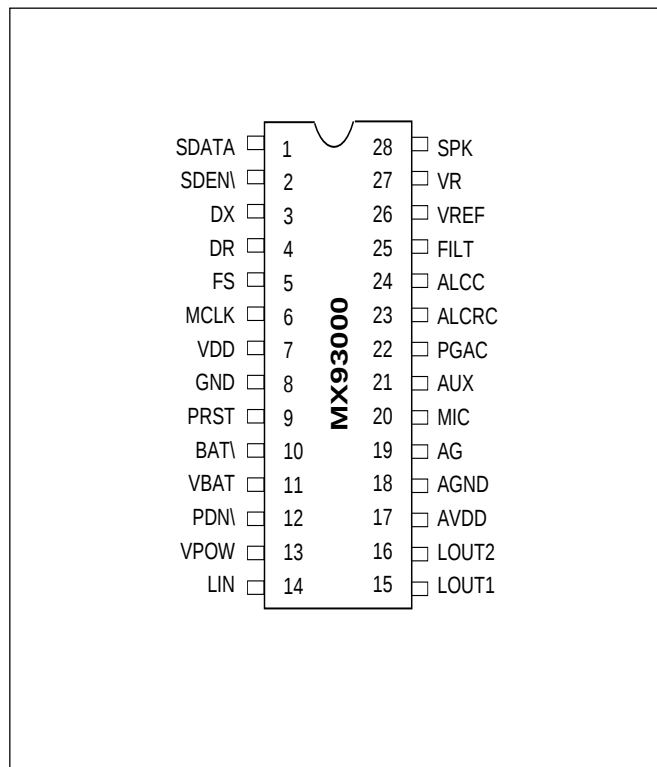


FEATURES

- Single +5V power supply
- Sigma-Delta A/D D/A with digital filters
- Support u/A Law and 16-bit linear format
- On-chip automatic level control
- On-chip differential line driver
- On-chip digital volume control
- Programmable transmit/receive gain control
- Support switch paths for DAM (Digital Answering Machine) applications
- Easy interface to general purpose DSPs
- Easy read/write of control register by microprocessors
- Programmable power-down
- Support power-low/battery-low detection
- 28-pin DIP/SOP package

PIN CONFIGURATION

28PIN SOP/DIP



PRODUCT OVERVIEW

The MX93000 Special Codec integrates key functions of the analog-front-end of Digital Answering Machine (DAM) into a single integrated circuit. The MX93000 is intended to provide a complete, low cost, and single chip solution for telephone applications requiring a single +5V power supply.

The MX93000 Special Codec is especially powerful when applied to some DAM models which are intended to meet different countries' specifications in the same system hardware. User can achieve this goal by simply setting control firmware. This benefit will help DAM system makers to save developing time and R/D resources.

The A/D D/A converters are implemented with 2nd-order sigma-Delta modulators. The on-chip digital filters, which are carried out with 16-bit and 2's complement format, are used to get the required frequency response of a PCM Codec. The Codec can support 8-bit u/A law and linear format. For the latter, it is 16-bit format with 14-bit resolution .

Before the A/D digitizing the voice-band analog signal into digital format, the analog signal can be processed by a built-in Automatic Level Control (ALC) and programmable Gain Amplifier (PGA). The ALC circuit controls the input level of A/D converter to about 1.5 Volt, so as to get a better signal to noise ratio during a low-level input. The PGA circuit is used to control the gain of different sources : microphone, aux or line input.

After the digital data is converted into analog signal by the D/A converter, a fully differential line driver is supported to drive the telephone line directly without the need of external amplifier. On the other hand, the analog signal can be monitored by passing the analog signal to the on-chip volume control circuit, which can drive an external driver like LM386.

In addition, the MX93000 supports switches and control registers so that users can program the Special Codec to be under line operations and all other specific operations of DAM. To enhance an easy read/write of control registers by microprocessors, the control data is clocked by the 8 kHz sampling clock and synchronized by SDEN\, where SDEN\ is coming from the output port of microprocessor by detecting one of the rising edge of 8 kHz clock.

FUNCTIONAL DESCRIPTION

PCM CODEC :

This block includes A/D & D/A converters and all of the digital filters.

A/D & D/A converters:

which are implemented with 2nd-order sigma-delta modulation. Output formats are A-Law/u-Law/16-bit linear, where u/A laws are of CCITT specifications and the 16-bit linear data can get 14-bit resolution and higher linearity than that of u/A law.

Digital filters :

For the purpose of A/D out-of-band noise filtering and D/A image attenuation, digital filters are implemented on the same chip.

The digital input applied to D/A converter can not be a dc signal other than idle (bits all zero), as limit cycles in the digital modulator at a level of -70 dBm will present at the analog output.

POWER MANAGEMENT :

The MX93000 supports the automatic power-down control and power supply detection. This function will work well even under 3V power supply.

Regarding the power_down procedure please refer to register 4 description for details.

POWER_LOW/BATTERY_LOW detectors : active low

2 comparators and references are used to check whether POWER_LOW/BATTERY_LOW or not. The relationship between POWER_ON_RESET and POWER_LOW/BATTERY_LOW is as the following table:

(I) POWER_LOW (PDN\)	0	0	1	1
(I) BATTERY_LOW (BAT\)	0	1	0	1
(O)POWER_ON_RESET (PRST)	0	1	1	1

LINE DRIVER :

Not only support the programmable gain from 0 to 22.5 dB with 16 steps and 1.5 dB/step, but also fully differentially drive -5 dBm power over 300 ohms. If switches SWE, SWJ, and SWK are opened, then the line driver will be muted to -70dB automatically. In addition, when SWJ or SWK are turned on, there are loss at the line driver output due to single-ended to fully-differential transform.

LINE_IN BUFFER :

Buffer stage with selection of echo cancellation path or not. For the echo cancellation path, 3-6 dB cancellation can get it.

