Frequency 1

BUF2	16-bit Frequency 2

Gain1, Gain2 -- 0~14 denote 3dB ~ -25dB (2dB/one step). 15 denotes no related signal.
STOP =1 stop the DTMF generation.
START =1 Start the DTMF generation.
when this bit is set, GAIN1 and GAIN2 must also be set and Frequency 1
is put in BUF1 (data address 7) and Frequency 2 in BUF2(data address 8).
16-bit Frequency = target frequence * 8.19.
Note:
for single-tone signals (GAIN1=15 or GAIN2=15), the output level is according to GAIN1 or GAIN2.
But for dual-tone signals, the output level is equal to half of sum of two individual signals.
Doing this can avoid saturation of output signals.

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00

RESP	000000000000000

Mode 5. LINE MONITOR MODE

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00

	15 14 13 12	11 10 09 08 07 06 05 04 03 02 01	00
CONF	0101	00000000000	STOP

STOP =0 start and continue the line monitor mode.
     =1 stop the line monitor mode.

	000000000	VOX	Tone	Cont Tone	DTMF
RESP	000000000	VOX	Tone	Cont Tone	DTMF

DTMF,CONT TONE,TONE and VOX -- see RECORD MODE

Mode 6. DELETE MESSAGE MODE

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
CONF				Del Mark CLR	Del New MSG	00		Del All Old	0			Msg ID			

(CONF: bits 15-12 = 0110)

MSG ID -- 1~63.
DEL ALL OLD =1 delete all old messages. (in this case, the MSG ID field is ignored)
DEL NEW MSG =1 the MSG ID is related to new messages.
            =0 the MSG ID is related to total messages.
DEL MARK CLR = 1 clear the message "Del Mark" (set by BIOS Mode 2 DEL MARK=1)

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
RESP	0110			000000000000											

Mode 7. SET CURRENT TIME/VOICE PROMPT/SILENCE THRESHOLD

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
CONF	0111			Request Code				Data							

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
RESP	0111			00000000000											

REQUEST CODE:

TIME	REQUEST CODE	DATA
SECOND	0000	0~59
MINUTE	0001	0~59
HOUR	0010	0~23
WEEK	0011	0~6

Request Code=0110 (set voice prompt configuration)

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00

| CONF | 0111 | | | | 0110 | | | | 000000 | | | | | EVOP Select | IVOP Select |

IVOP SELECT (internal voice prompt setting) :
1 -- internal voice prompt selected and tested
0 -- internal voice prompt not selected
EVOP SELECT (external voice prompt setting) :
1 -- external voice prompt selected and tested
0 -- external voice prompt not selected

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00

| RESP | 000000000000 | | | | | | | | | | | EVOP UNIT | EVOP ADDR | EVOP STATUS | IVOP STATUS |

IVOP SELECT (internal voice prompt test status) :
1 -- test o.k.
0 -- test fail
EVOP STATUS (external voice prompt test status) :
1 -- test o.k.
0 -- test fail
(when EVOP STATUS=1)
EVOP ADDR:
0 -- external voice prompt at data space 0800h
1 -- external voice prompt at program space 8000h
EVOP UNIT:
0 -- external voice prompt in byte unit
1 -- external voice prompt in word unit

Request Code=0111 (set silence threshold level - used by the silence compression algorithm)

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00

| CONF | 0111 | | | | 0111 | | | | 0000 | | | | SILENCE LEVEL | | | |

SILENCE LEVEL:0~15, the larger the level is, the more speech will be recognized as silence.
0 denotes no silence compression.
Please refer to Table 7 for Silence Threshold Level.

