

## Wavetable Sample ROM for Music Synthesis

### Features

- PCM sample data for General MIDI melodic instrument and percussion sets
- Also includes samples for GS compatible drum kits and special effects sounds
- Compressed data may be used to generate up to 343 sounds (190 instrument sounds, 107 percussion sounds and 46 special effects)
- Low-power operation:  
Operating current: 15 mA (max.)  
Standby current: 100  $\mu$ A (max.)
- Static CMOS operation,  
TTL-compatible I/O

### General Description

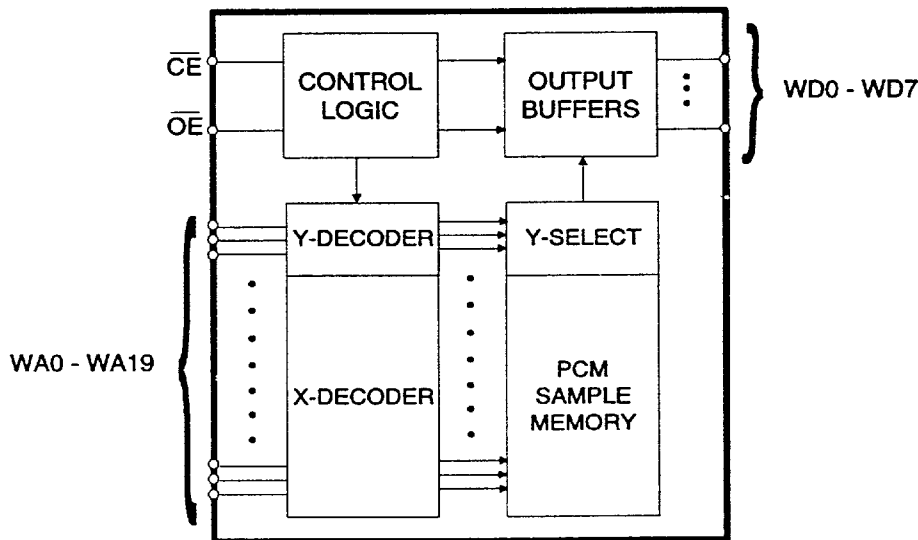
The CS4112 Read Only Memory (ROM), organized 1M x 8bits, contains PCM waveform data used by the CS9233 family of wavetable music synthesizers and associated firmware to provide complete General MIDI (GM) and Roland GS format compliant instrument and sound effect sets.

Proprietary compression and data reduction techniques were used to minimize stored data. When combined with Crystal's Microcode Firmware, high fidelity music and special effects result.

The CS4112 offers a power-down mode controlled by the Chip Enable  $\overline{CE}$  input.

### ORDERING INFORMATION

CS4112-CS 32-pin SOIC (14x21x3mm)



**GENERAL  
MIDI**



### Preliminary Product Information

This document contains information for a new product. Crystal Semiconductor reserves the right to modify this product without notice.

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DC Electrical Characteristics ( $T_A = 0^\circ\text{C}$  to  $+70^\circ\text{C}$ ,  $V_{CC} = 5.0\text{V} \pm 10\%$ ,  $\text{GND} = 0\text{V}$ )

| Parameter                 | Symbol     | Min  | Typ | Max          | Units         |
|---------------------------|------------|------|-----|--------------|---------------|
| Input LOW Voltage         | $V_{IL}$   | -0.5 | -   | 0.8          | V             |
| Input HIGH Voltage        | $V_{IH}$   | 2.2  | -   | $V_{CC}+0.3$ | V             |
| Output LOW Voltage        | $V_{OL}$   | -    | -   | 0.4          | V             |
| Output HIGH Voltage       | $V_{OH}$   | 2.4  | -   | $V_{CC}$     | V             |
| Input Leakage Current     | $ I_{LI} $ | -    | -   | 10           | $\mu\text{A}$ |
| Output Leakage Current    | $ I_{LO} $ | -    | -   | 10           | $\mu\text{A}$ |
| Operating Supply Current  | $I_{CC}$   | -    | 15  | 40           | mA            |
| Standby Supply Current    | $I_{SB}$   | -    | -   | 1.0          | mA            |
| Power-Down Supply Current | $I_{SB1}$  | -    | -   | 100          | $\mu\text{A}$ |

