1.0 GENERAL DESCRIPTIONS

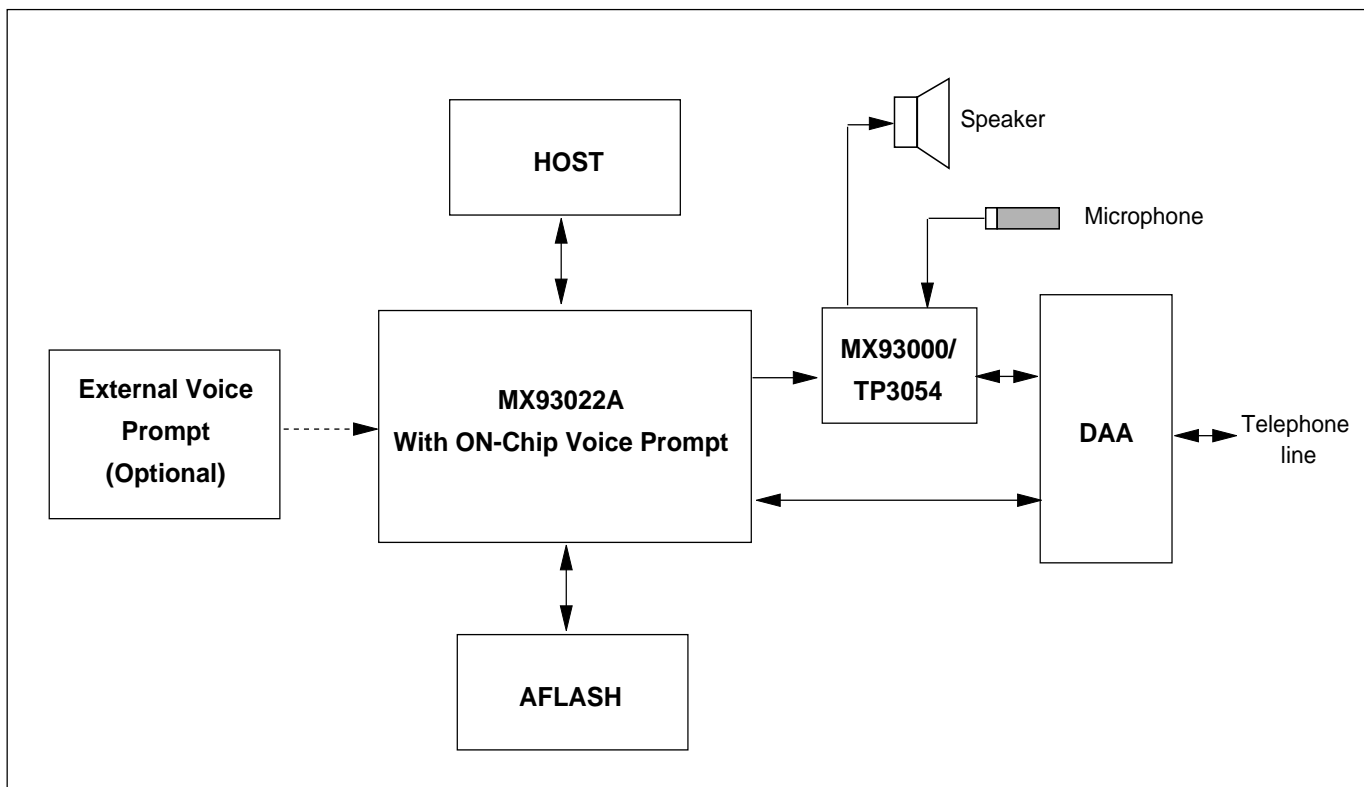The MX93022A is an engine chip for Digital-Answering-Machine(DAM).

The MX93022A provides functional modules, including speech compression/decompression, telephone line signal processing, voice prompt, AFLASH management.
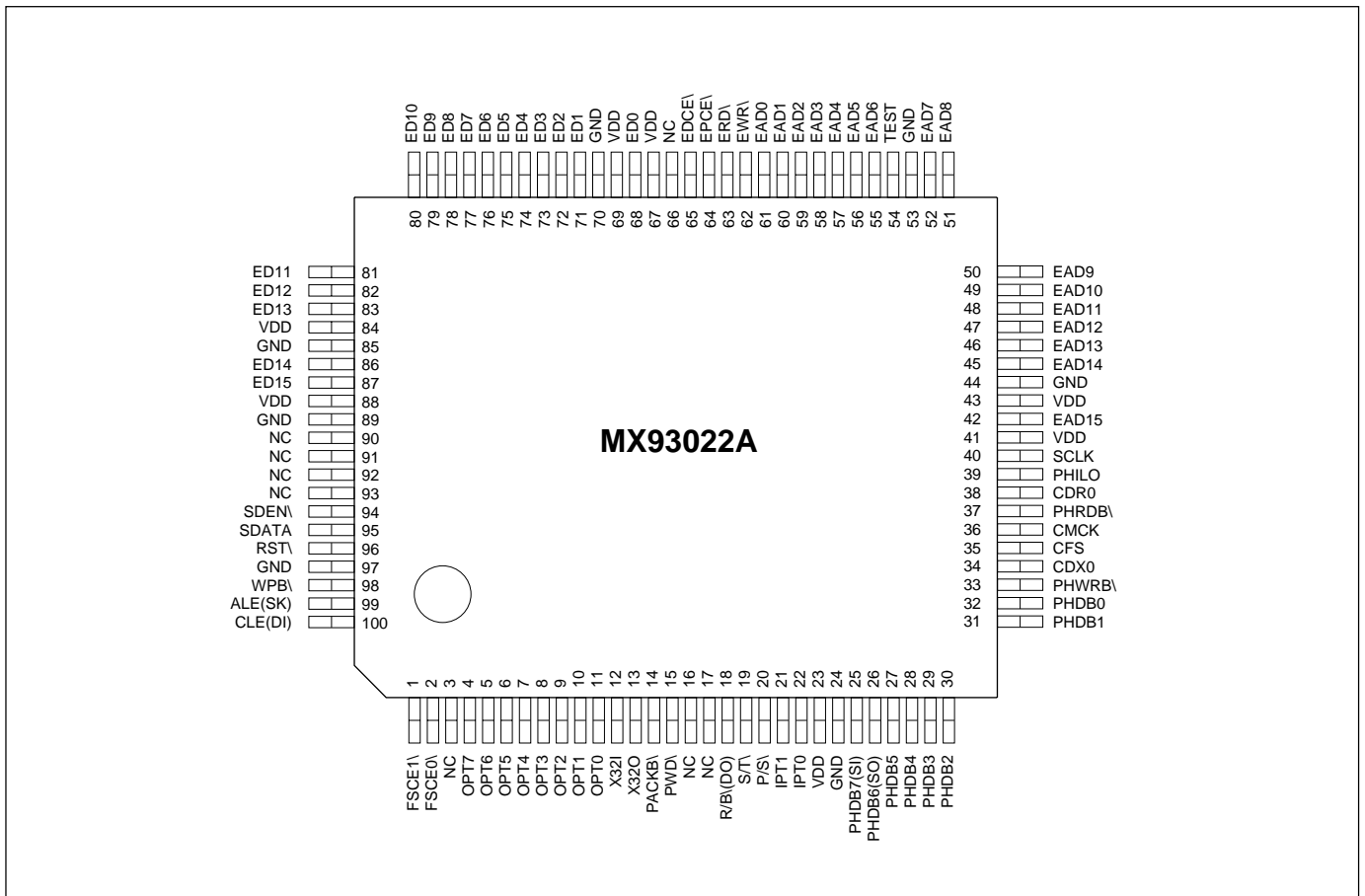
The MX93022A operates as a slave peripheral; that is controlled by an microcontroller via a 8 bits parallel or serial interface. The host activates the MX93022A by sending it command. The MX93022A executes the command and returns status response to the host.

2.0 FEATURES

- 4.8K bps compression rate with silence compression.
- Maximum 8 Personal Mail Supports (Separate 127 ICMs)
- DTMF generation and detection with near-end echo cancellation.
- Maskable internal voice prompt up to 40 seconds.
- 8-bit parallel & serial interface with host processor.
- ICM management
- AFLASH management.
  (SAMAUNG KM29N040 x2,KM29N160 x 1, TOSHIBA TC58A040x2)
- MX93000 codec interface.
- Single 32.768KHz crystal oscillation
- Extended I/O supporting

3.0 BLOCK DIAGRAM

4.0 PIN CONFIGURATIONS

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

Left pins		Right pins	
ED11	81	50	EAD9
ED12	82	49	EAD10
ED13	83	48	EAD11
VDD	84	47	EAD12
GND	85	46	EAD13
ED14	86	45	EAD14
ED15	87	44	GND
VDD	88	43	VDD
GND	89	42	EAD15
NC	90	41	VDD
NC	91	40	SCLK
NC	92	39	PHILO
NC	93	38	CDR0
SDEN\	94	37	PHRDB\
SDATA	95	36	CMCK
RST\	96	35	CFS
GND	97	34	CDX0
WPB\	98	33	PHWRB\
ALE(SK)	99	32	PHDB0
CLE(DI)	100	31	PHDB1

MX93022A

Bottom pins (left to right, 1 to 30):
FSCE1\, FSCE0\, NC, OPT7, OPT6, OPT5, OPT4, OPT3, OPT2, OPT1, OPT0, X32I, X32O, PACKB\, PWD\, NC, NC, R/B\(DO), S/T\, P/S\, IPT1, IPT0, VDD, GND, PHDB7(SI), PHDB6(SO), PHDB5, PHDB4, PHDB3, PHDB2

5.0 PIN DESCRIPTIONS

SYMBOL	PIN TYPE	PIN NUMBER	DESCRIPTION
VDD		23,41,43,67,69,84,88	5V power source
GND		24,44,53,70,85,89,97	Ground
RST\	I	96	Reset,Schmite-triggered
X32I		12	32.768KHz Crystal input
X32O	OA	13	32.768KHz Crystal output
TEST	I	54	Connect to Ground
S/T\	I	19	AFLASH selection NC:SAMSUNG,GND:TOSHIBA
P/S\	I	20	Interface mode selection NC:parallel,GND:serial
PWD\	I	15	AC power down input

SYMBOL	PIN TYPE	PIN NUMBER	DESCRIPTION
EAD0-ED15	OA	61-55,52-45,42	VOICE PROMPT (VOP) address bus.
ED0-ED15	I/OA	68,71-83,86,87	VOP & SAMSUNG Flash data bus.
EDCE\	OA	65	RAM VOP chip enable signal.
EPCE\	OA	64	ROM VOP chip enable signal.
ERD\	OA	63	external read control signal
EWR\	OA	62	external write control signal.

5.0 PIN DESCRIPTIONS(continued)

*AFLASH INTERFACE

SYMBOL	PIN TYPE	PIN NUMBER	DESCRIPTION
ALE(SK)	OB	99	Address Latch Enable signal for SAMSUNG, serial clock signal for TOSHIBA.
CLE(DI)	OB	100	Command Latch Enable signal for SAMSUNG serial data in signal for TOSHIBA.
FSCE0\	OB	2	AFLASH 0 chip enable
FSCE1\	OB	1	AFLASH 1 chip enable
WPB\	OB	98	AFLASH write protect control signal for SAMSUNG
R/B\(DO)	I	18	Ready/busy\ signal for SAMSUNG serial data out signal for TOSHIBA.

* CODEC INTERFACE

SYMBOL	PIN TYPE	PIN NUMBER	DESCRIPTION
CFS	OA	35	Codec frame sync. 8KHz
CMCK	OA	36	Codec master clock. 1.536MHz
CDX0	OA	34	Codec data transmit
CDR0	I	38	Codec data receive
SDEN\	OB	94	MX93000 interface data enable
SDATA	OB	95	MX93000 interface data signal

*uP PARALLEL INTERFACE

SYMBOL	PIN TYPE	PIN NUMBER	DESCRIPTION
PHILO	I	39	High/low byte select
PHRDB\	I	37	Host read control signal
PHWRB\	I	33	Host write control signal
PHDB(7:0)	B	25-32	Host data bus
PACKB\	OA	14	Response is ready

5.0 PIN DESCRIPTIONS(continued)

*uP SERIAL INTERFACE

SYMBOL	PIN TYPE	PIN NUMBER	DESCRIPTION
SCLK	I	40	Synchronous clock
SI	I	25	Host serial data in
SO	O	26	Host serial data out

*EXTENDED OUTPUT PORT(8 PINS)

SYMBOL	PIN TYPE	PIN NUMBER	DESCRIPTION
OPT0-7	OB	11-4	Output to pin.