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00

| RESP | 0000000000000000 | | | | | | | | | | | | | | | |

Mode 8. GET CURRENT TIME MODE

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00

CONF

1000	Request Code	00000000

RESP

Data
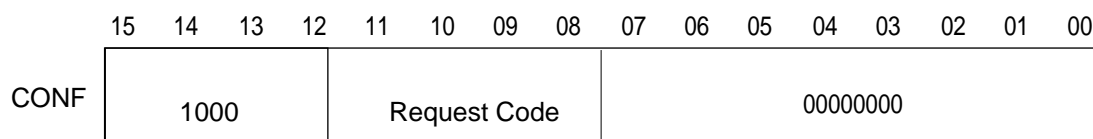
Request Code, 0000~0011 : (see Set Current Time/Voice Prompt/Silence Threshold)

Mode 9. INITIAL AND TEST MEMORY MODE

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
CONF	1001			0000				TAIL CUT UNIT	NEW/OLD SELECT	ANNC DEL	VOX on/off Record	LINE ON/OFF	FAST ARAM TEST	ARAM CHECK	Init Aram

INIT ARAM =1 initialize the ARAM. The information of ARAM type and ARAM good rate will be responsed in RESP.

ARAM CHECK =1 check the ARAM good/bad. The check result is put in RESP(8).

FAST ARAM TEST :(must be used with INIT ARAM)

1 -- fast ARAM initialization (about 17 sec for a 1Mx16 ARAM).

0 -- normal ARAM initialization (about 89 sec for a 1Mx16 ARAM).
LINE ON/OFF:

1 -- in remote line operation

0 -- not in remote line operation

VOX ON/OFF RECORD:

1 -- not record the starting silence speech which power level is under VOX LEVEL

0 -- record the starting silence speech

ANNC DEL:

1 -- delete the old OGMx before the new OGMx is recorded.

0 -- delete the old OGMx after the new OGMx is recorded.

NEW/OLD SELECT:(set the judgement point of message new/old attributes)

1 -- one message that has been played (even not played end) is viewed as an old message

0 -- one message that had been played end is viewed as an old message

TAIL CUT UNIT:(set the tail cut unit)

1 -- the tail cut unit is 200ms.

0 -- the tail cut unit is 400ms.

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
RESP	ARAM GOOD RATE							Aram Good	Aram Addr Size				Aram Bit Size		

ARAM BIT SIZE:the detected ARAM data bit number in one address access.

ARAM ADDR SIZE:the detected ARAM address space.

ARAM GOOD: a conclusion of ARAM initialization or checking.

1 -- ARAM is good

0 -- ARAM is bad
ARAM GOOD RATE:0~100%. it is significant when ARAM GOOD=1.

CODE	ARAM ADDR. SIZE	CODE	ARAM BIT SIZE
0000	00 M	0000	00
0001	64 K	0001	1
0010	128 K	0010	2
0011	256 K	0011	3
0100	512 K	0100	4
0101	1 M	1000	8
0110	2 M	1100	12
0111	4 M	1111	16
	1000		8 M
		1001	16 M

Mode 10. GET RECORD MESSAGE INFORMATION MODE

	15 14 13 12	11 10 09 08	07	06	05 04 03 02 01 00
CONF	1010	Request Code	NEW MSG	0	Msg ID

MSG ID : 1~63.

NEW MSG:

1 -- the MSG ID is related to new messages.

0 -- the MSG ID is related to total messages.

INFORMATION	REQUEST CODE	DATA
SECOND	0000	0000 ~ 003Bh
MINUTE	0001	0000 ~ 003Bh
HOUR	0010	0000 ~ 0017h
WEEK	0011	0000 ~ 0006h
RECORD LENGTH	0100	BIT 15 ~ BIT 0
TIMER STATUS	0101	1=Timer has set 0=default Timer
ICM/MEMO	0110	1=MEMO record 0=ICM record
DEL MARK STATUS	0111	1=Has del Mark 0=Has no del Mark
MSG NEW/OLD STATUS	1000	1=Has Old Mark 0=Has No Old Mark

RESP	Data

Mode 11. VOICE PROMPT MODE

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
CONF		10	11		FAST PLAY	0		STOP	Pause			PHRASE NUMBER				

PHRASE NUMBER:1~255
PAUSE, STOP and FAST PLAY : see PLAY MODE.