PROGRAMABLE GAIN CONTROL (PGA) :

It supports 0 to 22.5 dB gain with 16 steps and 1.5dB/step. The gain value is controlled separately by 3 registers, where different input signal paths will have a different gain value, and when the input path is changed, the respective register value will keep no change.

AUTOMATIC LEVEL CONTROL (ALC) :

The ALC can support 36 dB gain with the attack time and release time controlled by C6 and R3 * C6, respectively.

SPK ATTENUATOR :

Speaker output signal can be attenuated either by internal register or external resistor. For the former, the attenuation is from 0 to -45 dB with 16 steps and -3.0dB/step. For the later, 10K ohms variable resistor is suggested. If switches SWF and SWH are open, then attenuator will be muted to -70dB automatically.

SERIAL_CONTROL_INTERFACE :

To read/write the internal registers.

SDEN\ (serial data enable) is used to start receiving control signal.

8kHz frame sync.is used to transmit/receive the serial data (SDATA).

CODEC_SERIAL_PORT :

4-pin signal will complete the data trasmitting/receiving.

MCLK is not only the data rate but also the chip master clock. Currently, it is fixed at 1.536 MHz and the frame synchronization clock, Fs, is 8 kHz. For simplicity, the A/D and D/A are synchronous so that MCLK and Fs are enough.

Data transfer of DX/DR are MSB first in both 8-bit and 16-bit formats.

VOLTAGE REFERENCE :

Two 2.25V voltage references are on-chip generated . VREF is for external and AG is for internal uses. Both two pins need the decoupling capacitors AGND at all times. VREF can be used to bias the microphone, the level shift circuits, or others.

SWITCHES :

There are 2 registers which are used to control all of the switches so that user can direct many different signal paths, of which 3 of them are :

a) Path of normal operation

MIC input --> SWA --> PGA/ALC --> SWC --> SWD --> PCM Codec Ain

LOUT1/LOUT2 <-- LINE DRIVER <-- SWE <-- PCM Codec Aout

b) Path of room monitor

MIC input --> SWA --> PGA/ALC --> SWC --> SWJ --> Line Driver

LINE IN --> Line Buffer --> SWI --> PCM Codec Ain

c) Path of line play

LINE IN --> SWA --> PGA/ALC --> SWC --> SWD --> PCM Codec Ain

LOUT1/LOUT2 <-- Line Driver <-- SWE <-- PCM Codec Aout

SPK <-- Attenuator <-- SWF <-- PCM Codec Aout

SPECIFICATIONS

ANALOG INPUT

PARAMETER	MIN	TYP	MAX	UNITS
Input Voltage with max S/(N+THD) MIC/AUX/LINE/FILT		3.4		Vpp
Input Resistance*	15			Kohm
Input Capacitance*			15	pF

PROGRAMMABLE GAIN AMPLIFIER

PARAMETER	MIN	TYP	MAX	UNITS
Gain Range	0		22.5	dB
Step Size	1.3	1.5	1.7	dB

AUTOMATIC LEVEL CONTROL

PARAMETER	REG.5 D1=0			REG.5 D1=1			UNITS
	MIN	TYP	MAX	MIN	TYP	MAX	
Dynamic Range*	36			30			dB
THD*							
< 75 mVpp	40						dB
< 1 Vpp	30						dB
< 100 mVpp				40			dB
<1 Vpp				25			dB

ANALOG OUTPUT

PARAMETER	MIN	TYP	MAX	UNITS
Line Driver:				
Gain Range	0.0		22.5	dB
Step Size	1.2	1.5	1.8	dB
Full Swing Output (@600 ohm load)				
-- Fully differential(LOUT1-LOUT2)		6.0		Vpp
-- Single Ended (LOUT1)		3.0		Vpp
External Load				
-- Resistance*		300		ohm
-- Capacitance*			200	pF

SPK Attenuator :

Gain Range	-45		0.0	dB
Step Size	-3.5	-3.0	-2.4	dB
Full Swing Output			3.0	Vpp

External Load

-- Resistance*	10			Kohm
-- Capacitance*			100	pF

Mute Attenuation*

-70	dB
-----	----

FILT (I/O)

Input Resistance*	10			Kohm
Output Resistance*	10			Kohm

External Load

-- Capacitance *			1000	pF
------------------	--	--	------	----

AUX (I/O)

Input Capacitance*			15	pF
Input Resistance*	20			Kohm
Output Resistance*	1			Kohm

External Load

-- Capacitance*			100	pF
-----------------	--	--	-----	----

VOLTAGE REFERENCE

PARAMETER	MIN	TYP	MAX	UNITS
VREF Output	2.0	2.25	2.5	V
VREF Output Current*		800		uA

COMPARATOR DETECTOR

PARAMETER	MIN	TYP	MAX	UNITS
Comparator Transfer point	1.10	1.25	1.40	V
Hysteresis*			0.15	V

A/D PATH CHARACTERISTICS (Note 1)

PARAMETER	MIN	TYP	MAX	UNITS
Dynamic Range (-40 dB FS)		72		dB
THD+N (-6 dB FS)		-50		dB
THD+N (u Law)		-36		dB
Interchannel Isolation* Line/AUX/MIC		70		dB
Gain Variation (Note 3)			5	%
Frequency Response				
50-60	-25			dB
300-3k	-1.0		+1.0	dB
3.2k-3.4k	-0.9		+0.25	dB
4K		-15		dB
> 4.6 K		-32		dB

D/A PATH CHARACTERISTICS (Note 2)

PARAMETER	MIN	TYP	MAX	UNITS
Dynamic Range (-40 dB FS)		72		dB
THD+N (-6 dB FS)		-50		dB
Gain Variation (Note 3)		5		%
Total Out-of-Band Energy .6 Fs to 20 KHz			-50	dB
Frequency Response				
< 300	-0.25		+0.25	dB
300-3k	-0.25		+0.25	dB
3.2k-3.4k	-0.9		+0.25	dB
4K		-15		dB
> 4.6k		-32		dB