*EXTENDED INPUT PORT(2 PINS)

SYMBOL	PIN TYPE	PIN NUMBER	DESCRIPTION
IPT0-IPT1	I	22-21	IPT0 & IPT1 have internal pull-up resistor 32KΩ

NOTE:OA=8mA, OB=16mA output current.
Symbol with backslash is low active.

6.0 FUNCTIONAL DESCRIPTIONS

HOST INTERFACE

The command and response of the MX93022A is represented by an 16-bit code.
The MX93022A supports the synchronous serial and 8-bit parallel communication protocal with the host.

8-bit parallel:
The host can access PHDB(7:0) pins in two accesses selected by PHILO pin. When the host sets PHILO to low the host writes the low byte of the command to the register of DSP, and DSP does nothing but latches the data; While host sets PHILO to high, the host writes the high byte of the command to the register and then DSP executes the command. PACKB\ is defaultly set to high. After finished the command, DSP returns the response by set the PACKB\ low to indicate host. When host has read the high byte of reponse, PACKB\ will be reset to high. Note that the host accesses this register by low byte first,and then high byte.


Response
Data ready
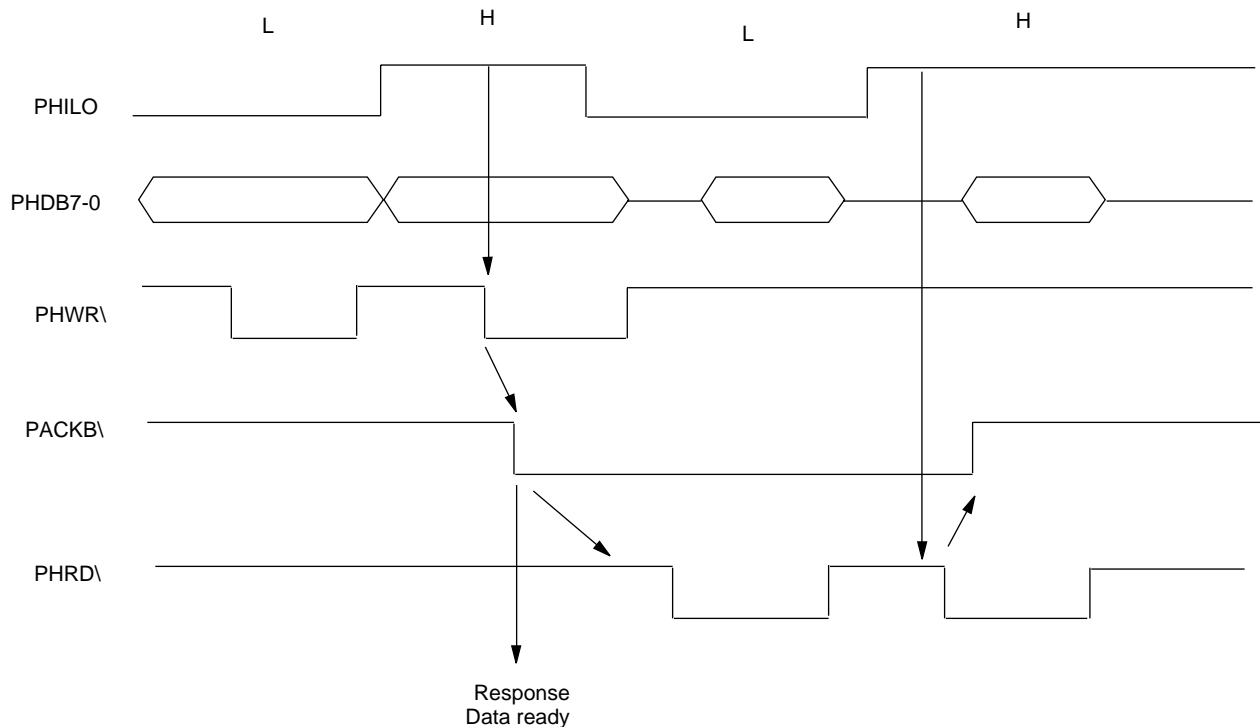
Synchronous serial:

The MX93022A supports the synchronous serial communication protocol. The microcontroller is the protocol master and prvides the clock for the protocol. The MX93022A can stand clock rate of up to 16KHz.

The following signals are relative to the MX93022A.

A start bit(0) on SI signals DSP that a command will be issued. C15(MSB) is transmited first. After the command is received and executed, the DSP set SO low to inform host that status is ready. The host should read the response from SO, after that the SO will be reset to high.
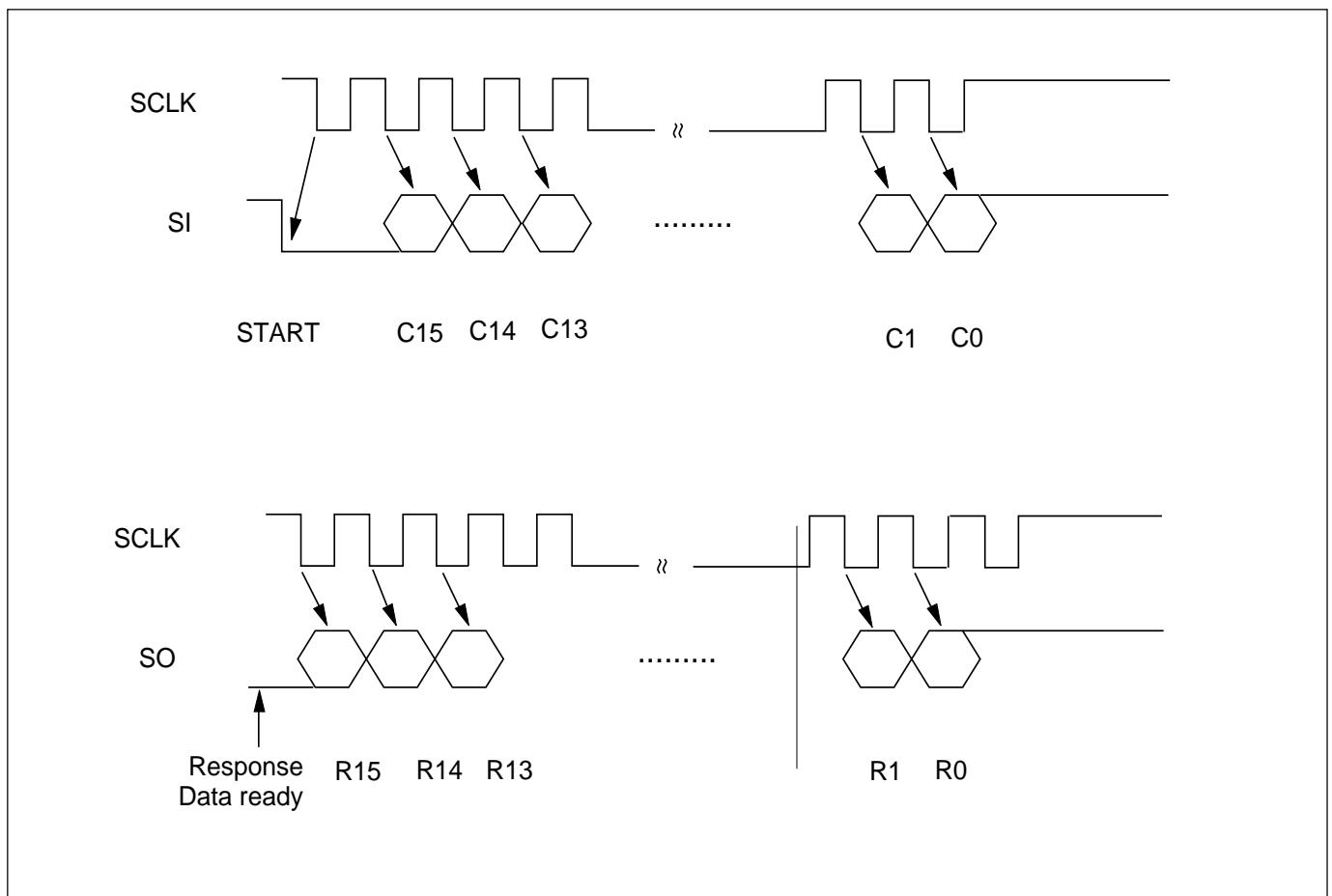
6.0 Functional Descriptions (continued)

AFLASH MANAGEMENT

The MX93022A supports SAMSUNG KM29N040, KM29N160 and TOSHIBA TC58A040 Flash memory management.

1. 128K x 8 (KM29N040 x1, TC58A040x1)
2. 256K x 8 (KM29N040 x 2, TC58A040x2)
3. 512K x 8 (KM29N160 x1)

Voice Message Recording and Storage

The MX93022A provides a high quality 4.8 kbps speech compression technique with silence compression to permit over 14 minutes of speech storage in each 4M bit of memory device.

The chip supports up to 127 variable length incoming and outgoing messages that are labeled as Msg ID 1 to 127. Although ICM could range from Msg 1 to 127, Msg IDs 127 to 121 are the only places for outgoing messages (OGM) storage so that the 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 MX93022A also monitors the telephone line signal to detect the presence of DTMF, Call progress Tone and Continuous Tone and responses to the HOST. The HOST can stop recording, and delete the last n*400 or n*200 ms from the memory using a Record Stop command with assigned Tail Cut Factor.

The MX93022A 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 MX93022A. This Loop-Back function can be disabled by the host in the personal mail command.

Announcement (ANNC) Record

The MX93022A provides flexible recording ways for outgoing message. The HOST can select to delete the old ANNC before a new one is recorded or to abort the new ANNC record without losing the old ANNC.

New/Old Message

For the HOST to manipulate incoming messages more handily, the MX93022A 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 DELETE 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 MX93022A in the command set.

Message Playback

Random access for playback of any new message or message with specified Msg ID is supported by the MX93022A. During playback, the MX93022A also monitors the telephone line signals, and Play Pause function is provided. The MX93022A is able to fast-forward the playback of a recorded message, and the playing speed will be up to 33%.

Message Deletion

The MX93022A provides two ways to delete recorded ICMs. One is the two-step method -- the combination of Del Mark on Play command and Real Del on Delete command, and the other is the immediate method -- Delete command. The two-step method enables the HOST to handle the deletion more flexibly, while the immediate method deletes a specified message directly.

Voice Prompt

For high-quality Voice Prompt playback, the MX93022A utilizes the built-in speech decoder and an internal ROM or/and external EPROM/ROM to store the vocabulary. 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 MX93022A 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 MX93022A monitors the telephone line signals.

Time Keeping

There is a timer clock in the MX93022A. The HOST 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 MX93022A monitors the incoming telephone line signal to detect the presence of DTMF signal.

Tone Generation

Up to double tones can be generated by the MX93022A. The levels and frequencies are programmable by the HOST.

Call Progress Tone Detection

The MX93022A 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 HOST, and could be used to terminate recording.

Near End Echo Cancellation

The MX93022A 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 HOST sets the Vox Record bit on Initial command, the recording of the speech would start when the voice activity is detected. The HOST has to set Vox threshold by issuing command mode 13. Hexadecimal numbers for Vox threshold are listed in Table 6.

Query and Report

The MX93022A is capable of reporting to the HOST 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, the status of recorded message.

Personal Mail

The MX93022A supports up to 8 mailboxes that may be used for personal mail application. Each mailbox has its own ICM/MEMO Msg ID. Before recording or playing messages, the HOST should set the corresponding mailbox number first with Personal Mail command.

Speed Dial Telephone Number Storage

The MX93022A can store up to 63 sets for telephone number storage. Each set supports 13bytes. These memory could be also used for other special purpose.

7.0 OPERATION DESCRIPTION

INITIAL PROCEDURE

When the system is powered up, the input PWD\ (pin 15) signal should go high followed by the input RST\ (pin 96) pulse that should be low at least 10 ms long. After reset, the MX93022A will initialize all the system parameters to their default values.

VOX LEVEL	C363hex
PERSONAL MAIL	MAIL 0
MEMO/ICM	ICM
LOOP BACK	ENABLE
SILENCE LEVEL	07HEX
TAIL CUT UNIT	400ms
NEW/OLD SEL.	PLAYED END
ANNC DEL	0:after ANNC rec
VOX ON/OFF	0:off
TIMER	RESET

After completing the above system initialization, the MX93022A is ready and indicates the HOST by setting PACK\ or SO low. The HOST should poll the indication to read the response first, then send the vocabulary configuration command to MX93022A and check the response status. If needed, the HOST should set the parameter by sending the relative command.
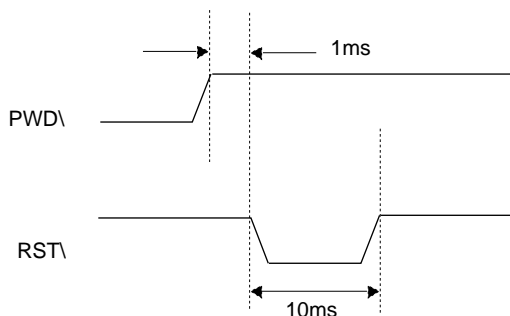
MODES OF OPERATION

After reset, the MX93022A is normally in Idle mode and keeps polling command from the HOST. When a command is issued by HOST, the system will enter the new mode. For some of the mode, the system will return to Idle mode after operation is completed. While other modes, Record, Playback, Line Monitor, Voice Prompt, and Telephone numbers, require Stop or Idle command to return to Idle mode.

