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SCF5249 Integrated ColdFire® Microprocessor Data Sheet

1 Introduction

This document provides an overview of the SCF5249 ColdFire® processor and general descriptions of SCF5249 features and its various modules.

The SCF5249 was designed as a system controller/decoder for MP3 music players, especially portable MP3 CD players. The 32-bit ColdFire core with Enhanced Multiply Accumulate (EMAC) unit provides optimum performance and code density for the combination of control code and signal processing required for MP3 decode, file management, and system control.

Low power features include a hardwired CD ROM decoder, advanced 0.18um CMOS process technology, 1.8V core power supply, and on-chip 96KByte SRAM. MP3 decode requires less than 20MHz CPU bandwidth and runs in on-chip SRAM with external access only for data input and output.

The SCF5249 is also an excellent general purpose system controller with over 125 Dhrystone 2.1 MIPS @ 140MHz performance at a very competitive price. The

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integrated peripherals and EMAC allow the SCF5249 to replace both the microcontroller and the DSP in certain applications. Most peripheral pins can also be remapped as General Purpose I/O pins.

1.1 Orderable Parts Numbers

1.1.1 Orderable Part Table

Table 1. Orderable Part Numbers

Orderable Part Number	Maximum Clock Frequency	Package Type	Operating Temperature Range	Part Status
SCF5249LPV120	120 MHz	144 pin QFP	-20°C to 70°C	Leaded
SCF5249LAG120	120 MHz	144 pin QFP	-20°C to 70°C	Lead Free
SCF5249VF140	140 MHz	160 ball MAPBGA	-20°C to 70°C	Leaded
SCF5249VM140	140 MHz	160 ball MAPBGA	-20°C to 70°C	Lead Free

1.2 SCF5249 Features

The SCF5249 integrated microprocessor combines a Version 2 ColdFire[®] processor core operating at 140MHz with the following modules.

- DMA controller with 4 DMA channels
- Integrated Enhanced Multiply-accumulate Unit (EMAC)
- 8-KByte Direct Mapped Instruction Cache
- 96-KByte SRAM (A 64K and a 32K bank)
- Operates from external crystal oscillator
- Supports 16-bit wide SDRAM memories
- Serial Audio Interface which supports IIS and EIAJ audio protocols
- Digital audio transmitter and two receivers compliant with IEC958 audio protocol
- CD-ROM and CD-ROM XA block decoding and encoding function
- Two UARTS
- Queued Serial Peripheral Interface (QSPI) (Master Only)
- Two timers
- IDE and SmartMedia interfaces
- Analog/Digital Converter
- Flash Memory Card Interface
- Two I²C modules
- System debug support
- General Purpose I/O pins shared with other functions

- 1.8V core, 3.3V I/O
- 160 pin MAPBGA package (qualified at 140 MHz) and 144 pin QFP package (qualified at 120 MHz)
- -20⁰ C to 70⁰ C ambient operating temperature range