NOISE

PARAMETER	MIN	TYP	MAX	UNITS
Idle-channel Noise (Note 4)				
-- A/D Path			-70	dB
-- D/A Path			-70	dB
VDD Power Supply Rejection (Note 5)				
-- A/D Channel		40		dB
-- D/A Channel		40		dB
AVDD Power Supply Rejection (Note 5)				
-- A/D Channel		-50		dB
-- D/A Channel		-50		dB
Crosstalk*				
-- A/D to D/A (Note 6)		-65		dB
-- D/A to A/D (Note 7)		-65		dB

DIGITAL STATIC SPECIFICATIONS

PARAMETER	MIN	TYP	MAX	UNITS
High Level Input Voltage (VIH)	2.0		VDD	Volt
Low Level Input Voltage (VIL)	0		0.8	Volt
High Level Output Voltage (VOH)	2.4		VDD	Volt
Low Level Output Voltage (VOL)			0.4	Volt
Output Capacitance*			15	pF
Input Capacitance*			15	pF

POWER SUPPLY

PARAMETER	MIN	TYP	MAX	UNITS
Power Supply - Digital & Analog	4.5		5.5	Volt
Power Supply Current -- Operating				
-- Analog (Note 8)		24		mA
-- Digital		6		mA
Power Supply Current -- Power Down			0.6	mA

Absolute Maximum Ratings

PARAMETER	Symbol	MIN	MAX	UNITS
Supply Voltage	VDD-GND	-0.3	6.0	Volt
Voltage on any I/O pin		GND-0.3	VDD+0.3	Volt
Current on any I/O pin			+8	mA
Operating Ambient Temperature		0	70	°C
Storage Temperature		-65	150	°C

NOTE:

* These items are guaranteed by characterization, not production testing.

1.VDD=AVDD=5.0V, Temp=25°C, Sampling Rate=8KHz, Linear Mode,
fin=1 KHz, Measurement Bandwidth=300--3.4K Hz
A/D Path=MIC --> PGA (0dB) --> A/D, No ALC.

2.VDD=AVDD=5.0V, Temp=25°C, Sampling Rate=8KHz, Linear Mode,
fin=1 KHz, Measurement Bandwidth=300--3.4K Hz
D/A Path=D/A --> SPK (0dB) output

3.Vin=0dB -- -50dB, fin=1KHz.

4. Input is grounded. Measurement Bandwidth=300 -- 3.4K Hz.

5. A/D & D/A input grounded,
Frequency=1KHz, 100m Vp signal on power supply.

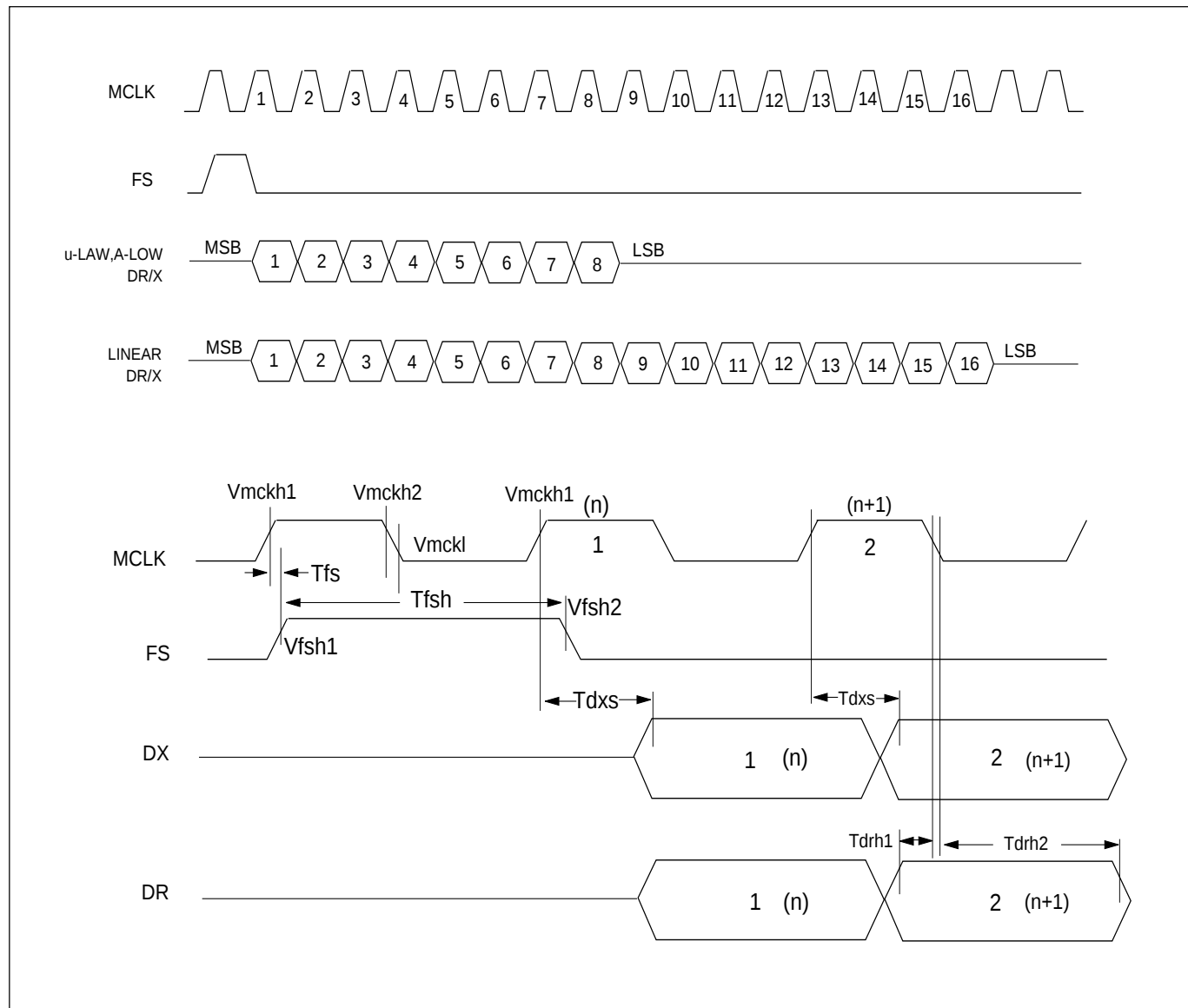
6. 0 dB at A/D input, D/A input grounded, then D/A output measured.