The MX93022A supports 15 modes of operation, those are listed as follows:

Command	Mode Name
0	Idle
1	Record
2	Play
3	Message status
4	Tone Generation
5	Line Monitor
6	Delete Message
7	Set Time/OPT0-7/Voice Prompt/ Silence Threshold
8	Get TIME/OPT/IPT
9	Initial & Test Memory
10	Get Record Message status
11	Voice Prompt
12	Voice Activity
13	Personal Mail
14	Telephone Number

Power-up Reset Timing

DESCRIPTION OF MODES OF OPERATION

RECORD

When Record command is received from the HOST, the MX93022A performs speech compression, stores the message and monitors telephone line. If the Vox Record bit had been set to 1 on Initial & Test command, recording of the speech will start upon the voice activity detected, else the MX93022A 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 HOST 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 command, the HOST can choose to delete the old announcement before a new one is recorded. But in this case, Mark Fail(bit 11) on Record Command is inhibited. If that bit is cleared to 0, the new announcement recording can be aborted without losing the old announcement by issuing Mark Fail (bit 11) on Record command.

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

While system memory is full, the MX93022A will stop message recording, show the status in response word (bit 7, Mfull), not perform line monitoring, but still remain in Record mode.

During Record mode, the HOST can instruct the MX93022A to generate a tone by issuing the Tone generation command. Setting Stop bit on Tone Generation command or Record command will stop tone generating.

In recording, all commands will be ignored except Idle Record, Get time/OPT/IPT, Set time/OPT0-7/Voice Prompt/Silence threshold and Tone Generation.

The MX93022A will terminate Record mode and return to Idle mode when Stop bit or mark fail bit on Record command is set to 1 or Idle command is issued.

Note: The MX93022A supports up to 127 incoming and outgoing messages recording which are labeled as Msg ID 1-127. The Msg IDs of incoming message are labeled chronologically and rearranged automatically after recording. Although ICM could range from Msg 1 to 127, Msg IDs 127 to 121 are the only place for outgoing message storage. So, it is strongly suggested that the HOST should keep an upper bound of the number of ICM. (For example, upper bound of ICM=127 - maximum OGM number that will be applied in user's specification.)
If the power supply of MX93022A is off, the current recording message will be discarded.

PLAY

When Play command is received from the HOST, the MX93022A performs message playback and line monitoring. The Msg ID (bit 0-6) is set by the HOST to specify which message to play. To playback new message (non-played one), set Play New (bit 10) to 1, then the MX93022A will search to play the non_played message with specified Msg ID.

During playing, the HOST can pause playback by setting Pause (bit 8) 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 HOST can set Del Mark (bit 7) on play command. After being tagged a Del Mark, the marked message is not really deleted until a Real Del (bit 8) on Delete command is issued. 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 HOST, it is used to issuing 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 MX93022A stops playback but still remains in Play mode.

The MX93022A will respond to the Play_End flag if the HOST wants to play invalid or nonexistent messages.

In playing, all commands will be ignored except Idle Play, Get time/OPT/IPT, Set time/OPT0-7/Voice prompt/Silence threshold and Tone Generation.

The MX93022A will terminate Play mode and return to Idle mode when Stop bit or Del Mark bit is set to 1 on Play command or Idle command is issued.

MESSAGE STATUS

In this mode, there are four request codes for the HOST to get message information:
1. Get the number of recorded message (request code=0)
2. Get the number of new message (request code=1)
3. Get the number of old message (request code=2)
4. Get the available recording time with unit of second (request code=3).

The result will be reported in the response word.

TONE GENERATOR

In this mode, up to double tones can be generated by the MX93022A. By the setting of CODE the frequency may be programmable or default.

CODE	FREQENCY
000	PROGRAMMABLE F1/F2
001	800 HZ
010	900 HZ
011	1000 HZ
100	1200 HZ
101	1500 HZ
110	1800 HZ
111	2100 HZ

Programmable frequency :
CODE(BIT8-10) on command is 000.
The tone levels and frequencies are programmable and controlled by the HOST. All the parameters are defined by the sequence of three Tone Generation commands. The first 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 0 dB (gain code 0000) to -28 dB (gain code 1110) with 2 dB resolution. The frequencies are defined in the second and third commands 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 MX93022A starts tone generation only after receiving the third command.

Default frequency :
CODE (bit8-10) on command is not 000. The output frequency is specified by the code. The MX93022A starts tone generation after receiveing the first command which defines the gain in bit 0-3.

The MX93022A will terminate tone generation when Start/Stop bit is set to 0 on Tone Generation command.

LINE MONITOR

In this mode the MX93022A monitors the telephone line signal for the detection of DTMF, Call Progress Tone, Vox, and/or Continuous Tone. The MX93022A keeps monitoring the line until Stop bit is set to 1.

The MX93022A returns to the HOST 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
0	No Tone
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
A	*
B	0
C	#

The MX93022A will terminate Line Monitor mode and return to Idle mode when Stop bit it set to 1 on Line Monitor command, or Idle command is issued.

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 0-6 and clear bit 11, 10, 8 and 7 to zero.

2.To delete a specified new ICM, set Del_New_Msg (bit 10) to 1, give the New Msg ID in bit 0-6, clear bit 11,8 and 7 to zero.

3.To delete all old ICM, set Del_All_Old (bit 7) to 1 and clear bit11, 8 to zero. (Bit 0-6 is ignored)

4.To delete message that has Del Mark tag, set Real Del (bit8) to 1 and clear bit 11,10 and 7 to zero.

If the HOST deletes invalid or nonexistent messages, an error flag will show on bit 0 of the response word.

SET TIME/OPT0-7/VOICE PROMPT/SILENCE THRESHOLD

In this mode the HOST can set the current time, output port7-0, voice configuration and silence threshold. The time information includes second, minute, hour and week. The timer in the MX93022A will be used to stamp time and day 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 OPT 0-7, put the output data in bit 0-7 and use request code(bit 8-11) 0100.

6.To configure voice prompt, put data in bit0-1 and use request code(bit 8-11) 0110.
The responded status includes internal voice prompt test result, external voice prompt test result, external voice prompt location and data unit.

7.To set silence threshold, use request code (bit 8-11) 0111.

8.To set MX93000, put the control data in bit 0-7, specify register in bit 8-10 and set bit 11 to 1.

GET TIME/OPT/IPT

In this mode the HOST can get the current time from the internal timer clock of the MX93022A. 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.

5.To get OPT 0-15, use request code (bit 8-11) 0100.

6.To get OPT 0-15, use request code (bit 8-11) 0101.

7.To get IPT 0-7, use request code (bit 8-11) 0110.

The requested data will be reported in the response word.

INITIAL & TEST MEMORY

In this mode there are 6 functions for the HOST to define:

1.Momory Initialization

The HOST can initialize the AFLASH by Mem. Init. (bit 0) to 1. This function is normally used after first power-up of the system. The HOST must send this command to the MX93022A in order to format MEMORY. The MX93022A performs MEMORY formatting to determine the MEMORY size and detect the good/bad memory unit of MEMORY. The response word reported to the HOST contains the information of MEMORY bit size (bit 0-3), MEMORY address size (bit 4-7), MEMORY good/bad status (bit 8) and MEMORY good rate (bit9-15). If the examination in the initialization shows that the MEMORY quality meets the pre-defined specification, the MX93022A responds 1 in G/B status bit.

After initialization, all messages in the MEMORY are lost.

2.Memory check & error correct

The MX93022A allows the HOST to check the status of MEMORY by setting the mem. Check (bit 1) on this

command. In the same time, it also completes the memory error correct.

3.Line On/Off

The HOST 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 HOST 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.Announcememt Deletion

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

6.Condition of message change to old

When the Real Del (bit 8) on Delete command is issued, the ICMs could be changed their status to old under the following conditions.
a.New/Old sel (bit 6) is set to 1 and the ICMs have been ever played.

b.New/Old sel (bit 6) is cleared to 0 and the ICMs have been played end.

GET RECORD MESSAGE

In this mode, there are ten request codes for the HOST to get the related information about a specified message.

Given the Msg ID (bit 0-6) and New_Msg flag (bit 7), the MX93022A 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 MX93022A internal timer has been set before with Set Time/OPT0-7/Voice Prompt/Silence Threshold command. Otherwise, the response word is 0.

7.Get the message 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 show the specified message has been tagged a Del Mark (response word = 1) or not (response word = 0)

9.Get the template Old Mark status.(Request Code=1000) To show the specified message which has been tagged a temp. Old Mark (response word=1) or not (response word=0)

10.Check OGM existence. (Request Code = 1111) Use this command to show whether an OGM with the Msg ID is recorded (response word = 1) or not (response word = 0).

All the results are reported in the response word.

VOICE PROMPT

In this mode the MX93022A plays a speech segment that the corresponding phrase number is given in command bit 0-7. Up to 255 speech segments, previously stored in an external ROM/EPROM,are provided by the MX93022A and pronounced using the speech decompression algorithm. The HOST can pause the playback by setting PS (bit 8) to 1 or resume from pause by clearing PS 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 MX93022A keeps monitoring the line signal and sends the results in response word to the HOST.

The MX93022A will terminate Voice Prompt mode and return to Idle mode when Stop bit is set to 1 on Voice Prompt Generation command, or Idle command is issued.

VOICE ACTIVITY

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

SET LOOP-BACK/PERSONAL MAIL

Three functtions are provided in this command shown as follows:

1.Set the personal mailbox number
In this mode the HOST 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. The default mailbox is number 0.

2.Set the recording message attribute
Before recording a message, the HOST can set the attribute of that message to be MEMO or ICM. Clear bit 3 to zero to identify a recorded message as an ICM or set bit 3 to one to identify a recorded 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 message Time.

3.Set the loop back function
Before recording a message, the Host should set the recording signal loop back function to be enabled or disabled. Clear LB (bit4) to zero for transmitting back the signal that is received through the codec input. Set LB (bit4) to one for disabling the received signal to be transmitted back to codec.

TELEPHONE NUMBER

In this mode the HOST can write/read telephone number to/from the MX93022A with the sequence of telephone number command as follows:

1.Write telephone number to the MX93022A.

The first command defines the telephone record ID(bit 0-5) and set W/R (bit 10) to zero.
Following command specifies the one-byte to be stored under that ID.

While the current record ID is full, the MX93022A will show the status in response word (bit0, FULL)

The MX93022A will terminate telephone number mode and return to Idle mode when stop (bit 9) is set to 1 on telephone number command or Ilde command.

2.Read telephone number from the MX93022A.

The first command defines the telephone record ID(bit 0-5) and set W/R (bit 10) to one. The telephone data will be shown on the response word.
Following command shows the one-byte data on the response on the HOST.

The reponse word contains the byte-data (bit 0-7) and Read End(bit 8). When the Read End bit is 1, the byte-data is invalid.

The MX93022A will terminate telephone number mode and return to Idle mode when stop (bit 9) is set to 1 on Telephone Number command or Idle command.

POWER-DOWN

The message and all memory management information store in AFLASH memory, thus there is no need to maintain the power to preserve stored memory. If the microcontroller real time clock is used to maintain the time and day, neither the AFLASH nor the MX93022A require battery backup during power failure. In this case, when returning to normal operating mode, the microcontroller should set the time and day.

While in Record mode or Telephone Number mode, if power failure happens, the power supply of the MX93022A is off, the current recording message or storing telephone ID will be considerd as failure. When power failure happens, the PWD\ go low at least 10ms before the supply power of, the current recording message or storing telephone ID will be valid.

POWER DOWN TIMING (AFLASH)
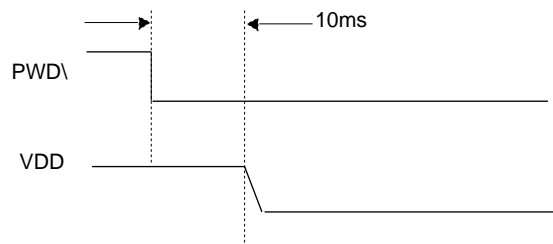
Note: While in power down mode, the OPT7-0 will be reset to low.