RECOMMENDED OPERATING CONDITIONS ( $T_A = 0^\circ\text{C}$  to  $+70^\circ\text{C}$ )

| Parameter                     | Symbol       | Min  | Typ  | Max  | Units            |
|-------------------------------|--------------|------|------|------|------------------|
| Ambient Operating Temperature | $T_A$        | 0    | -    | +70  | $^\circ\text{C}$ |
| Supply Voltage                | $V_{CC}$     | +4.5 | +5.0 | +5.5 | V                |
| Supply Ground                 | $\text{GND}$ | 0    | 0    | 0    | V                |

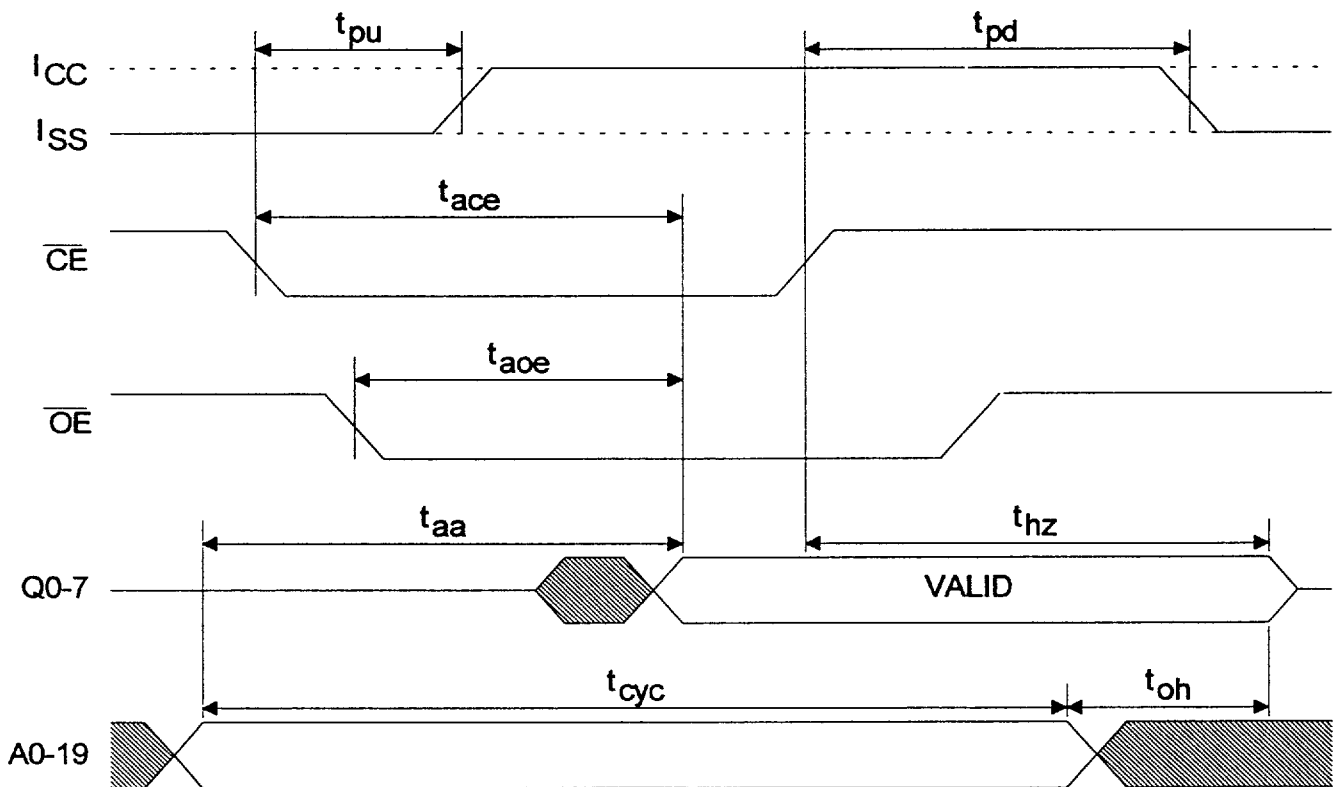
ABSOLUTE MAXIMUM RATINGS

| Parameter                          | Symbol | Min  | Max          | Units            |
|------------------------------------|--------|------|--------------|------------------|
| Storage Temperature                |        | -65  | +125         | $^\circ\text{C}$ |
| Supply Voltage to Ground Potential |        | -0.5 | +7.0         | V                |
| Output Voltage                     |        | -0.5 | $V_{CC}+0.5$ | V                |
| Input Voltage                      |        | -0.5 | $V_{CC}+0.5$ | V                |
| Power Dissipation                  |        | -    | 1            | W                |