7. 0 dB at D/A input, A/D input grounded, then A/D output measured.

8. Power supply current does not include output loading.

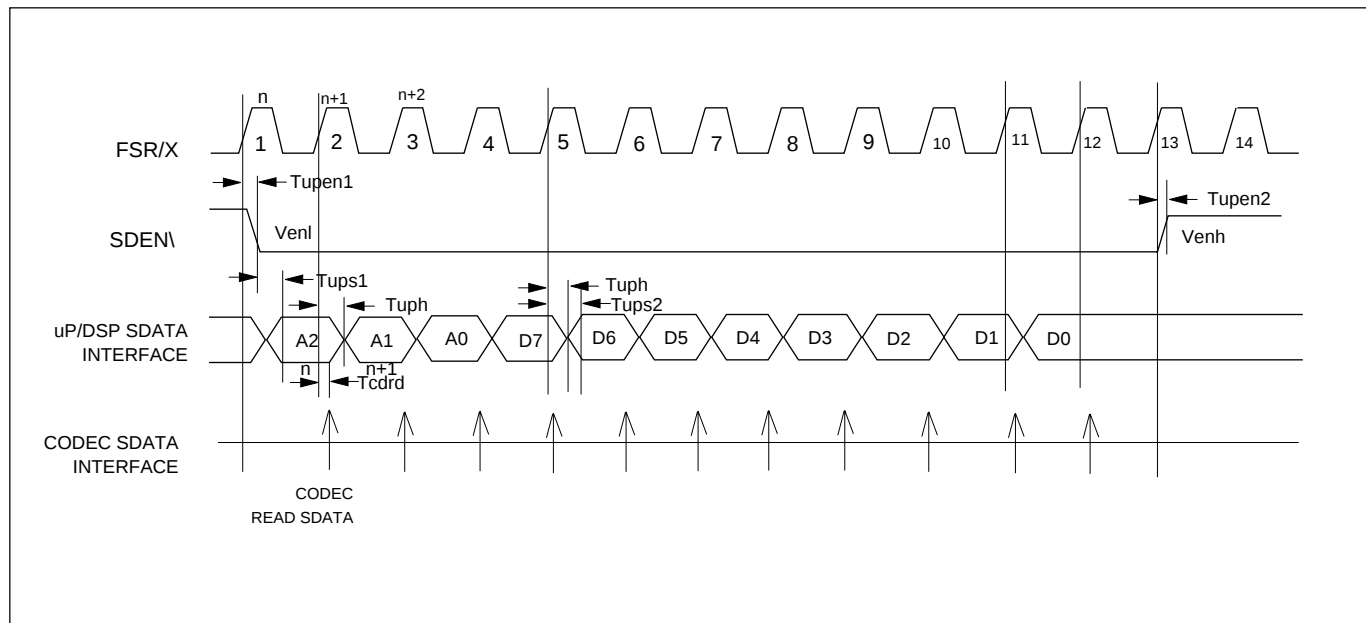
SPECIAL CODEC TIMING DESCRIPTION :

TIMING	DESCRIPTION	MIN	MAX	UNIT
Tfs	from Vmckh1 to Vfsh1	0		ns
Tfsh	Holding time for Frame Sync. from Vfsh1 to Vfsh2	MCLK		ns
Tdxs	setting time for Codec Transmit Data from Vmckh1(n) to DX(n) data ready	110		ns
Tdrh1	Holding time for Codec Receive Data from DR(n) data ready to Vmckh2(n)	0		ns
Tdrh2	Holding time for Codec Receive Data from Vmckl(n) to DR(n) ending	150		ns
Tupen1	from Vfsh1 to Venl	40	FS	ns
Tupen2	from Vfsh1 to Venh	40	FS	ns
Tups1	Setting time for uP/DSP Transmit SDATA from Vupenl to uP/DSP SDATA (n) ready (where Tupen1 + Tups1 must be less than FS)	40	FS	ns
Tups2	Setting time for uP/DSP Transmit SDATA from Vfsh1(n+1) to uP/DSP SDATA (n+1) ready	40	FS	ns
Tuph	Holding time for uP/DSP Transmit SDATA from Vfsh1(n+1) to uP/DSP SDATA(n) ending	40	Tups2	ns
Tcdrd	from Vfsh(n+1) to Codec read SDATA(n)		20	ns
Tupo2i	from Vupenl to uP/DSP changing its SDATA interface into input port	40	FS	ns
Tcdi2o	from Vfsh1 to Codec changing its SDATA interface into output port		20	ns
Tcds1	Setting time for Codec Transmit SDATA from Vcdi2o to Codec SDATA(n) ready		20	ns
Tcds2	Setting time for Codec Transmit SDATA from Vfsh1(n+2) to Codec SDATA(n+1) ready		20	ns
Tcdh	Holding time for Codec Transmit SDATA from SDATA(n) ready to Vfsh1(n+2)		FS	ns
Tcdo2i	from Venh to Codec changing its SDATA interface into input port		20	ns
Tuprd	from Vfsh1(n+1) to uP/DSP reading SDATA(n)	40	FS	ns
Tupi2o	from Vfsh1 to uP/DSP changing its SDATA interface into output port	40	FS	ns