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
RESP				Play Time (sec)					0	PLAY END	Tone	0		DTMF		

DTMF, PLAY END and PLAY TIME :see PLAY MODE.

Mode 12. VOICE ACTIVITY MODE

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
CONF		11	00						VOX LEVEL							

VOX LEVEL : see Table 6.

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
RESP								0000000000000000								

Mode 13. PERSONAL MAIL MODE

	15 14 13 12	11 10 09 08	07 06 05 04	03 02	01 00
CONF	1101	0000	0000	MEMO /ICM	PERSONAL MAIL

PERSONAL MAIL:0~7. total 8 personal mailboxes. the MSG IDs of PLAY MODE, DELETE MESSAGE MODE and GET ERCORD MESSAGE INFORMATION MODE are all limited to the personal mailbox specified by this command.

MEMO/ICM :
1 -- set the attribute of the recorded message to be MEMO
0 -- set the attribute of the recorded message to be ICM

	15 14 13 12 11 10 09 08 07 06 05 04 03 02 01 00
RESP	0000000000000000

(SET SOME STATUS)

	15 14 13 12	11 10 09 08	07 06 05 04 03 02	01	00
CONF	1101	0001	000000	CODEC FORMAT	OUTPUT LEVEL

OUTPUT LEVEL: (set the relation of the output speech level and the corresponding input speech level)

1 -- the output level (playback) is equal to the input level (recording)
0 -- the output level is 5dB less than the input level (default setting)
CODEC FPRMAT:(set codec data format)
1 -- 16-bit linear format, MX93000 family provide this mode
0 -- 8-bit u-law format (default)

	15 14 13 12 11 10 09 08 07 06 05 04 03 02 01 00
RESP	0000000000000000

TABLE 1 : PERFORMANCE TEST FOR TONE DETECTION

(noiseless) Power(dB)	0	-3	-6	-10	-20	-30	-33	-36	-39
p2p(volt)	5	3.54	2.5	1.58	.5	.158	.112	.079	.056
280Hz	x	x	x	x	x	x	x	x	x
300Hz	ok	ok	ok	ok	ok	ok	ok	x	x
400Hz	ok	ok	ok	ok	ok	ok	ok	ok	x
500Hz	ok	ok	ok	ok	ok	ok	ok	ok	x
600Hz	ok	ok	ok	ok	ok	ok	ok	ok	x
640Hz	ok	ok	ok	ok	ok	ok	ok	x	x
670Hz	x	x	x	x	x	x	x	x	x
480+620 Hz	ok	ok	ok	ok	ok	ok	x	x	x
350+440 Hz	ok	ok	ok	ok	ok	ok	x	x	x

 * 0 dB is defined as the Vrms of maximum codec input
** The maximum peak-to-peak voltage (P2P) of Codec input is assumed to be 5V

SNR(dB)	40	25	12
	detect time delay / off time delay (ms)		
300Hz	50 / 40	55 / 40	65 / 40
400Hz	40 / 40	40 / 40	45 / 45
500Hz	40 / 40	40 / 40	45 / 45
640Hz	45 / 40	45 / 40	60 / 35
480+620	40 / 40	45 / 40	50 / 40
350+440	45 / 40	45 / 40	55 / 40

* 0 dB is defined as the Vrms of maximum codec input
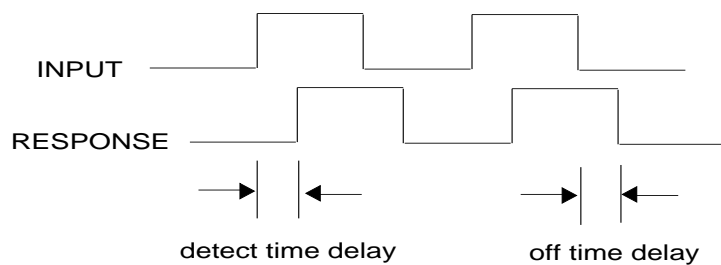** the detect/off time delay is defined as follows

detect time delay   off time delay

TABLE 2 : RESOLUTION TEST FOR DUAL TONE (FREQUENCY DETECTABLE RANGE)