8.0 COMMAND FORMAT AND PROTOCOL

8.0 IDLE MODE

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

CONF | 0000 | 000000000000

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

RESP | 0000 | 000000000000

8.1 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 -- cut tail in 200/400 ms unit.

Stop -- 1:stop recording and tail cut.

Pause -- 1:to pause recording

        0:to continue recording

Marked Record -- recording to special message record 127~121.

Marked record is not for normal recording message; they are reserved for announcement.

000 -- not a marked record

001 -- message record 127(7FH)

010 -- message record 126(7EH)

011 -- message record 125(7DH)

100 -- message record 124(7CH)

101 -- message record 123(7BH)

110 -- message record 122(7AH)

111 -- message record 121(79H)

Mark Fail -- 1:to recover original announcement message,

while Ann_del (bit-5) on Initial & Test Memory command is 0 and Record mode is stopped.

note:While Ann_del (bit-5) on Initial & Test Memory command is set to 1,

The Mark Fail function is inhibited.

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 index of DTMF which is detected in the process of recording

Cont tone -- 1 : the continue energy is detected.

Tone -- 1 : the call progress tone (300~640 Hz)is detected.

VOX -- 1 : the speech power level is under VOX threshold.

Mfull -- 1: memory full, no further recording is possible.

Record time -- 00 ~EFH : report how many seconds are recorded in this message.

8.2 PLACE MODE

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

CONF: 0010 | Fast Play | Play New | Stop | Pause | Del Mark | Msg ID
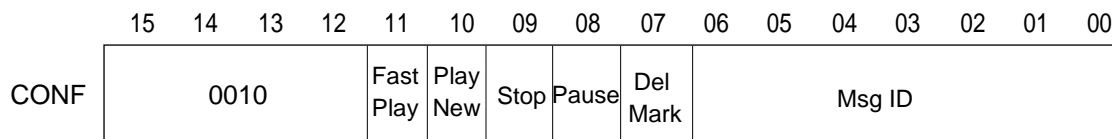
Msg ID -- 1~127:message ID which is assigned for playing
Del Mark -- 1:stop playing and tag a del mark to that message
Pause -- 1:pause playing
         0:continue playing
Stop -- 1:stop playing
Play New -- 1:search to play the new messages.
         0:search to play all messages.
Fast play -- 1:playing speed will be up to 33%.
         0:normal speed.

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

RESP: Play Time (sec) | Play End | Tone | 0 | DTMF
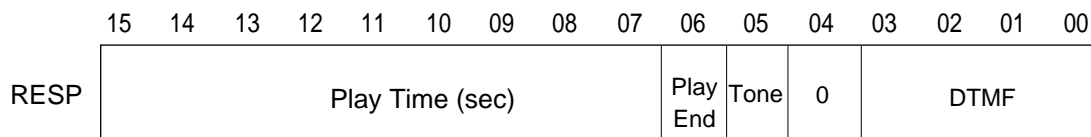
DTMF -- the index of DTMF which is detected in the process of recording.
Tone -- 1:the call progress tone(300~640Hz)is detected.

Play End -- 1:end of playing the message.
Record time -- :playing time till now.

8.3 MESSAGE STATUS MODE

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

CONF: 0011 | Request Code

RESP: Data
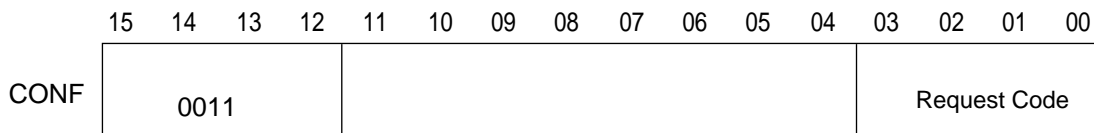
REQUEST CODE:

REQUEST CODE	STATUS	DATA
0000	number of total recorded messages	00 ~ 127
0001	number of new messages	00 ~ 127
0010	number of old messages	00 ~ 127
0011	available time to record (sec.)	00 ~ 65535

8.4 TONE GENERATION MODE

15 14 13 12	11	10 09 08	07 06 05 04	03 02 01 00
	start/ stop	CODE	Gain2	Gain1

CONF — 0100 (bits 15–12)

Gain1, Gain2 -- +3 dbm ~ -25 dbm, 2 db step down from 0.
Start/Stop -- "1" start to generate tone
              "0" stop generating tone
CODE -- tone generation by specified or default.

CODE	FUNCTION
000	SPECIFY F2/F1
001	800 Hz
010	900 Hz
011	1000 Hz
100	1200 Hz
101	1500 Hz
110	1800 Hz
111	2100 Hz

*SPECIFY F1,F2 TONE START

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			1		000			Gain2				Gain1		
RESP		0100			1		000			Gain2				Gain1		
CONF								F1								
RESP								F1								
CONF								F2								
RESP								F2								

Note:F1,F2=Target frequency *8.19

*DEFAULT TONE START

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
CONF		0100			1		---			1111				Gain 1		
RESP		0100			1		---			1111				Gain 1		

*TONE STOP

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
CONF		0100			0		000			0000				0000		
RESP		0100			0		000			0000				0000		

8.5 LINE MONITOR MODE

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

STOP -- "0" start to monitor line.
"1" stop monitoring line.

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
RESP									VOX	Tone	Cont Tone		DTMF		

DTMF, Cont. Tone, Tone, VOX -- see RECORD MODE

8.6 DELETE MESSAGE MODE

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
CONF		0110		0	Del New MSG	0	Real Del	Del All Old			Msg ID				

Msg ID -- 1~127 ICM/MEMO to be deleted.

Real Del -- 1 : actually delete the message that has del mark;
at the same time, tag the old mark to the message that has been played back.
Del New MSG -- 1 : search to delete the specified message of all new messages
0 : search to delete the specified message of all messages

Del All Old -- 1:delete all old message whcih have been played; MSG ID is don't care.

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
RESP		0110					00000000000								E

E -- "0" :indicate ok
"1" :indicate invalid message

8.7 SET TIME/OPT0-7/VOICE PROMPT/SILENCE THRESHOLD MODE

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

RESP	0111	

REQUEST CODE:

REQUEST CODE	FUNCTION	DATA
0000	SECOND	00~3BH
0001	MINUTE	00~3BH
0010	HOUR	00~17H
0011	WEEK	00~06H
0100	OPT7-0	00~FFH
0110	VOP CONFIG	00~03H
0111	SILENCE THRESHOLD	00~0FH
1aaa*	MX93000 CMD.	00~FFH

For adjusting silence threshold, please refer to TABLE 7
note:aaa* specify register of MX93000

* VOP CONFIG :

	15 14 13 12	11 10 09 08	07 06 05 04 03 02	01	00
CONF	0111	0110	000000	EVOP	IVOP

IVOP -- 1:internal voice prompt select and test.
EVOP -- 1:external voice prompt select and test.

	15 14 13 12	11 10 09 08 07 06 05 04	03	02	01	00
RESP	0111	00000000	EVOP UNIT	EVOP ADDR	EVOP STATUS	IVOP STATUS

IVOP STATUS -- 1:test ok
                0:test fail
EVOP STATUS -- 1:test ok
                0:test fail
EVOP ADDR --   1:program sapce 8000H.
                0:data space 800H.
EVOP UNIT --   1:word
                0:byte

8.8 GET TIME/OPT/IPT MODE
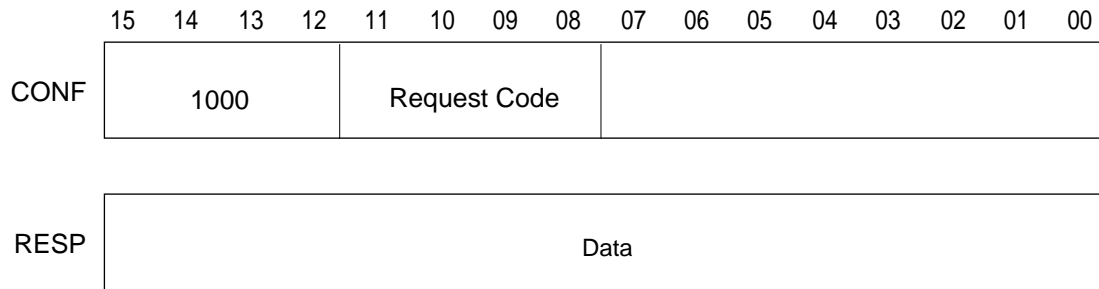
	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
CONF		10	00			Request Code										
RESP								Data								

REQUEST CODE:

REQUEST CODE	FUNCTION	DATA
0000	SECOND	00~3BH
0001	MINUTE	00~3BH
0010	HOUR	00~17H
0011	WEEK	00~06H
0100	OPT 7-0	00~XXFFH
0110	IPT 7-0	00~FFH

8.9 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 sel.	ANNC DEL	vox on/off	Line ON/ OFF	0	Mem. check	Mem. Init.

Mem. Init. -- 1:re-initialize memory.

Mem. check -- 1:Good/bad check, and error correct.

Line on/off -- 1:in remote line operation
                      0:not in remote line operation

VOX on/off -- 1:on;start to record, while vox level is over threshold.
                      0:off;immediatelly start to record.

ANNC DEL -- 1:delete old ANNC before New ANNC is recorded.
                      0: delete old ANNC after New ANNC is recorded.

new/old sel. (set the judgement point of message new/old attributes)
                      1:message which has ever been played.
                      0:message which has been played end.

Tail Cut Unit(set the tail cut unit)--
                      1:200 ms
                      0:400 ms

	15 14 13 12 11 10 09	08	07 06 05 04	03 02 01 00
RESP	MEMORY GOOD RATE	G/B	MEMORY SIZE	MEMORY BITS

MEMORY GOOD RATE --0~100
G/B   --1:good;0:bad

MEMORY SIZE		MEMORY BITS	
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

8.10 GET RECORD MESSAGE STATUS MODE

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
CONF		1010				Request Code			NEW MSG				Msg ID			
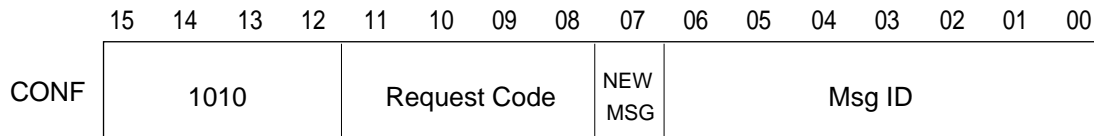
NEW MSG -- 1:the MSG ID is related to new messages.
0:the MSG ID is related to total messages.
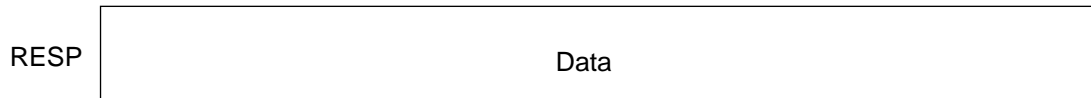
RESP	Data

REQUEST CODE	FUNCTION	DATA
0000	SECOND	00~3BH
0001	MINUTE	00~3BH
0010	HOUR	00~17H
0011	WEEK	00~06H
0100	RECORD TIME	00~EFH
0101	TIMER STATUS	1:timer has been set
		0:default timer
0110	ICM/MEMO	1:MEMO record
		0:ICM record
0111	DEL MARK STATUS	1:has del mark
		0:no del mark
1000	OLD MARK STATUS	1:has old mark
		0:no old mark
1111	OGM EXIST(79H~7FH)	1:OGM exist
		0:OGM not exist

8.11 VOICE PROMPT MODE

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
CONF		1011		FAST PLAY	0	STOP	Pause		PHRASE NUMBER						

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
RESP									PLAY END	Tone	0		DTMF		
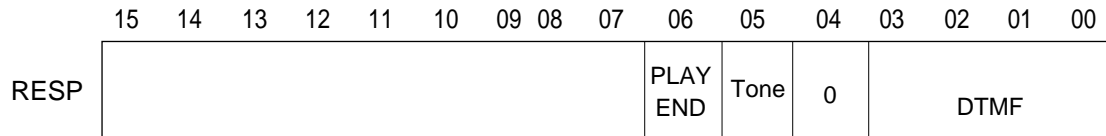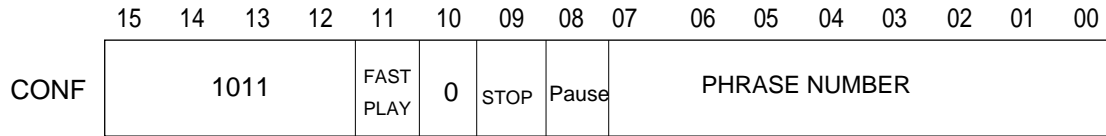
PHRASE NUMBER -- 1~255
Others : Refer to " Play Mode "
Please refer Table 10 for internal vocabulary

8.12 VOICE ACTIVITY MODE

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
CONF		1100		VOX LEVEL											

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
RESP		1100		VOX LEVEL											
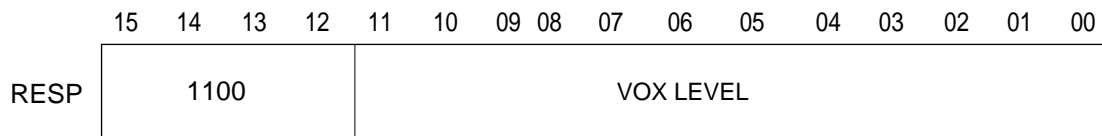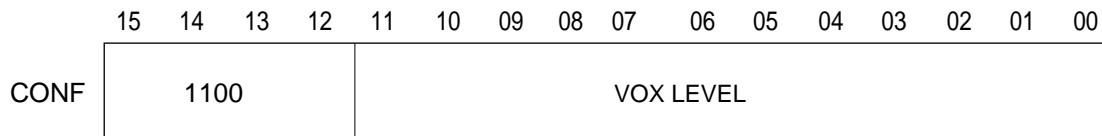
Adjust VOX Level, please refer to TABLE 6

8.13 PERSONAL MAIL MODE

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

CONF

1101	0000000	LB	MEMO /ICM	PERSONAL MAIL

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

RESP

PERSONAL MAIL-- Select the specified mail box; default is 0.
Only the messages in the specified mail box can be operated by other modes(PLAY,RECORD,...etc.)