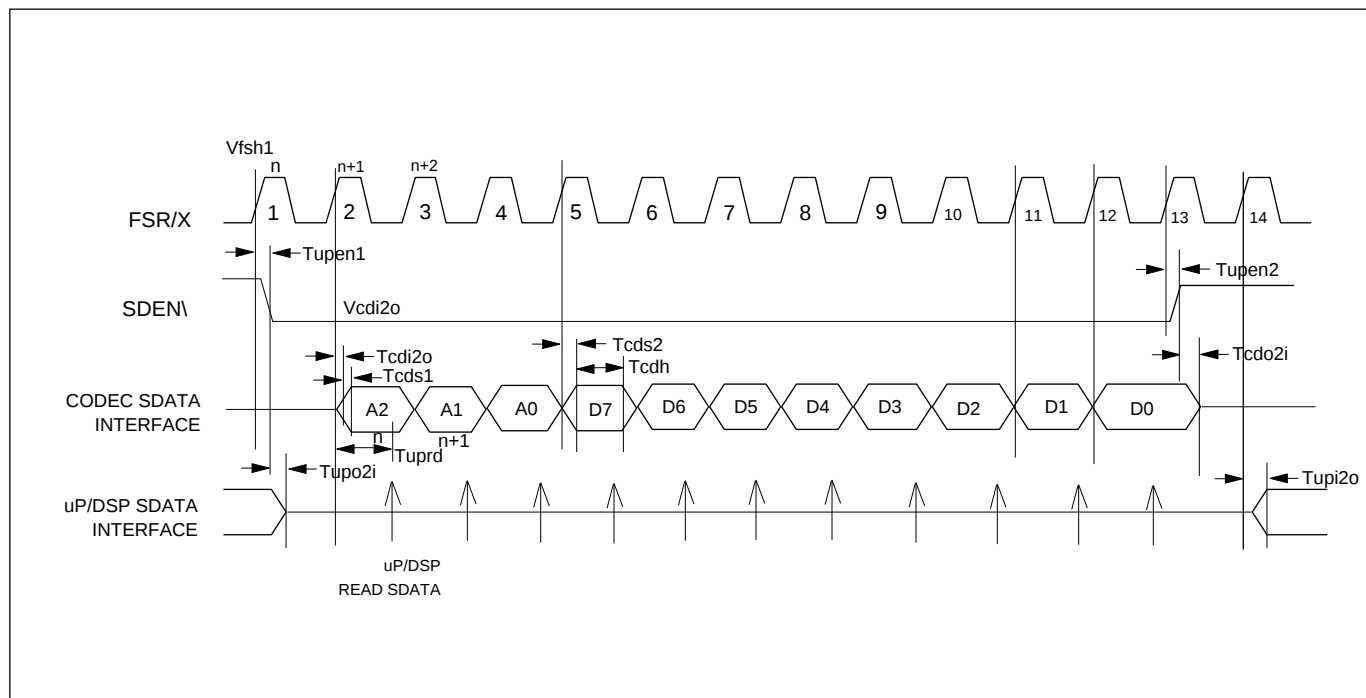
SPECIAL CODEC TIMING DIAGRAM :
PCM CODEC MASTER CLOCK , FRAME SYNC. & DATA TIMING


PCM CODEC CONTROL REGISTER R/W TIMING

CODEC READ SDATA



CODEC WRITE SDATA



REGISTER 0:

DATA BIT	D7	D6	D5	D4	D3	D2	D1	D0
POWER-ON	0	0	0	0	0	0	0	0
DESCRIPTION	SWA-CTL		SWB-CTL	SWC-CTL	SWD-CTL	SWE-CTL	SWF-CTL	SWG-CTL

(SWG-CTL)	D(0)	= (1)	: path of SWG (ATTENUATOR) is "A==>b"
			ATTENUATOR setting following ALARM-OUT SETTING
		= (0)	: path of SWG (ATTENUATOR) is "A==>a"
			ATTENUATOR adjusted by external VR1

REGISTER 1 :

ADDRESS BIT	A2	A1	A0
DATA	0	0	1

DATA BIT	D7	D6	D5	D4	D3	D2	D1	D0
POWER-ON	0	0	0	0	0	0	0	0
DESCRIPTION	LINE-IN GAIN SETTING				LINE-OUT GAIN SETTING			

(LINE-IN GAIN SETTING) D(7-4) = (F) - (0) : 22.5dB - 0dB, 1.5dB/STEP

(LINE-OUT GAIN SETTING) D(3-0) = (F) - (0) : 22.5dB - 0dB, 1.5dB/STEP

REGISTER 2 :

ADDRESS BIT	A2	A1	A0
DATA	0	1	0

DATA BIT	D7	D6	D5	D4	D3	D2	D1	D0
POWER-ON	0	0	0	0	0	0	0	0
DESCRIPTION	AUX-IN GAIN SETTING				MIC-IN GAIN SETTING			

(AUX-IN GAIN SETTING) D(7-4) = (F) - (0) : 22.5dB - 0dB, 1.5dB/STEP

(MIC-IN GAIN SETTING) D(3-0) = (F) - (0) : 22.5dB - 0dB, 1.5dB/STEP

REGISTER 3 :

ADDRESS BIT	A2	A1	A0
DATA	0	1	1

DATA BIT	D7	D6	D5	D4	D3	D2	D1	D0
POWER-ON	0	0	0	0	1	1	1	1
DESCRIPTION	SWH-CTL	SWI-CTL	SWJ-CTL	SWK-CTL	ALARM-OUT ATTENUATOR SETTING			

(SWH-CTL) D(7) = (1) : path of SWH is "CLOSE"
= (0) : path of SWH is "OPEN" (see Note 1.)

(SWI-CTL) D(6) = (1) : path of SWI is "CLOSE"
= (0) : path of SWI is "OPEN"

(SWJ-CTL) D(5) = (1) : path of SWJ is "CLOSE"
= (0) : path of SWJ is "OPEN"

(SWK-CTL) D(4) = (1) : path of SWK is "CLOSE"
= (0) : path of SWK is "OPEN" (see Note 1.)

