

Inside Macintosh™ Volumes I, II, and III



Addison-Wesley Publishing Company, Inc.
Reading, Massachusetts Menlo Park, California New York
Don Mills, Ontario Wokingham, England Amsterdam Bonn
Sidney Singapore Tokyo Madrid San Juan Paris
Seoul Milan Mexico City Taipei

de M

al
n from
puter, Inc.

ne to the wo
Macintosh®
ter has been
rogramming
g—body of
osh provid
ation you'll
ams, but the
elp speed a
opment eff

opment La
won't have t
age that su
ing family
developm
scal, C, Ass
C, LISP, M
nformation
ry of the M

Certified
our prima
ducts for
ggest you i
veloper P
duce and
viding su
ormation
llowing:
Technical
pport Gr
CI electr
Macinto:
ackage o
AppleLi
an get an
urrent in
roducts
Certifi
mailings
develop
directio

Copyright © 1985 by Apple Computer, Inc.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission of Apple Computer, Inc. Printed in the United States of America.

Apple, the Apple logo, LaserWriter, and Lisa are registered trademarks of Apple Computer, Inc. Macintosh, the Macintosh logo, MacWrite, MacPaint, MacDraw, and MacWorks are trademarks of Apple Computer, Inc.

Simultaneously published in the United States and Canada.

Written by Caroline Rose with Bradley Hacker, Robert Anders, Katie Withey, Mark Metzler, Steve Chernicoff, Chris Espinosa, Andy Averill, Brent Davis, and Brian Howard, assisted by Sandy Tompkins-Leffler and Louella Pizzuti. Special thanks to Cary Clark and Scott Knaster.

This book was produced using the Apple Macintosh computer and the LaserWriter printer.

ISBN 0-201-17737-4

12 13 14 15 16 17 18-MU-9594939291
Twelfth printing, October 1991

ABOUT THIS CHAPTER

The Sound Driver is a Macintosh device driver for handling sound and music generation in a Macintosh application. This chapter describes the Sound Driver in detail.

You should already be familiar with:

- events, as discussed in chapter 8 of Volume I
- the Memory Manager
- the use of devices and device drivers, as described in chapter 6

ABOUT THE SOUND DRIVER

The Sound Driver is a standard Macintosh device driver in ROM that's used to synthesize sound. You can generate sound characterized by any kind of waveform by using the three different sound synthesizers in the Sound Driver:

- The **four-tone synthesizer** is used to make simple harmonic tones, with up to four "voices" producing sound simultaneously; it requires about 50% of the microprocessor's attention during any given time interval.
- The **square-wave synthesizer** is used to produce less harmonic sounds such as beeps, and requires about 2% of the processor's time.
- The **free-form synthesizer** is used to make complex music and speech; it requires about 20% of the processor's time.

The Macintosh XL is equipped only with a square-wave synthesizer; all information in this chapter about four-tone and free-form sound applies only to the Macintosh 128K and 512K.

Figure 1 depicts the **waveform** of a typical sound wave, and the terms used to describe it. The **magnitude** is the vertical distance between any given point on the wave and the horizontal line about which the wave oscillates; you can think of the magnitude as the volume level. The **amplitude** is the maximum magnitude of a periodic wave. The **wavelength** is the horizontal extent of one complete cycle of the wave. Magnitude and wavelength can be measured in any unit of distance. The **period** is the time elapsed during one complete cycle of a wave. The **frequency** is the reciprocal of the period, or the number of cycles per second—also called hertz (Hz). The **phase** is some fraction of a wave cycle (measured from a fixed point on the wave).

There are many different types of waveforms, three of which are depicted in Figure 2. Sine waves are generated by objects that oscillate periodically at a single frequency (such as a tuning fork). Square waves are generated by objects that toggle instantly between two states at a single frequency (such as an electronic "beep"). Free-form waves are the most common of all, and are generated by objects that vibrate at rapidly changing frequencies with rapidly changing magnitudes (such as your vocal cords).