2 SCF5249 Block Diagram

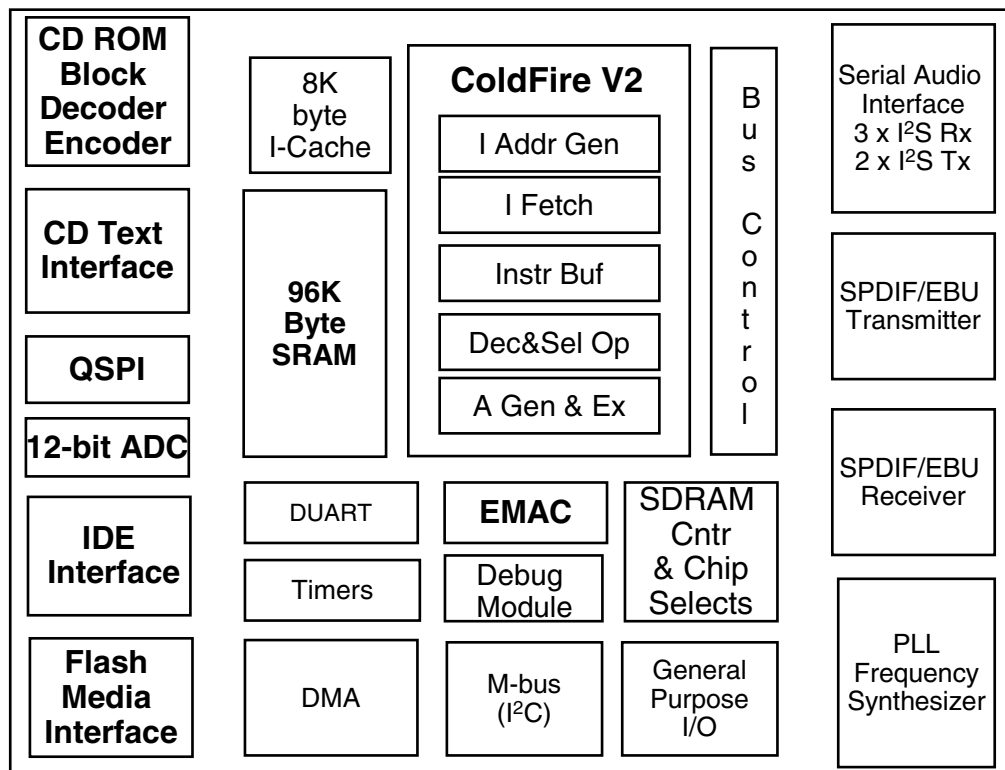


Figure 1. SCF5249 Block Diagram

3 SCF5249 Feature Details

The primary features of the SCF5249 integrated processor include the following:

- ColdFire V2 Processor Core operating at 140MHz
 - Clock-doubled Version 2 microprocessor core
 - 32-bit internal data bus, 16 bit external data bus
 - 16 user-visible, 32-bit general-purpose registers
 - Supervisor/user modes for system protection
 - Vector base register to relocate exception-vector table
 - Optimized for high-level language constructs

- DMA controller
 - Four fully programmable channels: Two dedicated to the audio interface module and two dedicated to the UART module (External requests are not supported.)
 - Supports dual- and single-address transfers with 32-bit data capability
 - Two address pointers that can increment or remain constant
 - 16-/24-bit transfer counter
 - Operand packing and unpacking support
 - Auto-alignment transfers supported for efficient block movement
 - Supports bursting and cycle stealing
 - All channels support memory to memory transfers
 - Interrupt capability
 - Provides two clock cycle internal access
- Enhanced Multiply-accumulator Unit
 - Single-cycle multiply-accumulate operations for 32 x 32 bit and 16 x 16 bit operands
 - Support for signed, unsigned, integer, and fixed-point fractional input operands
 - Four 48-bit accumulators to allow the use of a 40-bit product
 - The addition of 8 extension bits to increase the dynamic number range
 - Fast signed and unsigned integer multiplies
- 8-KByte Direct Mapped instruction cache
 - Clock-doubled to match microprocessor core speed
 - Flush capability
 - Non-blocking cache provides fast access to critical code and data
- 96-KByte SRAM
 - Provides one-cycle access to critical code and data
 - Split into two banks, SRAM0 (32K), and SRAM1 (64K)
 - DMA requests to/from internal SRAM1 supported
- Crystal Trim
 - The XTRIM output can be used to trim an external crystal oscillator circuit which would allow lock with an incoming IEC958 or serial audio signal
- Audio Interfaces
 - IEC958 input and output
 - Four serial Philips IIS/Sony EIAJ interfaces
 - One with input and output, one with output only, two with input only (Three inputs, two outputs)
 - Master and Slave operation