(ALARM-OUT ATTENUATOR SETTING) D(3-0) = (F) - (0) : -45dB - 0dB 3dB/STEP

where ALARM-OUT ATTENUATOR ==> ATTENUATOR CHANNEL-b

SPK-OUT ATTENUATOR ==> ATTENUATOR CHANNEL-a (adjusted by VR1 10K Ω)

REGISTER 4 :

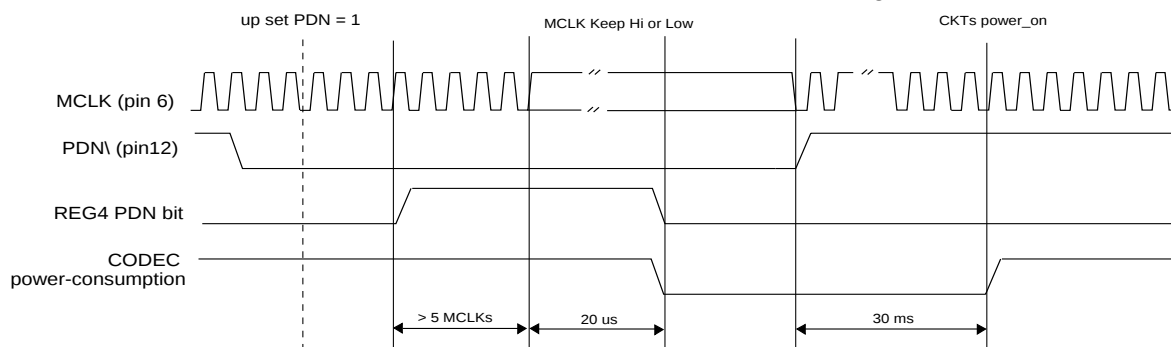
ADDRESS BIT	A2	A1	A0
DATA	1	0	0

DATA BIT	D7	D6	D5	D4	D3	D2	D1	D0
POWER_ON	0	0	0	0	0	0	0	0
DESCRIPTION		PDN	ECHO		MASTER CLOCK		CODEC FORMAT	

(PDN)

D(6)=1 : POWER DOWN MODE.

- When D(6) is set to 1, the MX93000 will enter power down mode after 5 MCLKS. The 5_MCLK period is for the initialization of digital circuits in the MX93000.
- When the MX93000 enters power down mode, it will clear all registers after 20us.
- When system power recovers and MCLK is enabled, the MX93000 will wake up after 30ms and then user can restore all registers.



(ECHO)

D(5) = (1):ECHO CANCELLER ON (3-6dB)
(0):ECHO CANCELLER OFF

(MASTER CLOCK)

D(3,2) = (0,0): 1.536 MHz

(CODEC FORMAT)

D(1,0) = (1,1): LINEAR CODER & DECODER (16 BITS FORMAT)
= (1,0): LINEAR CODER & DECODER (16 BITS FORMAT)
= (0,1): A-LAW CODER & DECODER (8 BITS FORMAT)
= (0,0): u-LAW CODER & DECODER (8 BITS FORMAT)

LINEAER 16 BITS FORMAT : 14 BITS RESOLUTION with 2LSB=0

SIGN\SCALE	MIN	MAX
POSITIVE	0000 0000 0000 0000	0111 1111 1111 1100
NEGATIVE	1111 1111 1111 1100	1000 0000 0000 0000

REGISTER 5 :

ADDRESS BIT	A2	A1	A0
DATA	1	0	1

DATA BIT	D7	D6	D5	D4	D3	D2	D1	D0
POWER-ON	0	0	0	0	0	0	0	0
DESCRIPTION								ALC

(ALC) D(1) = 1 : ALC loop gain attenuate 6dB

D(1) = 0 : ALC loop gain attenuate 0dB

@@ reserve for internal use

REGISTER 6 :

ADDRESS BIT	A2	A1	A0
DATA	1	1	0

DATA BIT	D7	D6	D5	D4	D3	D2	D1	D0
POWER-ON	0	0	0	0	0	0	0	0
DESCRIPTION								

@@ reserve for future use

REGISTER 7 :

ADDRESS BIT	A2	A1	A0
DATA	1	1	1

DATA BIT	D7	D6	D5	D4	D3	D2	D1	D0
POWER-ON	0	0	0	0	0	0	0	0
DESCRIPTION					READ	REGISTER ADDRESS		

(READ) D(3) = 1 : read data from register 0-6
= 0 : write data to register 0-7

(REGISTER ADDRESS) D(2-0) :

1. When READ = 1, READ will be cleared automatically.

2. When READ = 1, next uP/DSP SDEN\ signal active low, CODEC will change CODEC SDATA interface into output and following the last time REGISTER ADDRESS to output the content of register.

Note 1. :When using SWK or SWH, the path between AUX and SWA will disconnect. Oppositely, if using the path between AUX and SWA, then SWK and SWH will be invalid.

THE FOLLOWING LIST IS BASIC COMPONENT REQUIRED :

REFERENCE	PART	DESCRIPTION
R1	620 Ω	matching resistor; to reflect 600 Ω at the transformer primary
R2	2 K Ω	current-limit resistor; to limit MIC bias current ; please follow MIC specification
R3	75 K Ω	time constant ; ALC release time constant = $R3 * C6$
R4,R5		to scale down SYSTEM power supply (VPOW) and compare with 1.25V to do power-down check
R6,R7		to scale down BATTERY (VBAT) and compare with 1.25V to do power-down check
R8	10K Ω	the time constant for power-on-reset circuits ; where $RC=R8 * C11$
R9	10 K Ω	current-limit resistor for Q1
R10	330 K Ω	discharge path for ALC circuit when Q1 turns off
R11	200 K Ω	to attenuate line-in signal
C1,C4	0.1 μ F	DC blocking capacitor
C2,C3	10 μ F	to decouple analog virtual ground ; where $AG = VREF = 2.25v$
C5	10 μ F	DC blocking capacitor
C6	47 μ F	time constant ; ALC Attack time constant > $2k\Omega \pm 10\% * C6$
C7	1 μ F	DC offset cancellation decouple capacitor
C8	1000 pF	anti-aliasing capacitor
C9	0.1 μ F	decoupling capacitor for power supply of Codec digital circuit
C10	0.1 μ F	decoupling capacitor for power supply of Codec analog circuit
C11	10 μ F	the time constant for power-on-reset circuits ; where $RC = R8 * C11$
VR1 then	10K Ω	to attenuate the input signal from SWH or SWF ; if using digital volume control, connecting pin-27 VR to VREF
Q1	2N3904	ALC feedback component ; all NPN ($\beta > 100$) transistor can play this role
D1	1N4148	to protect reset circuits from spike