AC CHARACTERISTICS ( $T_A = 0^\circ\text{C}$  to  $+70^\circ\text{C}$ ,  $V_{CC} = 5.0\text{V} \pm 10\%$ ,  $\text{GND} = 0\text{V}$ )

| Parameter                                  | Symbol    | Min | Typ | Max | Units |
|--|-----------|-----|-----|-----|-------|
| Cycle Time                                 | $t_{cyc}$ | 120 | -   | -   | ns    |
| Address Access Time (Normal Read) (Note 1) | $t_{aa}$  | -   | 72  | 120 | ns    |
| Chip Enable Access Time (Note 1)           | $t_{ace}$ | -   | 87  | 120 | ns    |
| Output Enable Access Time (Note 1)         | $t_{aoe}$ | -   | 18  | 80  | ns    |
| Output Hold After Address Change           | $t_{oh}$  | 10  | -   | -   | ns    |
| Output HIGH Z Delay                        | $t_{hz}$  | -   | -   | 70  | ns    |
| Power down Time (Note 2)                   | $t_{pd}$  | -   | -   | 100 | ns    |
| Power up Time (Note 2)                     | $t_{pu}$  | 0   | -   | -   | ns    |

Notes: 1. The minimum parameter is sampled and not 100% tested.  
 2. This parameter is sampled and not 100% tested.



## FUNCTIONAL OVERVIEW

The CS4112 contains PCM sample data which is processed by the CS9233 (or CS9203) and associated firmware in order to generate high quality melodic instrument, percussion, and special effects sounds. The CS4112's 1 Msample data set includes all of the samples needed to implement a complete General MIDI (GM) compliant and GS compatible synthesizer. A typical connection diagram for the CS4112 with the CS9233 is shown in Figure 1. In this case an optional DRAM memory is also included for downloadable sample data. For more information see the CS9233 Integrated Wavetable Music Synthesizer data sheet and the CS9233 Microcontroller Firmware data sheet.

## System Solutions

The CS4112 may be used in system solutions using either the CS9203 Advanced Music Synthesizer or the CS9233 Integrated Wavetable Music Synthesizer.

Crystal Semiconductor provides complete reference design data kits for a variety of system solutions. The reference design kits include functional boards, plus data sheets containing complete schematics, board layouts, Bill of Materials (BOM), technical overviews, and firmware descriptions. Please contact Crystal Semiconductor for information on reference designs employing the CS9233 wavetable synthesizer and CS4112 wavetable sample ROM.

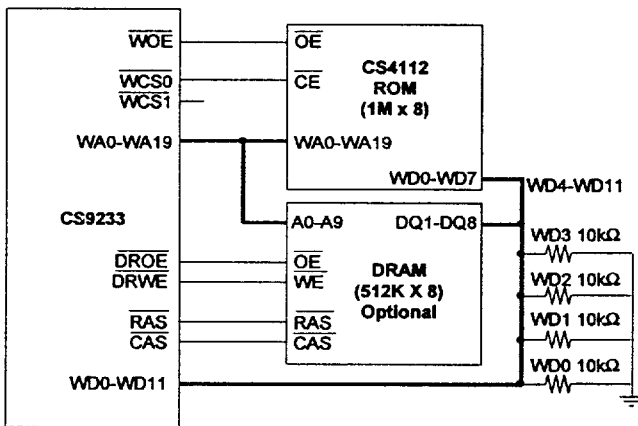


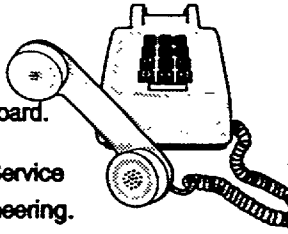
Figure 1. Typical Connections of CS4112 and optional DRAM to the CS9233