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

LB -- 1:loop back disable
0:loop back enable(default)

8.14 TELEPHONE NUMBER MODE

WRITE TELEPHONE NUMBER

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
CONF		1110				000000							TEL. Record ID			

TEL. Record ID -- 1~3FH,each telephone record has 13 bytes.

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
RESP		1110					000000000000									

note: if TEL. Record ID=0 or memory bad, the RESP is FFFFH and return to Idle mode.

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
CONF C2		1110			00		Stop	0				DATA				

Stop -- 1:stop this command mode.

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
RESP		1110					00000000000									FULL

FULL -- 1:the telephone record is full

READ TELEPHONE NUMBER

	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
CONF		1110			01		stop	000				TEL. Record ID				

stop -- 1:stop reading data

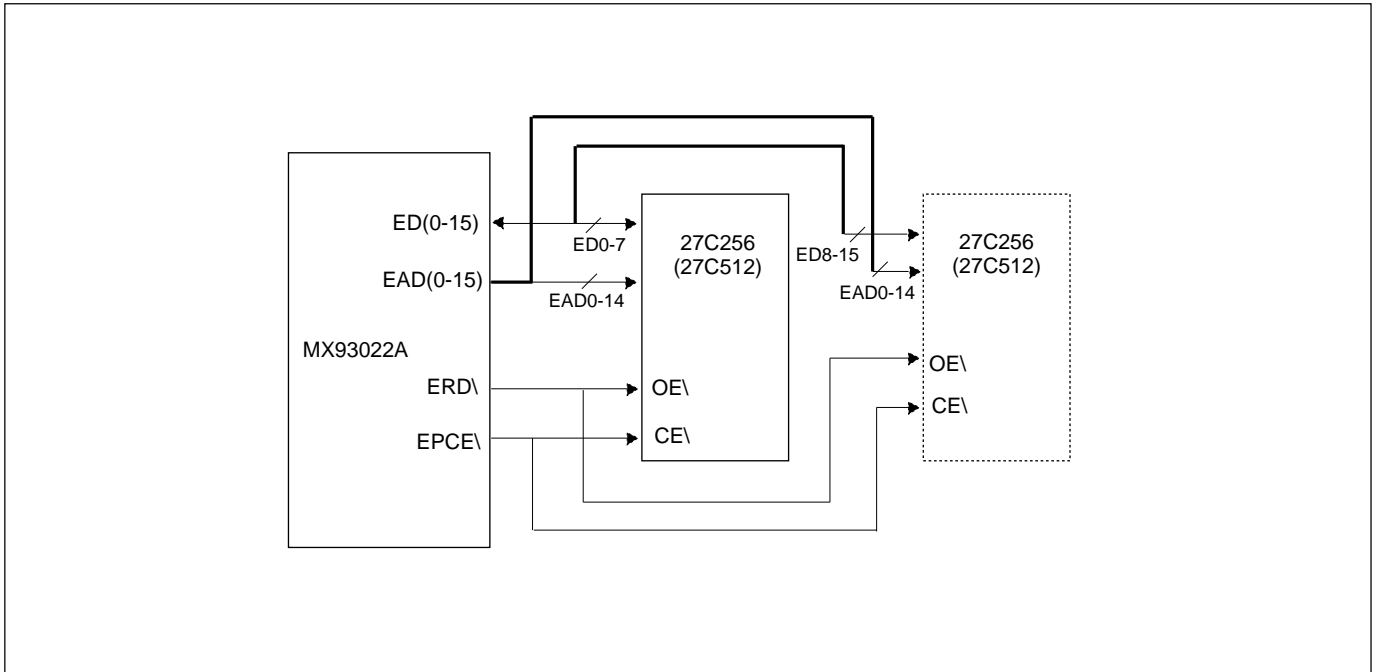|	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
RESP		0000				000		Read End				DATA				

Read End -- 1:End of the current Tel. Record ID and DATA is invalid
Note:If Tel. Record ID = o, the RESP is FFFFH and return to Idle mode.

AFLASH INTERFACE
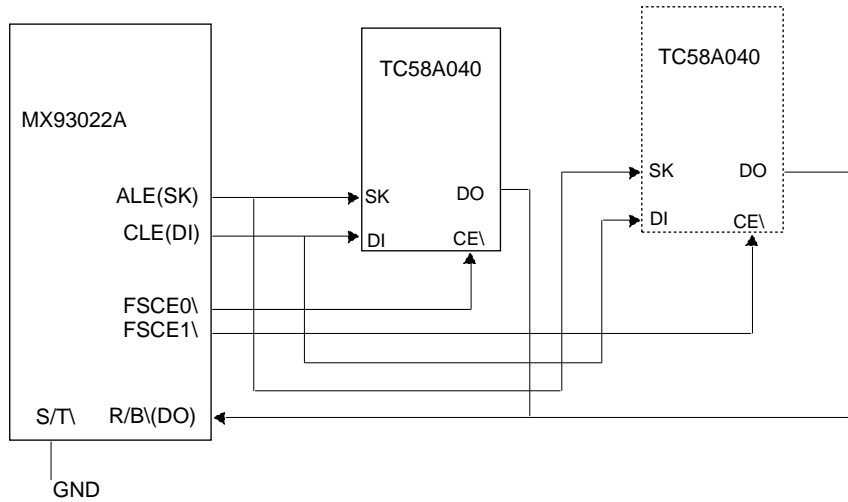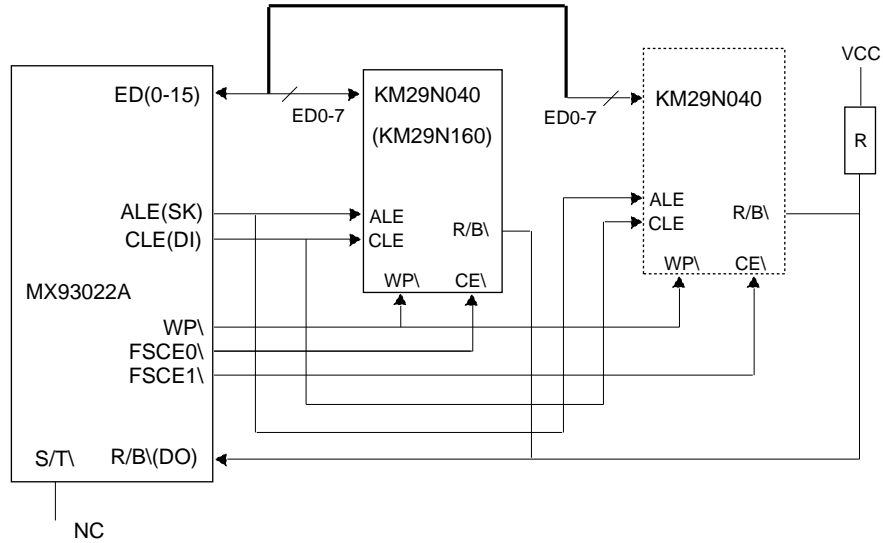
VOICE PROMPT EPROM/ROM INTERFACE --- LOCATION 8000H

The interface allows to read data from 8000h to FFFFh using 8bits or 16bits program memory bus

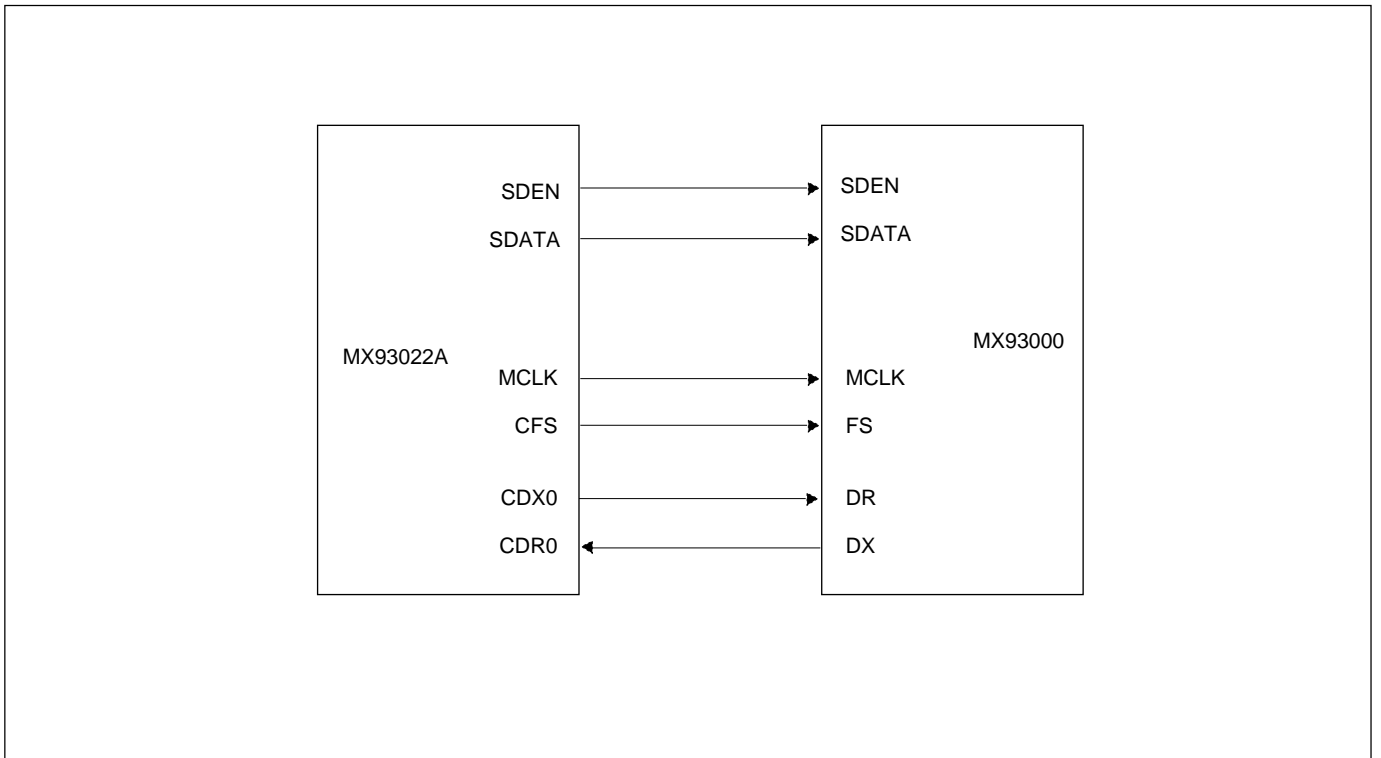## VOICE PROMPT EPROM/ROM INTERFACE --- LOCATION 800H-FEFFH