PIN DESCRIPTIONS :

SYMBOL	PIN TYPE	PIN NUMBER	DESCRIPTION
SDATA	I/O(D)	1	Bidirectional serial port ; It's an interface for microprocessor serial data transfer
SDEN\	I (D)	2	Serial data enable ; active low ; for starting to receive/transmit serial data (A2-D0)
DX	O (D)	3	Transmit data pin (Codec serial data)
DR	I (D)	4	Receive data pin (Codec serial data)
FS	I (D)	5	Codec frame sync ; 8KHz frame synchronization clock for the transmit/receive channel
MCLK	I (D)	6	Master clock input (MCLK=1.536 MHz) When this pin is continuously high or low and set register4/bit-6 "PDN=1", then the MX93000 will enter power-down mode
VDD	(D)	7	Digital power ; 5V power supply for all internal digital logic
GND	(D)	8	Digital ground ; ground reference (0V) for all internal digital logic
PRST	O (D)	9	Power on reset (active high) ; Determined by PDN\ and BATT\ input signal
BAT\	O (A)	10	Battery detector output (active low); referenced to 1.25V
VBAT	I (A)	11	Battery detector input ; the voltage is divided from battery power for reference to 1.25V
PDN\	O (A)	12	Power down detector output (active low) ; referenced to 1.25V
VPOW	I (A)	13	Power down detector input ; System DC power is divided and then connected so as to compare with reference voltage (1.25v)
LIN	I (A)	14	Telephone signal line input , can be switched to PGA.
LOUT1	O (A)	15	Telephone line output (positive) with PGA ; where PGA gain is from 0 to 22.5dB
LOUT2	O (A)	16	Telephone line output (negative) with PGA ; where PGA gain is from 0 to 22.5dB

Note : "D" means digital
"A" means analog

SYMBOL	PIN TYPE	PIN NUMBER	DESCRIPTION
AVDD	(A)	17	Analog power supply ; 5V power for all internal analog circuitry
AGND	(A)	18	Analog ground ; ground reference(0V) for all internal analog circuitry
AG	O (A)	19	Internal analog ground ; nominal 2.25V and must not be used to sink or source current
MIC	I (A)	20	Microphone signal input, can be switched to PGA, where PGA gain is from 0 to 22.5dB
AUX	I/O (A)	21	1.Auxiliary signal input, can be switched to PGA, where PGA gain is from 0 to 22.5dB 2.As an output port for Aout or an input port for attenuator or line driver
PGAC	O (A)	22	Programmable Gain Amplifier output port
ALCRC	O (A)	23	Auto level control time constant ; where $RC=2K\pm 10\%*C6$
ALCC	O (A)	24	Offset cancellation capacitor (positive) ; normally add a 1 uF capacitor
FILT	I/O (A)	25	1.Anti-aliasing filter; normally add a 1000pF capacitor 2.As an input port for Codec or an output port for SWD or SWI
VREF	O (A)	26	Voltage reference ; normal 2.25V and can sink 500uA
VR	O (A)	27	Speaker volume control ; use a variable resistor 10k Ω
SPK	O (A)	28	Speaker output ; it can be attenuated by VR or control register from 0 to -45dB

APPENDIX :**MX93000 Buglist****1.A/D Full Swing :**

Full Swing of A/D is 3.4 Volt in stead of the original target 3.0 Volt.

2.Maximum External Attenuation of SPK through VR pin is only 27 dB.**3.Line Drive Gain:**

Line driver will behave as a gain loss rather than a gain loss rather than a gain stage whenever line driver inputs are come from SWK and/or SWJ.

Line Driver gain if input from

SWE	SWK/SWJ
0.0 dB	-9.0 dB
1.5 dB	-8.7 dB
3.0 dB	-7.6 dB
4.5 dB	-6.8 dB
6.0 dB	-6.0 dB
7.5 dB	-5.3 dB
9.0 dB	-4.6 dB
10.5 dB	-4.0 dB
12.0 dB	-3.5 dB
13.5 dB	-3.0 dB
15.0 dB	-2.6 dB
16.5 dB	-2.2 dB
18.0 dB	-1.9 dB
19.5 dB	-1.6 dB
21.0 dB	-1.4 dB
22.5 dB	-1.2 dB

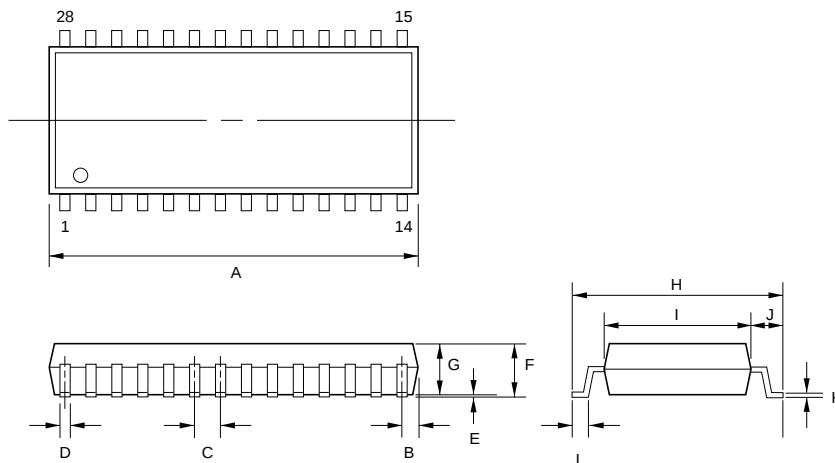
4.The larger of VREF's bypass capacitor, the better of D/A idle channel noise.