RANGE / POWER	-4 dB	-25 dB
(300 + F2 Hz)	F2 > 320 Hz	F2 > 320 Hz
(640 + F2 Hz)	F2 < 620 Hz	F2 < 620 Hz

TABLE 3 : THD DISTORTION TEST FOR DUAL TONE (DISTORTION TOLERANCE)

INPUT / POWER	-4 dB	-25 dB
(300 + 320 Hz)	> 10 dB	> 10 dB
(640 + 620 Hz)	> 10 dB	> 10 dB

* 0 dB is defined as the Vrms of maximum codec input

TABLE 4 : CALL PROGRESS TONE DETECTOR CHARACTERISTICS

PARAMETER	MIN	TYP	MAX	UNIT
Detection level *	-30			dB
Rejection level			-37	dB
Frequency range	300		640	Hz
Noise tolerance			-12	dB
THD tolerance			-10	dB
Rejection Frequency range	< 280 Hz or >670Hz			
Minimum signal duration accept	50 ms			
Maximum response time	50 ms			

* 0 dB is defined as the Vrms of maximum codec input

TABLE 5 : DTMF CHARACTERISTICS

PARAMETER	MIN	TYP	MAX	UNIT
DTMF Signal level for detection*	-43		0	dB
DTMF Twist (High/Low Tone)		+/-9		dB
DTMF Noise Tolerance		-10		dB
DTMF Tone duration accept	50			ms
DTMF interdigit pause accept	50			ms
DTMF Frequency deviation accept limit		+/-1.5		%
DTMF Frequency deviation reject limit		+/-3		%
Tone Generator level	- 25		+ 3	dB
Tone Generator frequency accuracy		± 0.1		%
Tone Generator level accuracy		± 0.5		dB

* 0 dB is defined as the vrms of maximum codec input

APPLICATION NOTE (E2 VERSION)

TABLE 6. VOX THRESHOLD *

TABLE 7. SILENCE THRESHOLD LEVEL

dB	VOX_LEVEL
-9	0ef5
-10	0d55
-11	0be5
-12	0a95
-13	0975
-14	0875
-15	0ef4
-16	0d54
-17	0be4
-18	0a94
-19	0974
-20	0874
-21	0ef3
-22	0d53
-23	0be3
-24	0a93
-25	0973
-26	0873
-27	0783
-28	06b3
-29	05f3
-30	0553
-31	04c3
-32	0433
-33	03c3
-34	0363
-35	0303
-36	02b3
-37	0263
-38	0223
-39	01e3
-40	01b3
-41	04c2
-42	0442
-43	03c2
-44	0362
-45	0302
-46	02b2
-47	0262
-48	0222
-49	01e2
-50	01b2
-51	0301
-52	02b1
-53	0261
-54	0221
-55	01e1
-56	01b1
-57	0300
-58	02b0
-59	0260
-60	0220
-61	01e0
-62	01b0

* 0 dB is defined as the vrms of maximum Codec input.

SILENCE LEVEL	dB
1	-58
2	-55
3	-52
4	-49
5	-46
6	-43
7	-40
8	-37
9	-34
10	-31
11	-28
12	-25
13	-22
14	-19
15	-16

0 dB:maximum input of sinusoidal wave

TABLE 8. Echo CANCELLER PERFORMANCE *

Test Description	
Final Echo Return Lose Improvement (ERLI) (Singletalk mode)	> 28 dB
Maximum tail length	12 ms
CONVERGENCE RATE (SINGLETALK MODE) 500ms after initialization with cleared register and with near-end signal set to zero at initialization time	> 28 dB
Infinite Return Loss Convergence Return Echo Loss Improvement 500ms after echo path is interrupted	> 28 dB