The interface allows to read data from 800h to FEFFh using 8bits or 16bits program memory bus
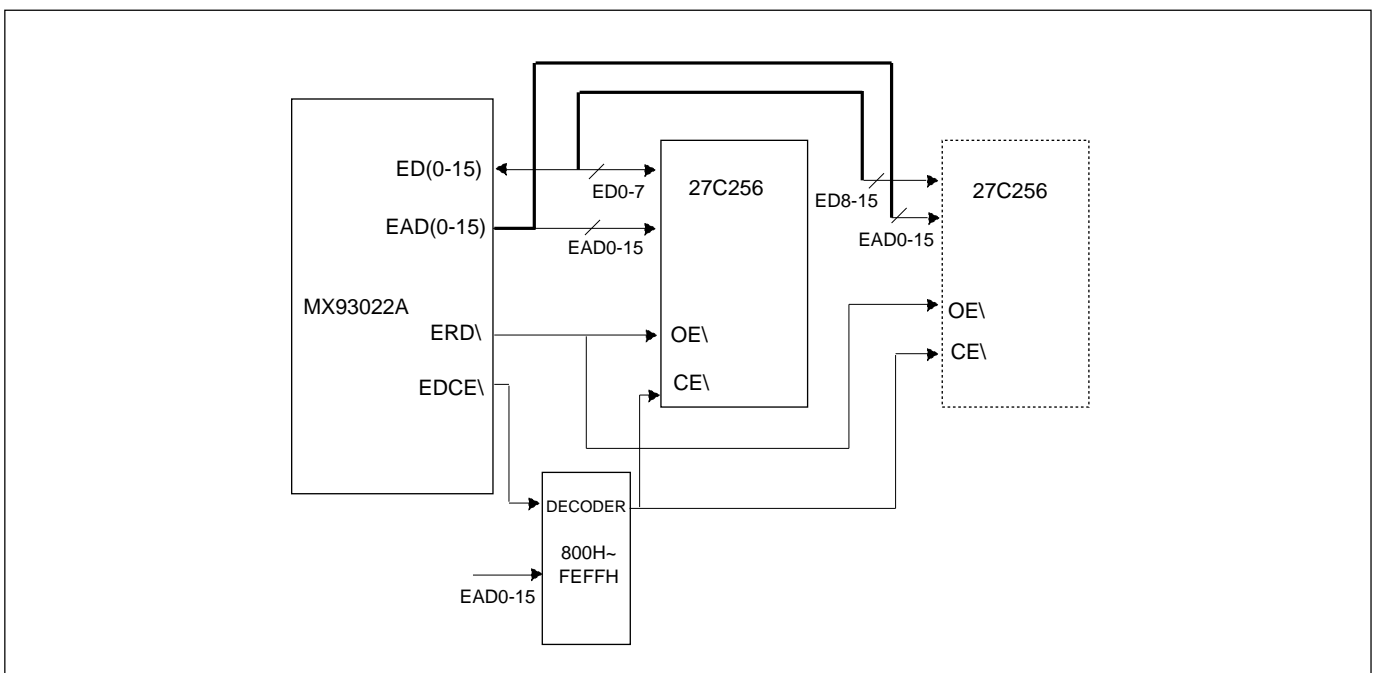
Note:
1. EDCE\ directly connect to CE\ while using TC58A040 Flash.
2. EDCE\ connect to CE\ through decoder while using KM29N040(160)
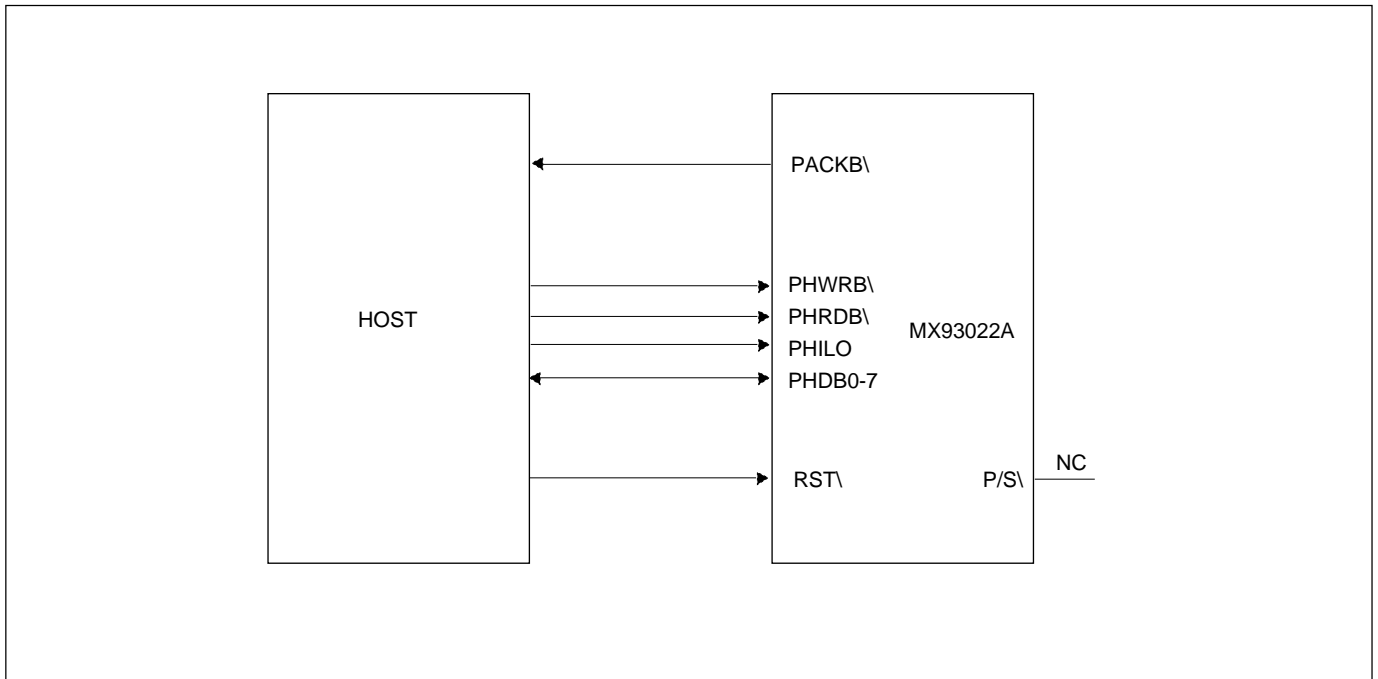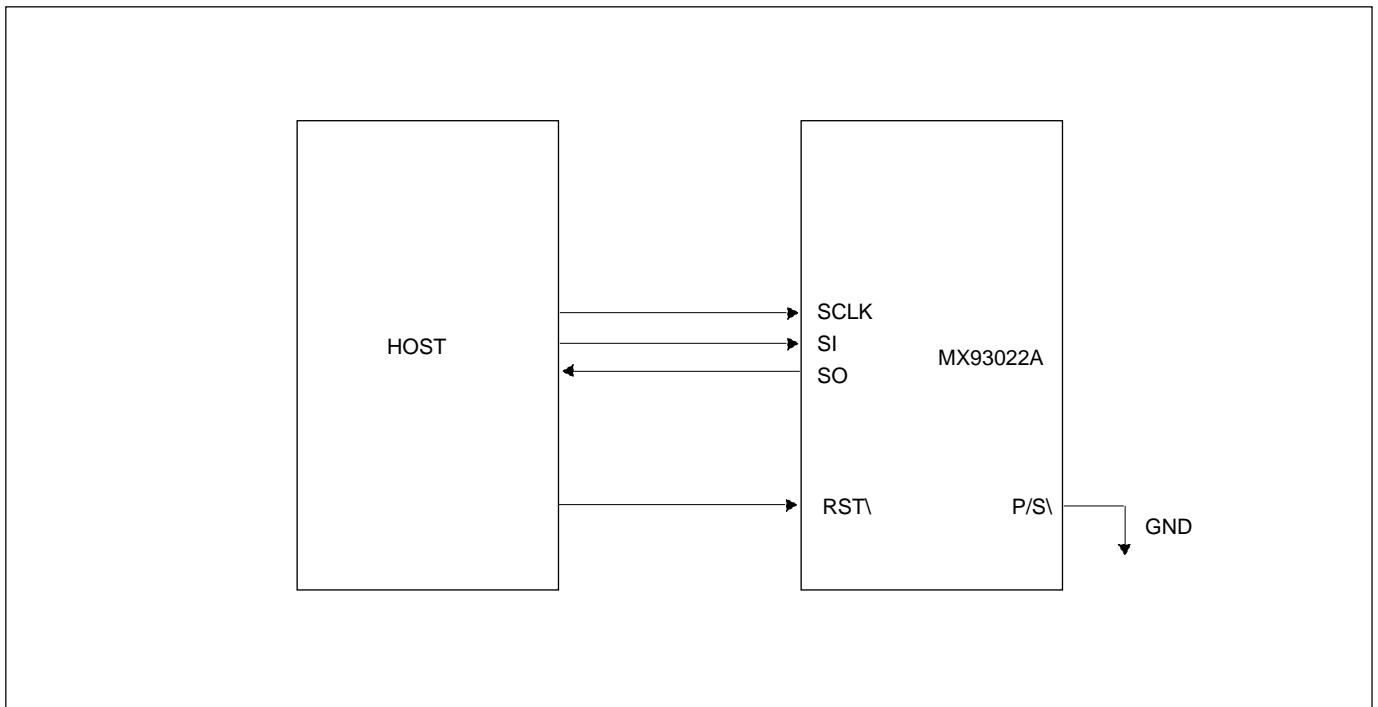
CODEC INTERFACE

HOST PARALLEL INTERFACE

```
+----------+          +-------------------+
|          |  <-------| PACKB\            |
|          |          |                   |
|          |  ------->| PHWRB\            |
|          |  ------->| PHRDB\   MX93022A |
|  HOST    |  ------->| PHILO             |
|          |  <------>| PHDB0-7           |
|          |          |                   |
|          |  ------->| RST\      P/S\ ---- NC
|          |          |                   |
+----------+          +-------------------+
```

HOST SERIAL INTERFACE

```
+----------+          +-------------------+
|          |  ------->| SCLK              |
|          |  ------->| SI                |
|  HOST    |  <-------| SO       MX93022A |
|          |          |                   |
|          |  ------->| RST\      P/S\ ----> GND
|          |          |                   |
+----------+          +-------------------+
```

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
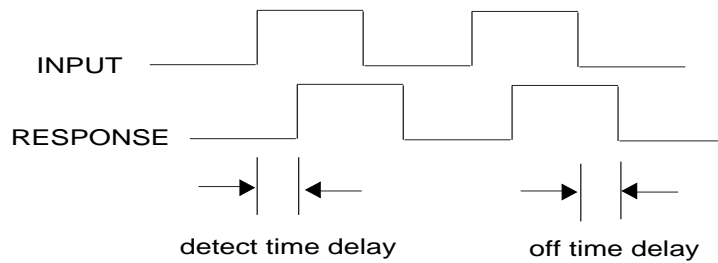** the detect/off time delay is defined as follows

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	55			ms
DTMF interdigit pause accept	55			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

TABLE 6. VOX THRESHOLD *

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.

TABLE 7. SILENCE THRESHOLD LEVEL

SILENCE LEVEL	dB
1	-87
2	-81
3	-75
4	-69
5	-63
6	-57
7	-51
8	-45
9	-39
10	-33
11	-27
12	-21
13	-15
14	-9
15	-3

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	KM29N040 x 1	TC58A040 x 1
RECORD --- STARTING	25 ms	200 ms
RECORD --- NORMAL	11 ms	13 ms
RECORD --- STOP (without tail cut)	5 ms	17 ms
RECORD --- STOP (with tail cut)	62 ms	135 ms
RECORD --- STOP (with garbage collection)	247 ms	1000 ms
PLAY --- START	14 ms	72 ms
PLAY --- NORMAL	5 ms	5 ms
PLAY --- STOP	1 ms	1 ms
MESSAGE NUMBER MODE	10 ms	78 ms
TONE GENERATION MODE	1 ms	1 ms
LINE MONITOR MODE	7 ms	7 ms
DELETE MESSAGE MODE	750 ms	2280 ms
SET TIME/OPT/VOICE/SILENCE MODE	1 ms	1 ms
INITIAL AND TEST MEMORY MODE	1650 ms	1600 ms
GET RECORD MESSAGE STATUS MODE	16 ms	102 ms
VOICE PROMPT MODE	5 ms	5 ms
VOICE ACTIVITY MODE	1 ms	1 ms
PERSONAL MAIL MODE	1 ms	1 ms
WRITE TELEPHONE NUMBER --- START	14 ms	54 ms
WRITE TELEPHONE NUMBER --- NORMAL	1 ms	1 ms
WRITE TELEPHONE NUMBER --- STOP	1 ms	1 ms
WRITE TELEPHONE NUMBER --- STOP (with garbage collection)	119 ms	731 ms
READ TELEPHONE NUMBER	7 ms	7 ms

Note : In some mode, the reponse time will increase if the block number increase, such as in KM29N160 , KM29N040 by 2 , or TC58A040 by 2 are installed.