100 uF rather than 10uF can get a good performance.

28-PIN PLASTIC SOP (300 mil)

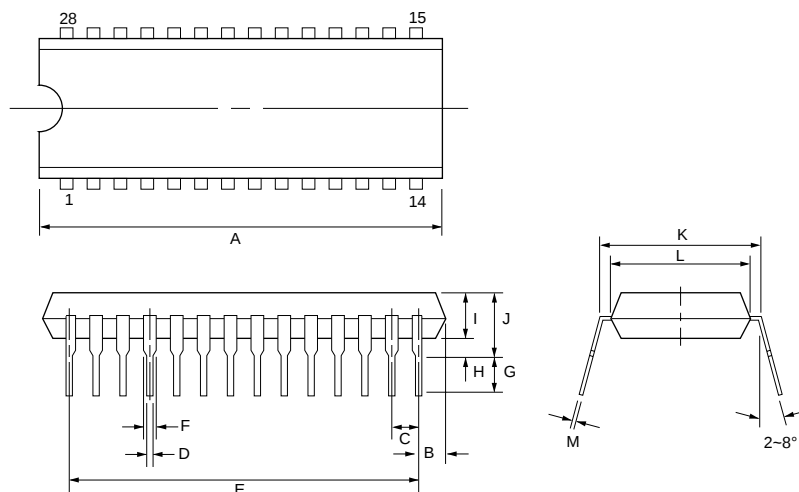
ITEM	MILLIMETERS	INCHES
A	17.83 max.	.702 max.
B	1.194 max.	.026 max.
C	1.27 [TP]	.047 [TP]
D	.41 [Typ.]	.016 [Typ.]
E	.20 min.	.008 min.
F	2.54 max.	.100 max.
G	2.34 ± .13	.092 ± .005
H	10.31 ± .31	.406 ± .012
I	7.60 ± .13	.299 ± .005
J	1.37 ± .20	.054 ± .008
K	.25 [Typ.]	.010 [Typ.]
L	.91 ± .20	.036 ± .008

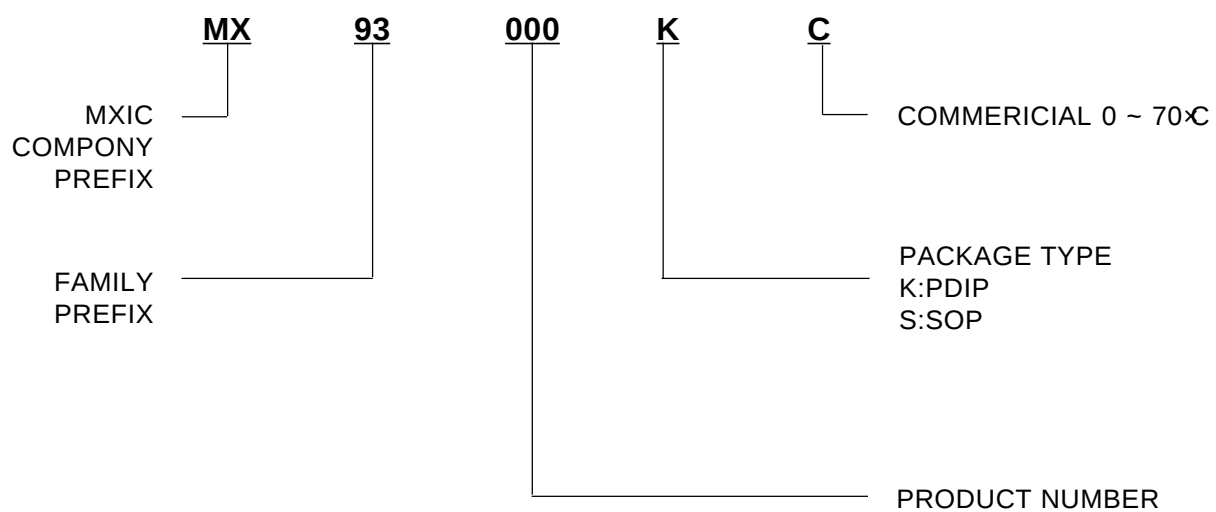
NOTE: Each lead centerline is located within .25 mm [.01 inch] of its true position [TP] at a maximum material condition.


28-PIN PLASTIC DIP (300 mil)

ITEM	MILLIMETERS	INCHES
A	34.29 max	1.350 max
B	.64 [REF]	.025 [REF]
C	2.54 [TP]	.100 [TP]
D	.46 [Typ.]	.018 [Typ.]
E	32.99	1.300
F	1.52 [Typ.]	.060 [Typ.]
G	3.30 ± .25	.130 ± .010
H	.51 [REF]	.020 [REF]
I	3.30 ± 2.5	.130 ± .098
J	3.81 max.	.150 max.
K	7.87 ± 2.5	.310 ± .098
L	7.32 ± 2.5	.288 ± .098
M	.25 [Typ.]	.010 [Typ.]

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



ORDERING INFORMATION

MACRONIX INTERNATIONAL CO., LTD

HEADQUARTERS :

TEL : +886-3-578-8888
FAX : +886-3-578-8887

EUROPE OFFICE :

TEL : +32-2-456-8020
FAX : +32-2-456-8021

JAPAN OFFICE :

TEL : +81-44-246-9100
FAX : +81-44-246-9105

SINGAPORE OFFICE :

TEL : +65-747-2309
FAX : +65-748-4090

TAIPEI OFFICE :

TEL : +886-2-2509-3300
FAX : +886-2-2509-2200

MACRONIX AMERICA INC.

TEL : +1-408-453-8088
FAX : +1-408-453-8488

CHICAGO OFFICE :

TEL : +1-847-963-1900
FAX : +1-847-963-1909

[http : //www.macronix.com](http://www.macronix.com)