* test signals : band-limited white-noise(300-3400Hz)
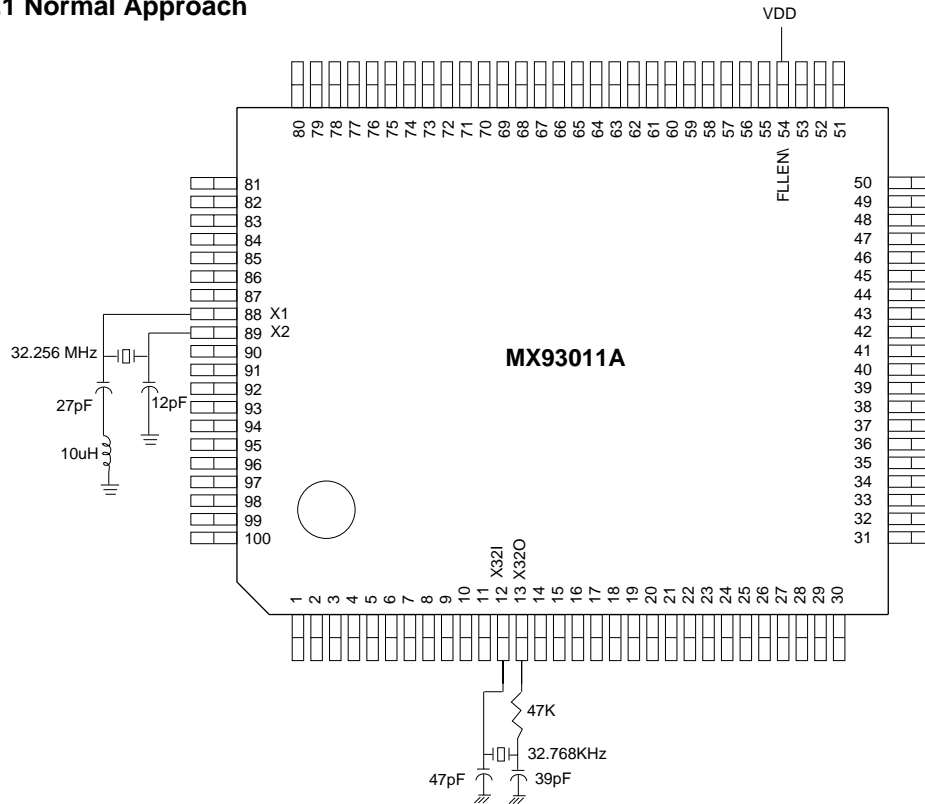
TABLE 9. : MAXIMUM COMMAND RESPONSE TIME

COMMAND	MAX RESP TIME (ms)
Record Mode: 1.start calling 2.normal calling 3.stop calling (without tail cutting) 4.stop calling (with tail cutting)	 1 5 10 106
Play Mode : 1.start calling 2.normal calling 3.stop calling 4.real delete	 14 4 1 99
Message Status Mode: 1.get total message number (Command 3000) 2.get new message number (Command 3001) 3.get old message number (Command 3002) 4.get ARAM available time(command 3003)	 8 9 18 52
DTMF Generator Mode	1
Line monitor Mode	4
Delete Message Mode: 1.delete one message (Command 60xx/64xx) 2.delete all old message (Command 6080) 3.clear one message delete-mark (command 68xx/6cxx)	 30 760 16
Set Current Time/Voice Prompt/Silence Threshold Mode	1
Get Current Time Mode	1
Initial And Test Memory Mode: 1.ARAM initialization (Command 90x1, normal, 1Mx16) 2.ARAM initialization (Command 90x5, fast, 1Mx16) 3.ARAM good/bad check (Command 90x2) 4.other misc. setting	 89000 17000 3 1
Get Record Message Information Mode	12
Voice Prompt Mode : 1.start calling 2.normal calling 3.stop calling	 1 4 1
Voice Activity Mode	1
Personal Mail Mode	1