TABLE 10 : INTERNAL VOCABULARY

| INDEX	WORD	INDEX	WORD
1	ONE	21	THIRTY
2	TWO	22	FORTY
3	THREE	23	FIFTY
4	FOUR	24	SUNDAY
5	FIVE	25	MONDAY
6	SIX	26	TUESDAY
7	SEVEN	27	WEDNESDAY
8	EIGHT	28	THURSDAY
9	NINE	29	FRIDAY
10	TEN	30	SATURDAT
11	ELEVEN	31	A.M.
12	TWELVE	32	P.M.
13	THIRTEEN	33	O CLOCK
14	FORTEEN	34	PLEASE WAIT
15	FIFTEEN	35	MESSAGE
16	SIXTEEN	36	NO
17	SEVENTEEN	37	NUMBER
18	EIGHTEEN	38	OH
19	NINTEEN	39	ZERO
20	TWENTY	40	INCOMING

DC CHARACTERISTICS: TA = 0 to 70°C, VCC = 5V ± 10%

Storage temperature range : -55°C - 150°C

SYMBOL	PARAMETER	CONDITION	MIN	TYPE	MAX	UNIT
VCC	Supply voltage		4.5	5	5.5	V
GND	Ground			0		V
TTL LEVEL INPUT(IT)						
VIH	Input high voltage		2.0			V
VIL	Input low voltage				0.8	V
SCHMITT TRIGGER INPUT(IS)						
VIH	Input high voltage		0.7*VCC			V
VIL	Input low voltage				0.3*VCC	V
8mA OUTPUT(OA)						
VOH	Output high voltage	IOH=-8mA	2.4			V
VOL	Output low voltage	IOL= 8mA			0.4	V
16mA OUTPUT(OB)						
VOH	Output high voltage	IOH=-16mA	2.4			V
VOL	Output low voltage	IOL=16mA			0.4	V
SUPPLY CERRENT						
ICC	NORMAL			45	70	mA
ICC	POWER DOWN			3	6	mA

CODEC TRANSMIT AND RECEIVE TIMING
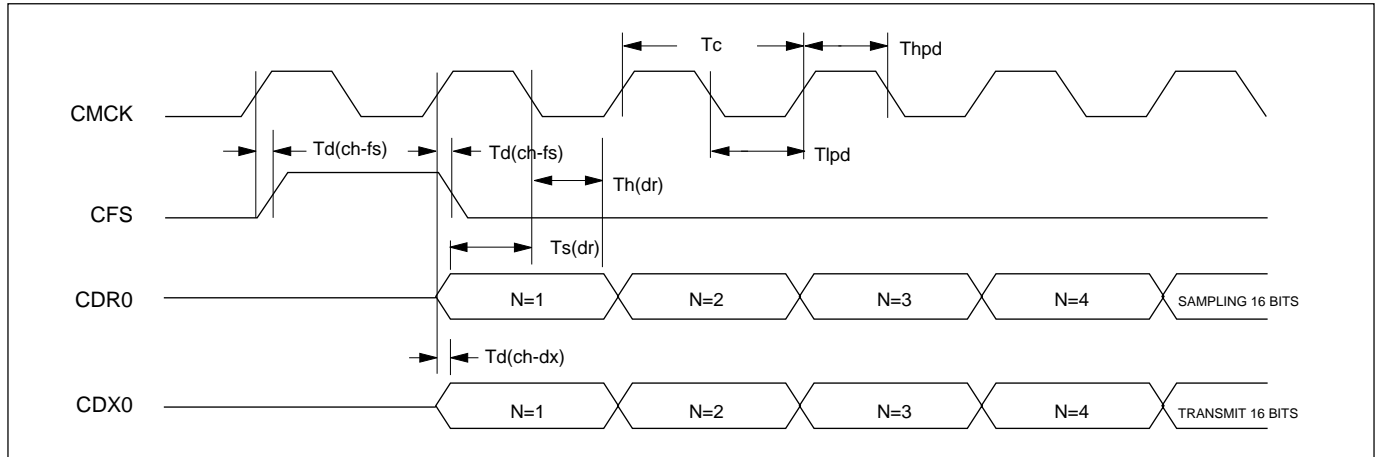
SYMBOL	PARAMETER	MIN	NOM	MAX	UNIT
Tc	CMCK cycle time		650		ns
Tlpd	CMCK low pulse duration	315		335	ns
Thpd	CMCK high pulse duration	315		335	ns
Td (ch-fs)	CMCK to CFS delay time			20	ns
Td (ch-dx)	CMCK rising edge to CDX0 valid			10	ns
Ts (dr)	CDR0 set-up time before CMCK falling edge	10			ns
Th (dr)	CDR0 hold time after CMCK falling edge	10			ns

FLASH/ROM READ TIMING
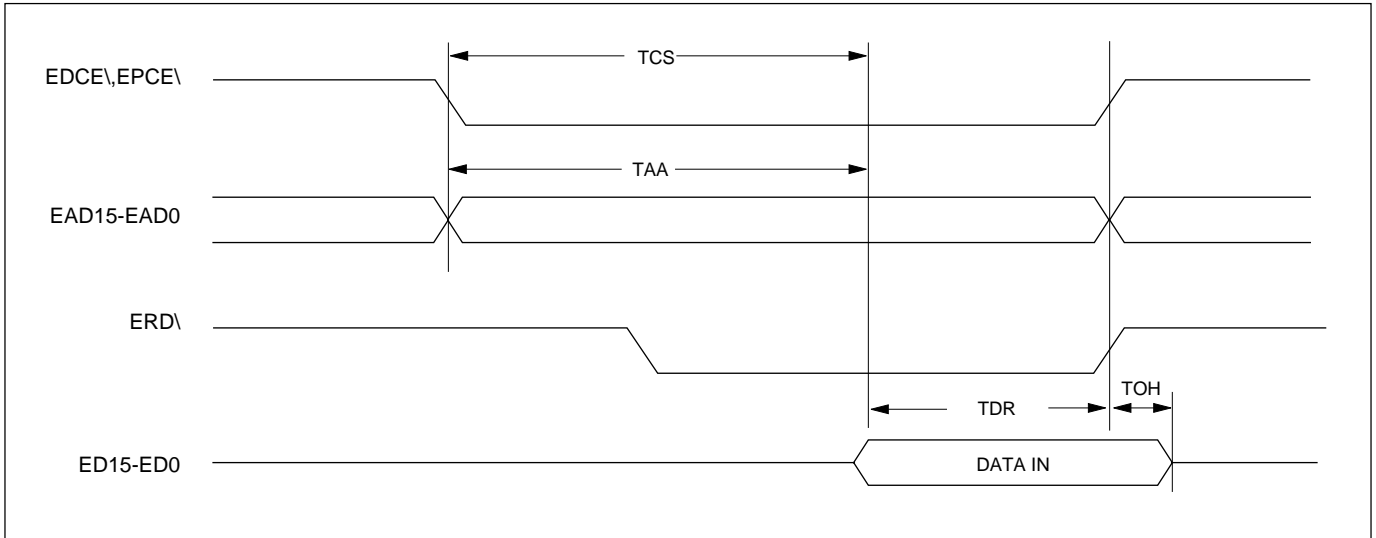
FLASH WRITE TIMING
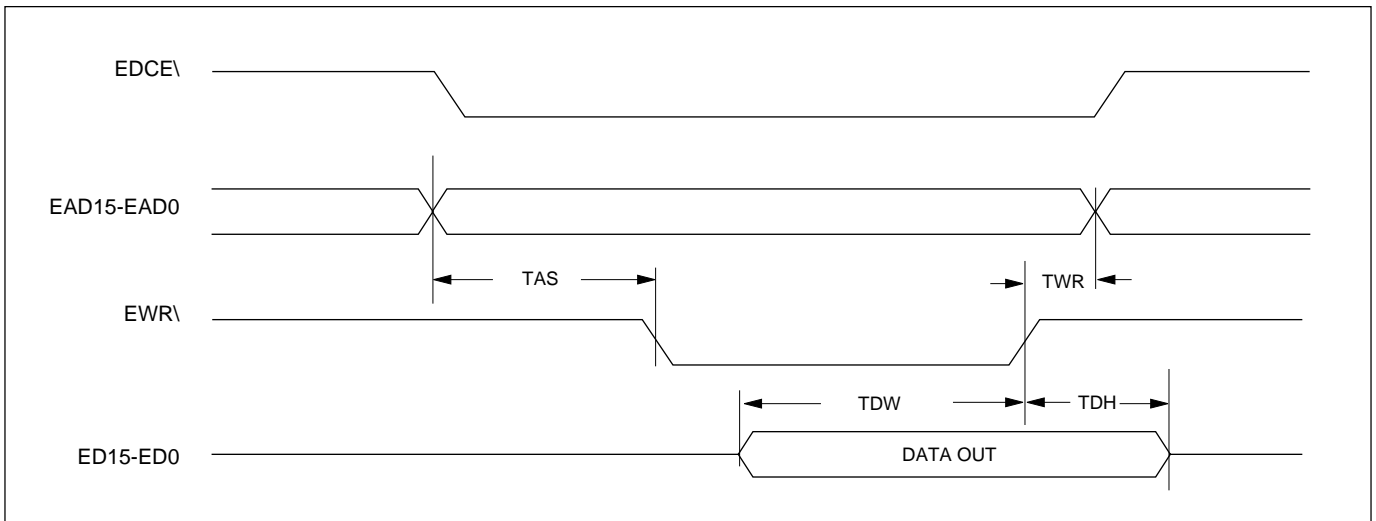
SYMBOL	PARAMETER	MIN	NOM	MAX	UNIT
TCS	Chip select access time			245	ns
TAA	Address access time			245	ns
TDR	Data read setup time	12			ns
TOH	Data hold from end of read	0			ns
TAS	Address setup time	0		5	ns
TDW	Data to EWR\ low overlap			12	ns
TDH	Data hold from end of write	0			ns
TWR	Write recovery time	0			ns

μP PARALLEL INTERFACE TIMING
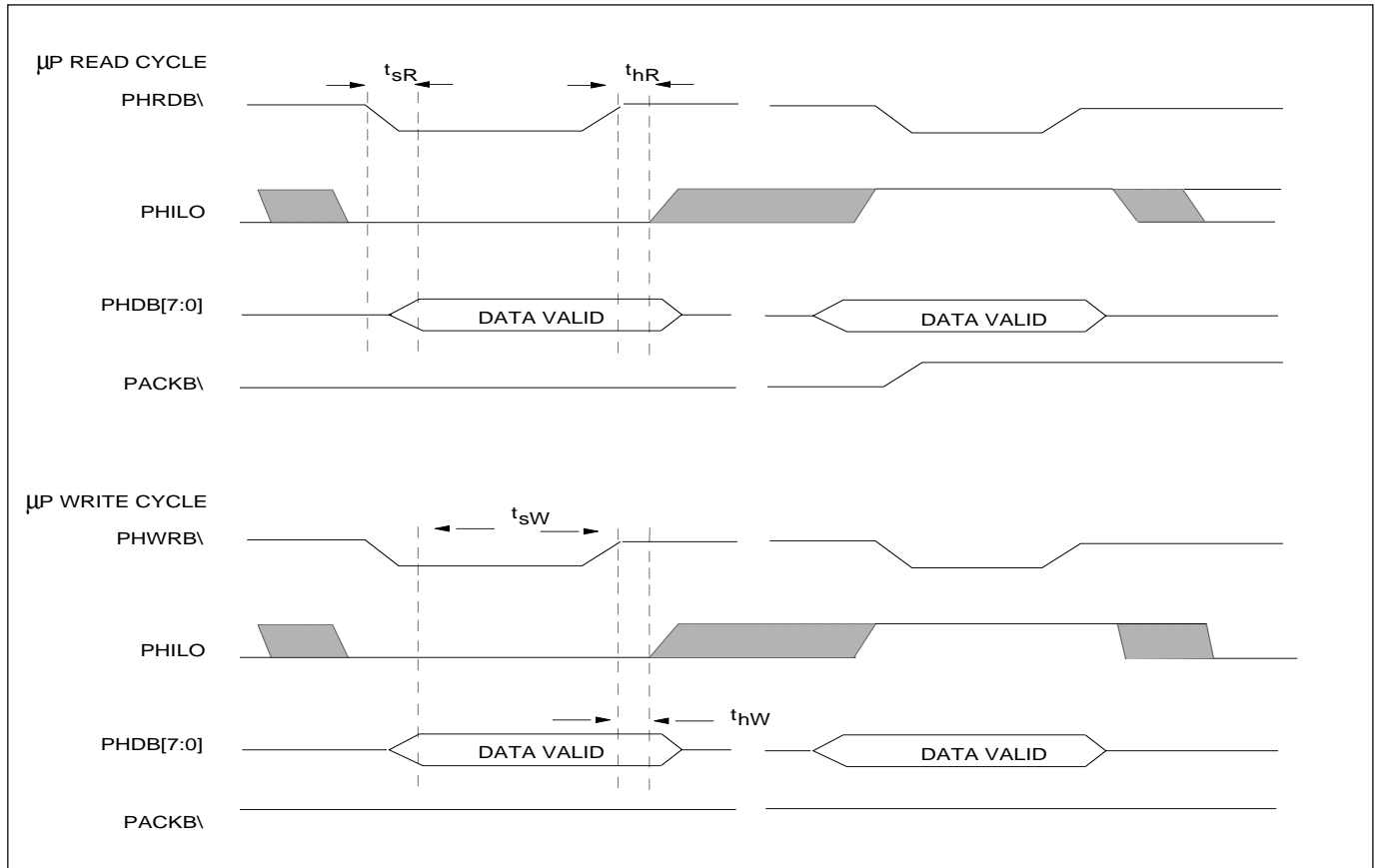
uP PARALLEL INTERFACE TIMING