- CD Text Interface
 - Allows the interface of CD subcode (transmitter only)
- Dual Universal Synchronous/asynchronous Receiver/Transmitter (Dual UART)
 - Full duplex operation
 - Baud-rate generator
 - Modem control signals: clear-to-send (CTS) and request-to-send (RTS)
 - DMA interrupt capability
 - Processor-interrupt capability
- Queued Serial Peripheral Interface (QSPI)
 - Programmable queue to support up to 16 transfers without user intervention
 - Supports transfer sizes of 8 to 16 bits in 1-bit increments
 - Four peripheral chip-select lines for control of up to 15 devices
 - Baud rates from 273 Kbps to 17.5 Mbps at 140MHz
 - Programmable delays before and after transfers
 - Programmable clock phase and polarity
 - Supports wraparound mode for continuous transfers
 - Master mode only
- Dual 16-bit General-purpose Multimode Timers
 - Clock source selectable from external, CPU clock/2 and CPU clock/32.
 - 8-bit programmable prescaler
 - 2 timer inputs and 2 outputs
 - Processor-interrupt capability
 - 14.3 nS resolution with CPU clock at 140MHz
- IDE/ SmartMedia Interface
 - Allows direct connection to an IDE hard drive or other IDE peripheral
- Analog/Digital Converter
 - 12-Bit Resolution
 - 4 Muxed inputs
- Flash Memory Card Interface
 - Allows connection to Sony MemoryStick compatible devices
 - Support SD cards and other types of flash media
- Dual I²C Interfaces
 - Interchip bus interface for EEPROMs, LCD controllers, A/D converters, keypads
 - Master and slave modes, support for multiple masters
 - Automatic interrupt generation with programmable level

160 MAPBGA Ball Assignments

- System debug support
 - Real-time instruction trace for determining dynamic execution path
 - Background debug mode (BDM) for debug features while halted
 - Debug exception processing capability
 - Real-time debug support
- System Interface
 - Glueless bus interface with four chip selects and DRAMC support for interface to 16-bit for DRAM, SRAM, ROM, FLASH, and I/O devices
 - Two programmable chip-select signals for static memories or peripherals, with programmable wait states and port sizes.
 - Two dedicated chip selects for 16-bit wide DRAM /SDRAM.
 - CS0 is active after reset to provide boot-up from external FLASH/ROM.
 - Programmable interrupt controller
 - Low interrupt latency
 - Eight external interrupt requests
 - Programmable autovector generator
 - 44 programmable general-purpose inputs*
 - 46 programmable general-purpose outputs*
 - * For the 160 MAPBGA package
 - IEEE 1149.1 Test (JTAG) Module
- Clocking
 - Clock-multiplied PLL, programmable frequency
- 1.8V Core, 3.3V I/O
- 160 pin MAPBGA package (qualified at 140 MHz) and 144 pin QFP package (qualified at 120 MHz)

4 160 MAPBGA Ball Assignments

The following signals are not available on the 144 QFP package.

NOTE

The 144 QFP part is qualified for 120 MHz operation. The 160MAPBGA part is qualified for 140 MHz.

Table 2. 160 MAPBGA Ball Assignments

160 MAPBGA Ball Number	Function	GPIO
E3	cmd_sdio2	gpio34
G4	sdata0_sdio1	gpio54
H3	RSTO/sdata2_bs2	
K3	A25	gpo8
L4	QSPI_CS1	gpio24
L8	QSPI_CS3	gpio22
N8	SDRAM_CS2	gpio7
P9	EbuOut2	gpo 37
K11	BUFENb2	gpio17
G12	subr	gpio 53
F13	sfsy	gpio 52
F12	rck	gpio 51
E8	SRE	gpio11
B8	lrck3	gpio 45
E7	SWE	gpio12
A7	sclk3	gpio 49

5 SCF5249 Functional Overview

5.1 ColdFire V2 Core

The ColdFire processor Version 2 core consists of two independent, decoupled pipeline structures to maximize performance while minimizing core size. The instruction fetch pipeline (IFP) is a two-stage pipeline for prefetching instructions. The prefetched instruction stream is then gated into the two-stage operand execution pipeline (OEP), which decodes the instruction, fetches the required operands, and then executes the required function. Because the IFP and OEP pipelines are decoupled by an instruction buffer that serves as a FIFO queue, the IFP can prefetch instructions in advance of their actual use by the OEP, which minimizes time stalled waiting for instructions. The OEP is implemented in a two-stage pipeline featuring a traditional RISC data path with a dual-read-ported register file feeding an arithmetic/logic unit (ALU).

