

# DSP56004 DSP56004ROM

## Product Brief

## 24-bit Digital Signal Processor

The DSP56004 is a high-performance, programmable Digital Signal Processor (DSP) suitable for a variety of cost-sensitive audio functions, such as Dolby Pro Logic decoding and Lucasfilm Home THX<sup>®</sup> enhancements. Software for these functions is available to licensees from Motorola for integration with user-developed features, such as digital equalization and sound field processing in products like audio/video receivers, televisions, and automotive sound systems. The DSP56004 Symphony<sup>™</sup> is an MPU-style general purpose DSP, composed of an efficient 24-bit digital signal processor core, program and data memories, various peripherals optimized for audio, and support circuitry. As illustrated in Figure 1, the 56000-Family-compatible DSP core is fed by program memory, two independent data RAMs, and two data ROMs with sine and logarithm tables in the DSP56004, a Serial Audio Interface, Serial Host Interface, External Memory Interface, dedicated I/O lines, on-chip Phase-Locked Loop (PLL), and On-Chip Emulation (OnCE<sup>™</sup>) port.

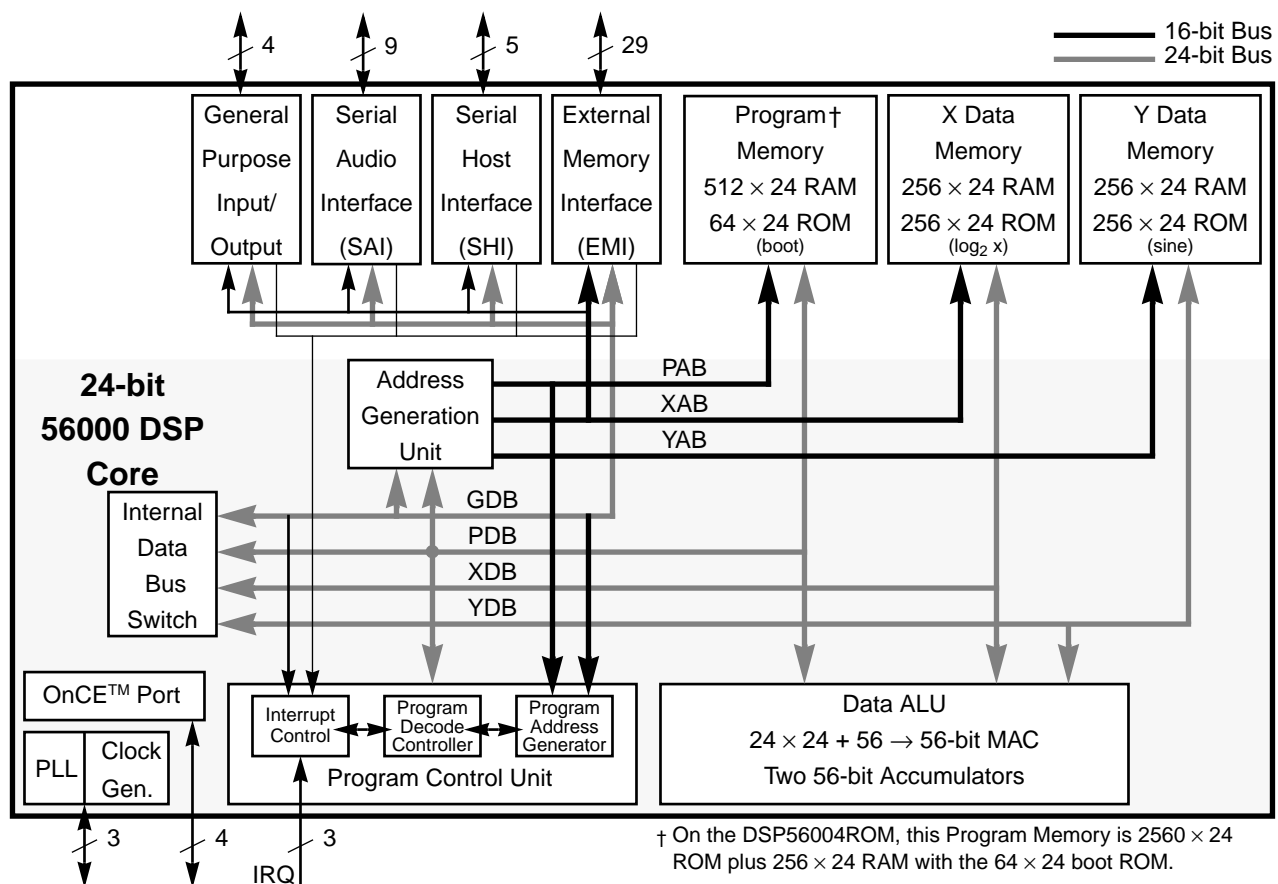


Figure 1 DSP56004 Block Diagram

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# DSP56004 Features

## Digital Signal Processing Core

- Efficient, object code compatible, 24-bit 56000-Family DSP engine
  - Up to 33 Million Instructions Per Second (MIPS) – 30.3 ns instruction cycle at 66 MHz
  - Up to 180 Million Operations Per Second (MOPS) at 66 MHz
  - Highly parallel instruction set with unique DSP addressing modes
  - Two 56-bit accumulators including extension byte
  - Parallel  $24 \times 24$ -bit multiply-accumulate in 1 instruction cycle (2 clock cycles)
  - Double precision  $48 \times 48$ -bit multiply with 96-bit result in 6 instruction cycles
  - 56-bit addition/subtraction in 1 instruction cycle
  - Fractional and integer arithmetic with support for multiprecision arithmetic
  - Hardware support for block-floating point Fast Fourier Transforms (FFT)
  - Hardware nested DO loops
  - Zero-overhead fast interrupts (2 instruction cycles)
  - Four 24-bit internal data buses and three 16-bit internal address buses for simultaneous accesses to one program and two data memories

## Memory

Table 1 lists the memory configurations of the DSP56004.

- On-chip Harvard architecture permitting simultaneous accesses to program and two data memories
- $512 \times 24$ -bit on-chip program RAM and  $64 \times 24$ -bit bootstrap ROM
  - On the DSP56004ROM this program memory is replaced with  $2560 \times 24$ -bit on-chip program ROM\*,  $256 \times 24$ -bit on-chip program RAM, and the  $64 \times 24$ -bit bootstrap ROM
- Two  $256 \times 24$ -bit on-chip data RAMs
- Two  $256 \times 24$ -bit on-chip data ROMs containing sine and logarithm tables
  - On the DSP56004ROM these data ROMs contain developer-provided data
- Bootstrap loading from Serial Host Interface or External Memory Interface
- Proprietary Bootstrap for Securing Program ROM contents