APPENDIX 1. Difference list between MX93011A D6 and E1 version

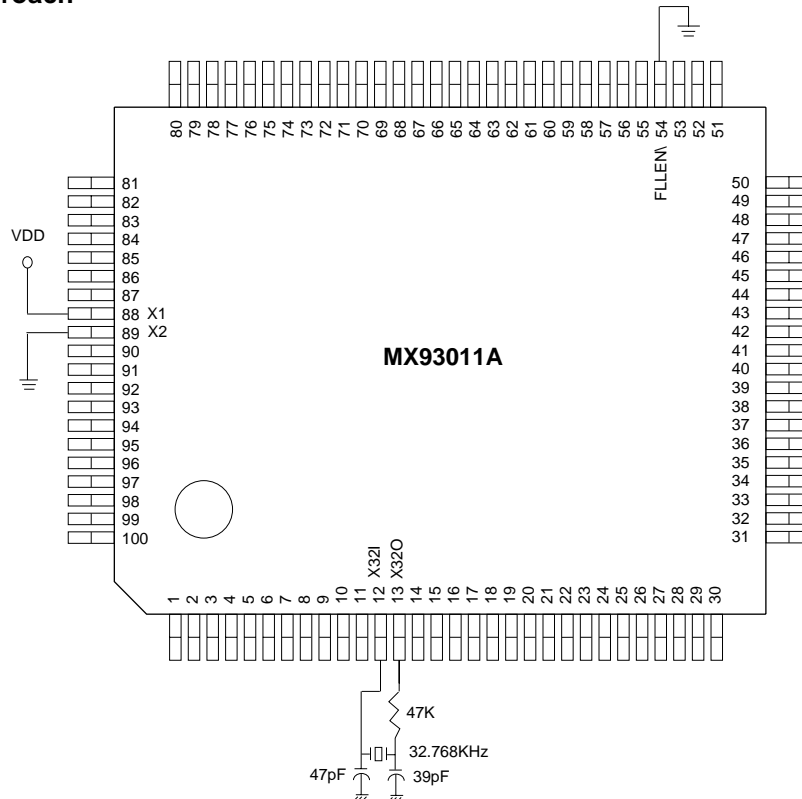| Item	D6 version	E1 version
Speech compression rate	4.8 Kbps	12 Kbps, sound quality is much better than D6
ARAM configuration	Support ARAM of x3 and x12 configurations	Not support x3 and x12 configurations
ARAM initialization time	37 sec.(normal)/7 sec.(fast) for one 1Mx4 ARAM	89 sec.(normal)/17 sec. (fast) for one 1Mx16 ARAM
Codec data format	Only support u-law format	Support u-law and linear format (see BIOS mode 13)
Get BIOS version (BIOS mode 3004h)	RESP=00D6h	RESP=00E1h

APPENDIX 2. CIRCUIT DIAGRAMS (CLOCK APPLICATION)

A1.1 Normal Approach

VDD

MX93011A

80 79 78 77 76 75 74 73 72 71 70 69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54 53 52 51

81
82
83
84
85
86
87
88 X1
89 X2
90
91
92
93
94
95
96
97
98
99
100

50
49
48
47
46
45
44
43
42
41
40
39
38
37
36
35
34
33
32
31

FLLEN

32.256 MHz

27pF

12pF

10uH

X32I
X32O

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

47K

32.768KHz

47pF   39pF

A1.2 FLL Approach

MX93011A

80 79 78 77 76 75 74 73 72 71 70 69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54 53 52 51

81
82
83
84
85
86
87
88 X1
89 X2
90
91
92
93
94
95
96
97
98
99
100

50
49
48
47
46
45
44
43
42
41
40
39
38
37
36
35
34
33
32
31

FLLEN

VDD

X32I
X32O

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

47K

32.768KHz

47pF   39pF

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