Sign
here

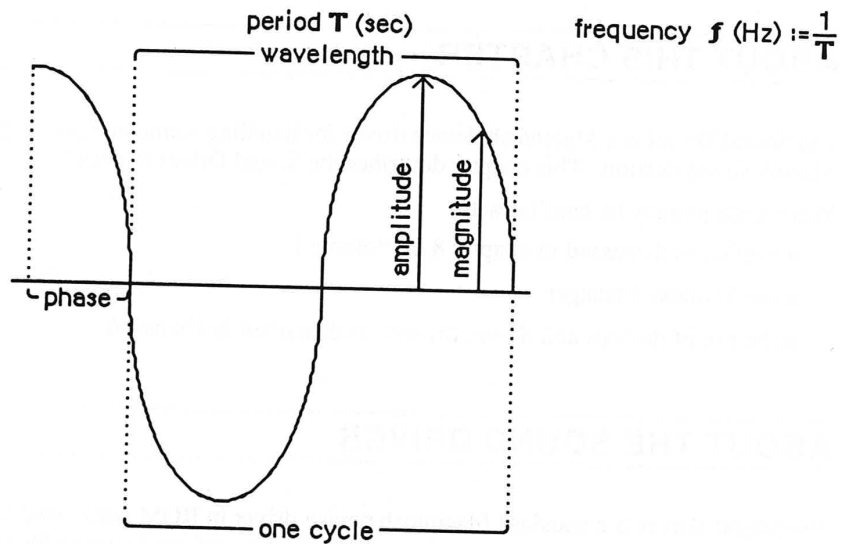


Figure 1. Waveform

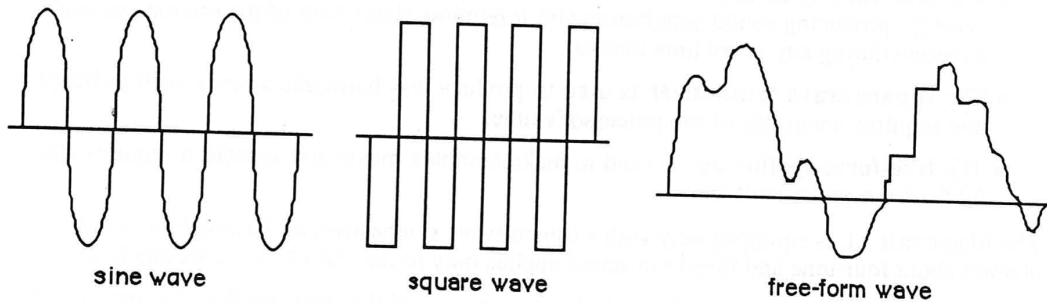


Figure 2. Types of Waveforms

Figure 3 shows analog and digital representations of a waveform. The Sound Driver represents waveforms digitally, so all waveforms must be converted from their analog representation to a digital representation. The rows of numbers at the bottom of the figure are digital representations of the waveform. The numbers in the upper row are the magnitudes relative to the horizontal zero-magnitude line. The numbers in the lower row all represent the same relative magnitudes, but have been normalized to positive numbers; you'll use numbers like these when calling the Sound Driver.

A digital representation of a waveform is simply a sequence of wave magnitudes measured at fixed intervals. This sequence of magnitudes is stored in the Sound Driver as a sequence of bytes, each one of which specifies an instantaneous voltage to be sent to the speaker. The bytes are stored in a data structure called a **waveform description**. Since a sequence of bytes can only represent a group of numbers whose maximum and minimum values differ by less than 256, the magnitudes of your waveforms must be constrained to these same limits.

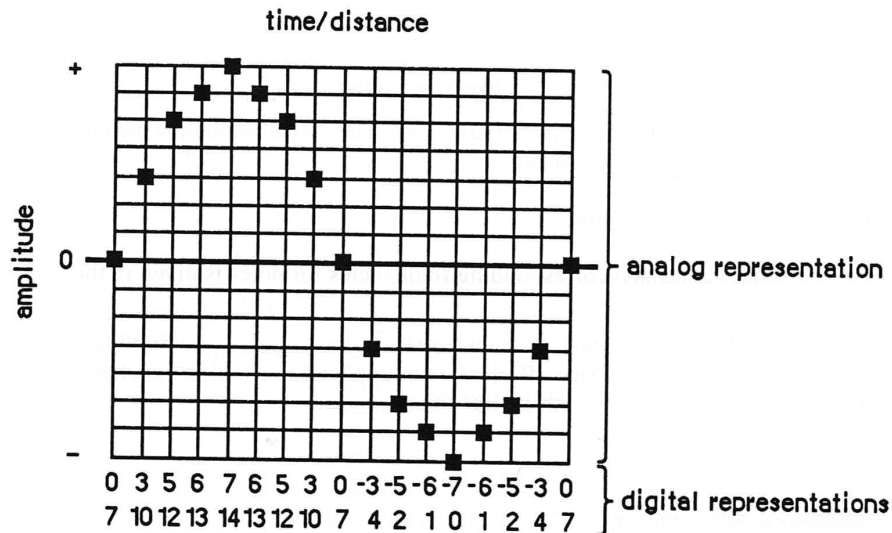
The Sound Driver

Figure 3. Analog and Digital Representations of a Waveform

SOUND DRIVER SYNTHESIZERS

A description of the sound to be generated by a synthesizer is contained in a data structure called a **synthesizer buffer**. A synthesizer buffer contains the duration, pitch, phase, and waveform of the sound the synthesizer will generate. The exact structure of a synthesizer buffer differs for each type of synthesizer being used. The first word in every synthesizer buffer is an integer that identifies the synthesizer, and must be one of the following predefined constants:

```
CONST swMode = -1; {square-wave synthesizer}
      ftMode = 1; {four-tone synthesizer}
      ffMode = 0; {free-form synthesizer}
```

Square-Wave Synthesizer

The square-wave synthesizer is used to make sounds such as beeps. A square-wave synthesizer buffer has the following structure:

```
TYPE SWSynthRec = RECORD
    mode: INTEGER; {always swMode}
    triplets: Tones {sounds}
END;

SWSynthPtr = ^SWSynthRec;

Tones = ARRAY[0..5000] OF Tone;
Tone = RECORD
    count: INTEGER; {frequency}
    amplitude: INTEGER; {amplitude, 0-255}
    duration: INTEGER {duration in ticks}
END;
```

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.