SYMBO	PARAMETER	MIN	NOM	MAX	UNIT
tsR	Host read access time		50		ns
thR	Read data hold time	5			ns
tsW	Write data set up time	20			ns
thW	Write data hold time	10			ns

uP SERIAL INTERFACE TIMING

uP WRITE CYCLE
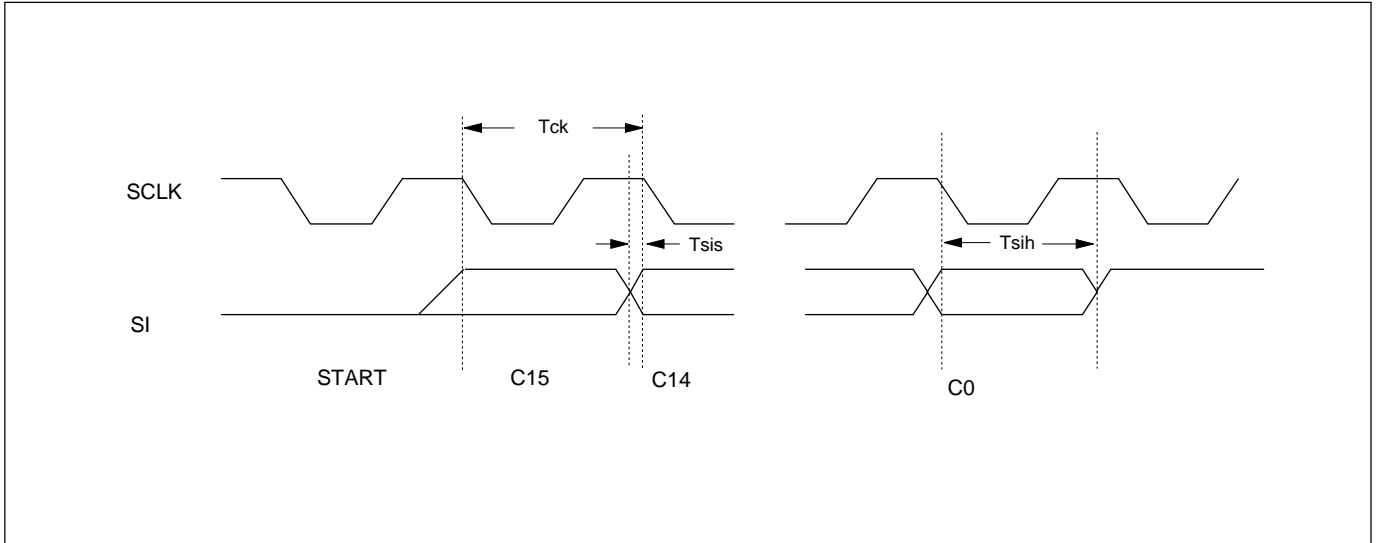
uP READ CYCLE
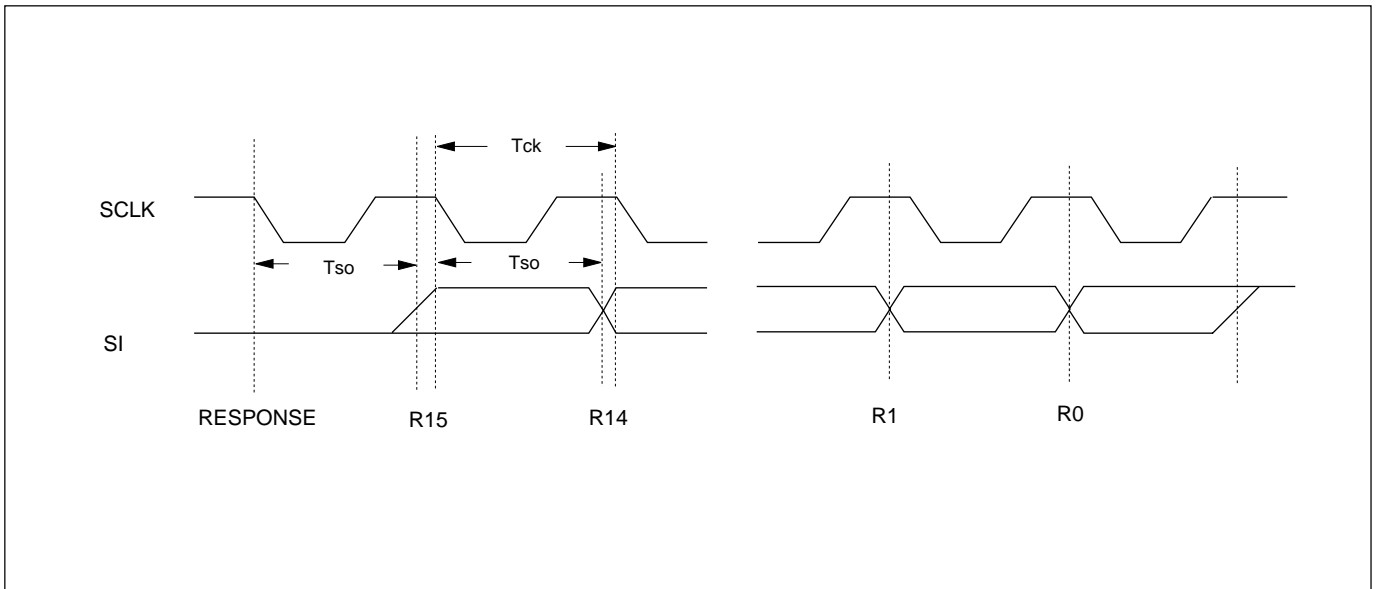
uP SERIAL INTERFACE TIMING

SYMBO	PARAMETER	MIN	NOM	MAX	UNIT
Tck	SCLK cycle time	62			us
Tsis	SI data set up time	2			us
Tsih	SI data hold time	60			us
Tso	SO data access time	60			us

ORDERING INFORMATION

PART NO.	PACKAGE
MX93022AFC	PQFP

```
        MX      93      022A      F      C
```

MXIC
COMPONY
PREFIX

FAMILY
PREFIX

COMMERCIAL 0 ~ 70°C

PACKAGE TYPE
F : PQFP

PRODUCT NUMBER
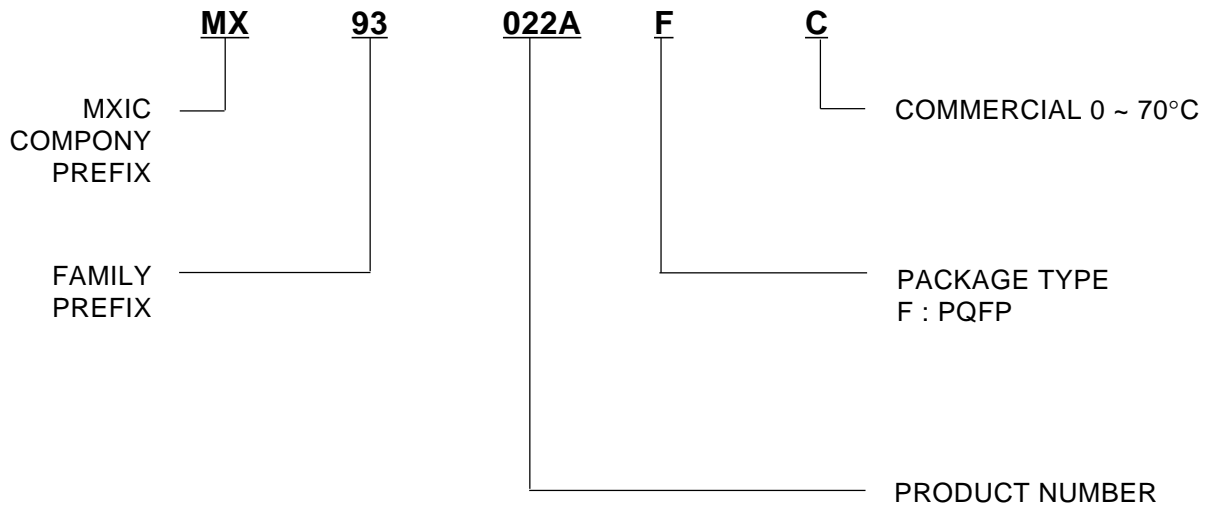
PACKAGE INFORMATION
100-PIN PQFP

ITEM	MILLIMETERS	INCHES
A	24.80 ± .40	.976 ± .016
B	20.00 ± .13	.787 ± .005
C	14.00 ± .13	.551 ± .005
D	18.80 ± .40	.740 ± .016
E	12.35 [REF]	.486 [REF]
F	.83 [REF]	.033 [REF]
G	.58 [REF]	.023 [REF]
H	.30 [Typ.]	.012 [Typ.]
I	.65 [Typ.]	.026 [Typ.]
J	2.40 [Typ.]	.094 [Typ.]
K	1.20 [Typ.]	.047 [Typ.]
L	.15 [Typ.]	.006 [Typ.]
M	.10 max.	.004 max.
N	2.75 ± .15	.108 ± .006
O	.10 min.	.004 min.
P	3.30 max.	.130 max.

NOTE: Each lead centerline is located within .25mm[.01 inch] of its true position [TP] at a maximum material condition.
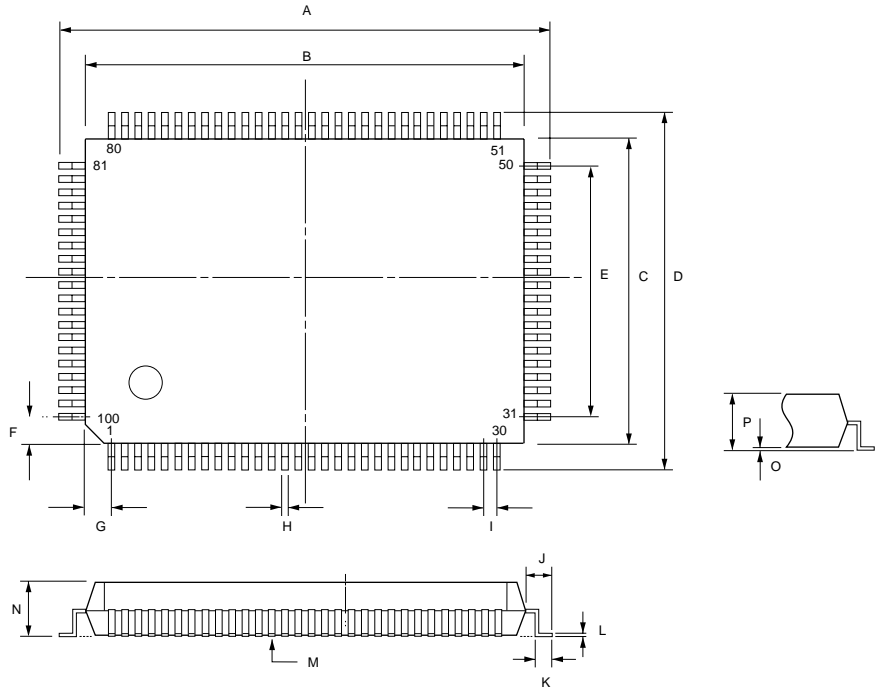
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