5.2 DMA Controller

The SCF5249 provides four fully programmable DMA channels for quick data transfer. Single and dual address mode is supported with the ability to program bursting and cycle stealing. Data transfer is selectable as 8, 16, 32, or 128-bits. Packing and unpacking is supported.

Two internal audio channels and the dual UART can be used with the DMA channels. All channels can perform memory to memory transfers. The DMA controller has a user-selectable, 24- or 16-bit counter and a programmable DMA exception handler.

External requests are not supported.

5.3 Enhanced Multiply and Accumulate Module (EMAC)

The integrated EMAC unit provides a common set of DSP operations and enhances the integer multiply instructions in the ColdFire architecture. The EMAC provides functionality in three related areas:

1. Faster signed and unsigned integer multiplies
2. New multiply-accumulate operations supporting signed and unsigned operands
3. New miscellaneous register operations

Multiplies of 16x16 and 32x32 with 48-bit accumulates are supported in addition to a full set of extensions for signed and unsigned integers plus signed, fixed-point fractional input operands. The EMAC has a single-clock issue for 32x32-bit multiplication instructions and implements a four-stage execution pipeline.

5.4 Instruction Cache

The instruction cache improves system performance by providing cached instructions to the execution unit in a single clock. The SCF5249 processor uses a 8K-byte, direct-mapped instruction cache to achieve 125 MIPS at 140 Mhz. The cache is accessed by physical addresses, where each 16-byte line consists of an address tag and a valid bit. The instruction cache also includes a bursting interface for 16-bit and 8-bit port sizes to quickly fill cache lines.

5.5 Internal 96-KByte SRAM

The 96-KByte on-chip SRAM is split over two banks, SRAM0 (32k) and SRAM1 (64K). It provides one clock-cycle access for the ColdFire core. This SRAM can store processor stack and critical code or data segments to maximize performance. Memory in the second bank can be accessed under DMA.

5.6 DRAM Controller

The SCF5249 DRAM controller provides a glueless interface for up to two banks of DRAM, each of which can be up to 32 MBytes. The controller supports a 16-bit data bus. A unique addressing scheme allows for increases in system memory size without rerouting address lines and rewiring boards. The controller operates in page mode, non-page mode, and burst-page mode and supports SDRAMs.

5.7 System Interface

The SCF5249 provides a glueless interface to 16-bit port size SRAM, ROM, and peripheral devices with independent programmable control of the assertion and negation of chip-select and write-enable signals.

The SCF5249 also supports bursting ROMs.

5.8 External Bus Interface

The bus interface controller transfers information between the ColdFire core or DMA and memory, peripherals, or other devices on the external bus. The external bus interface provides 23 bits of address bus space, a 16-bit data bus, Output Enable, and Read/Write signals. This interface implements an extended synchronous protocol that supports bursting operations.

5.9 Serial Audio Interfaces

The SCF5249 digital audio interface provides four serial Philips IIS/Sony EIAJ interfaces. One interface is a 4-pin (1 bit clock, 1 word clock, 1 data in, 1 data out), the other three interfaces are 3-pin (1 bit clock, 1 word clock, 1 data in or out). The serial interfaces have no limit on minimum sampling frequency. Maximum sampling frequency is determined by maximum frequency on bit clock input. This is 1/3 the frequency of the internal system clock.