### Schematic & Layout Review Service

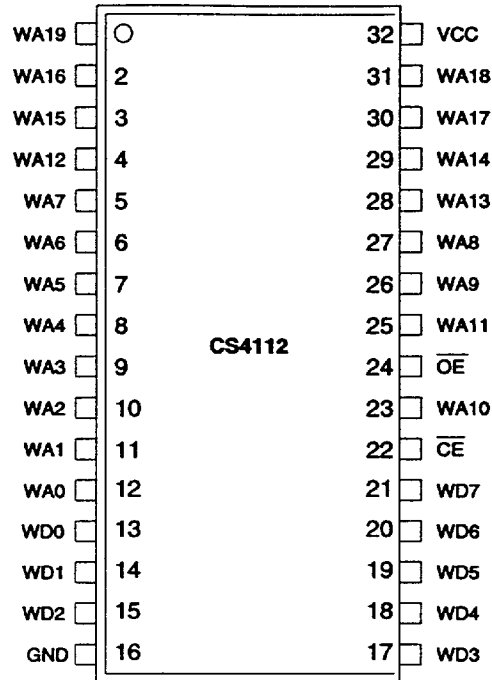
Confirm Optimum  
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**PIN DESCRIPTIONS**



**GND - Power Ground. Pin 16.**

The ground pin should be connected to a low impedance ground plane.

**VCC - +5V ± 10%. Pin 32.**

The power pin should be connected to a low impedance digital power plane.

**WA0-WA19 - Address Input. Pins 12-5, 27, 26, 23, 25, 4, 28-29, 3-2, 30-31, 1.**

These input address lines are used to address the stored PCM data.

**WD0-WD7 - Output Data. Pins 13-21.**

These output data lines provide the data.

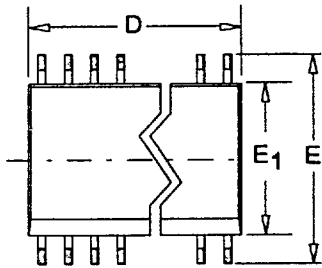
**$\overline{CE}$  - Chip Enable. Active low. Pin 22.**

This active low input signal is a chip select, and also acts as the Power-down pin.

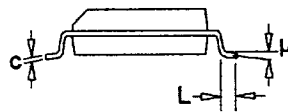
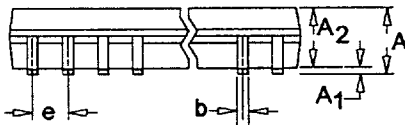
**$\overline{OE}$  - Output Enable. Active low. Pin 24.**

This active low input signal puts the PCM data stored at the address on the specified by WA0-WA19 on the output data lines WD0-WD7.

## MECHANICAL DESCRIPTION



32-PIN  
SOIC



| pins | MILLIMETERS |       |       | INCHES |       |       |
|------|-------------|-------|-------|--------|-------|-------|
|      | MIN         | NOM   | MAX   | MIN    | NOM   | MAX   |
| 16   | 9.91        | 10.16 | 10.41 | 0.390  | 0.400 | 0.410 |
| 20   | 12.45       | 12.70 | 12.95 | 0.490  | 0.500 | 0.510 |
| 24   | 14.99       | 15.24 | 15.50 | 0.590  | 0.600 | 0.610 |
| 28   | 17.53       | 17.78 | 18.03 | 0.690  | 0.700 | 0.710 |

| DIM            | MILLIMETERS     |       |       | INCHES |       |       |
|----------------|-----------------|-------|-------|--------|-------|-------|
|                | MIN             | NOM   | MAX   | MIN    | NOM   | MAX   |
| A              | 2.41            | 2.54  | 2.67  | 0.095  | 0.100 | 0.105 |
| A <sub>1</sub> | 0.127           | -     | 0.300 | 0.005  | -     | 0.012 |
| A <sub>2</sub> | 2.29            | 2.41  | 2.54  | 0.090  | 0.095 | 0.100 |
| b              | 0.33            | 0.46  | 0.51  | 0.013  | 0.018 | 0.020 |
| c              | 0.203           | 0.280 | 0.381 | 0.008  | 0.011 | 0.015 |
| D              | see table above |       |       |        |       |       |
| E              | 10.11           | 10.41 | 10.67 | 0.398  | 0.410 | 0.420 |
| E <sub>1</sub> | 7.42            | 7.49  | 7.57  | 0.292  | 0.295 | 0.298 |
| e              | 1.14            | 1.27  | 1.40  | 0.040  | 0.050 | 0.055 |
| L              | 0.41            | -     | 0.89  | 0.016  | -     | 0.035 |
| μ              | 0°              | -     | 8°    | 0°     | -     | 8°    |

Note: The inches dimensions were estimated from the millimeter dimensions. For board layout purposes, the millimeter dimensions should be used.

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