**Table 1** DSP56004 Memory Configurations

Part Type	Program		X Data		Y Data	
	ROM	RAM	ROM	RAM	ROM	RAM
DSP56004	none	512	256 $\log_2 X$	256	256 sine	256
DSP56004ROM	2560*	256	256*	256	256*	256

Word width is 24 bits.

\* These ROMs may be factory-programmed with data/program provided by the application developer.

## Peripheral and Support Circuits

- Serial Audio Interface (SAI) includes 2 receivers and 3 transmitters, master or slave capability, and implementation of I<sup>2</sup>S, Sony, and Matshushita audio protocols; two sets of SAI interrupt vectors
- Serial Host Interface (SHI) features single master capability, 10-word receive FIFO, and support for 8-, 16- and 24-bit words
- External Memory Interface (EMI), implemented as a peripheral supporting:
  - Page-mode DRAMs (one or two chips): 64k × 4, 256k × 4, and 4M × 4 bits
  - SRAMs (one to four): 256k × 8 bits
  - Data bus may be 4 or 8 bits wide
  - Data words may be 8, 12, 16, 20, or 24 bits wide
- Four dedicated, independent, programmable General Purpose I/O (GPIO) lines
- On-chip peripheral registers memory mapped in data memory space
- Three external interrupt request pins
- On-Chip Emulation (OnCE™) port for unobtrusive, processor speed-independent debugging
- Software-programmable, Phase Locked Loop-based (PLL) frequency synthesizer for the core clock
- Power-saving Wait and Stop modes
- Fully static, HCMOS design for operating frequencies from 40, 50, and 66 MHz down to DC
- 80-pin plastic Quad Flat Pack surface-mount package; 14 × 14 × 2.45 mm; 0.65 mm lead pitch
- Completely pin compatible with the DSP56007 for easy upgrades
- 5 V power supply

The DSP56004ROM is a ROM-based version of the RAM-based DSP56004. The DSP56007 / L007 is a pin-compatible version of the DSP56004 with a different memory configuration.

## Documentation

The three documents listed in Table 2 are required for a complete description of the DSP56004 and are necessary to properly design with the part. Documentation is available from a local Motorola distributor, a Motorola semiconductor sales office, or a Motorola Literature Distribution Center listed below.

**Table 2** Additional DSP56004 Documentation


Document Name	Description	Order Number
DSP56000 Family Manual	Detailed description of the 56000-family architecture and the 24-bit core processor and instruction set	DSP56KFAMUM/AD
DSP56004/007 User's Manual	Detailed description of memory, peripherals, and interfaces	DSP56004UM/AD
DSP56004/007 Data Sheet	Electrical and timing specifications, and pin and package descriptions	DSP56004/D



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### Literature Distribution Centers

USA/EUROPE: Motorola Literature Distribution; P.O. Box 20912; Phoenix, Arizona USA 85036.

JAPAN: Nippon Motorola Ltd.; 4-32-1, Nishi-Gotanda, Shinagawa-ku, Tokyo 141 Japan.

ASIA-PACIFIC: Motorola Semiconductors H.K. Ltd.; Silicon Harbor Center, No. 2 Dai King Street, Tai Po Industrial Estate, Tai Po, N.T., Hong Kong.



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