5.10 IEC958 Digital Audio Interfaces

The SCF5249 has two digital audio input interfaces, and one digital audio output interface. There are four digital audio input pins, two digital audio output pins. An internal multiplexer selects one of the four inputs to the digital audio input interface. There is one digital audio output interface but it has two IEC958 outputs. One output carries the professional “c” channel, and the other carries the consumer “c” channel. The rest carry identical data.

The IEC958 output can take the output from the internal IEC958 generator, or multiplex out one of the four IEC958 inputs.

5.11 Audio Bus

The audio interfaces connect to an internal bus that carries all audio data. Each receiver places its received data on the audio bus and each transmitter takes data from the audio bus for transmission. Each transmitter has a source select register.

In addition to the audio interfaces, there are six CPU accessible registers connected to the audio bus. Three of these registers allow data reads from the audio bus and allow selection of the audio source. The other three register provide a write path to the audio bus and can be selected by transmitters as the audio source. Through these registers, the CPU has access to the audio samples for processing.

Audio can be routed from a receiver to a transmitter without the data being processed by the core so the audio bus can be used as a digital audio data switch. The audio bus can also be used for audio format conversion.

5.12 CD-ROM Encoder/Decoder

The SCF5249 is capable of processing CD-ROM sectors in hardware. Processing is compliant with CD-ROM and CD-ROM XA standards.

The CD-ROM decoder performs following functions in hardware:

- Sector sync recognition
- Descrambling of sectors
- Verification of the CRC checksum for Mode 1, Mode 2 Form 1, and Mode 2 Form 2 sectors
- Third-layer error correction is not performed

The CD-ROM encoder performs following functions in hardware:

- Sector sync recognition
- Scrambling of sectors
- Insertion of the CRC checksum for Mode 1, Mode 2 Form 1, and Mode 2 Form 2 sectors.
- Third-layer error encoding needs to be done in software. This can use approximately 5-10 Mhz of performance for single-speed.

5.13 Dual UART Module

Two full-duplex UARTs with independent receive and transmit buffers are in this module. Data formats can be 5, 6, 7, or 8 bits with even, odd, or no parity, and up to 2 stop bits in 1/16 increments. Four-byte receive buffers and two-byte transmit buffers minimize CPU service calls. The Dual UART module also provides several error-detection and maskable-interrupt capabilities. Modem support includes request-to-send ($\overline{\text{RTS}}$) and clear-to-send ($\overline{\text{CTS}}$) lines.

The system clock provides the clocking function from a programmable prescaler. You can select full duplex, auto-echo loopback, local loopback, and remote loopback modes. The programmable Dual UARTs can interrupt the CPU on various normal or error-condition events.

5.14 Queued Serial Peripheral Interface QSPI

The QSPI module provides a serial peripheral interface with queued transfer capability. It supports up to 16 stacked transfers at a time, making CPU intervention between transfers unnecessary. Transfers of up to 37 Mbits/second are possible at a CPU clock of 140 MHz. The QSPI supports master mode operation only.

5.15 Timer Module

The timer module includes two general-purpose timers, each of which contains a free-running 16-bit timer for use in any of three modes:

1. Timer Capture. This mode captures the timer value with an external event.
2. Output Capture. This mode triggers an external signal or interrupts the CPU when the timer reaches a set value
3. Event Counter. This mode counts external events.

The timer unit has an 8-bit prescaler that allows programming of the clock input frequency, which is derived from the system clock. In addition to the $\div 1$ and $\div 16$ clock derived from the bus clock (CPU clock / 2), the programmable timer-output pins either generate an active-low pulse or toggle the outputs.

5.16 IDE and SmartMedia Interfaces

The SCF5249 system bus allows connection of an IDE hard disk drive and SmartMedia flash card with a minimum of external hardware. The external hardware consists of bus buffers for address and data and are intended to reduce the load on the bus and prevent SDRAM and Flash accesses to propagate to the IDE bus. The control signals for the buffers are generated in the SCF5249.

5.17 Analog/Digital Converter (ADC)

The four channel ADC is based on the Sigma-Delta concept with 12-bit resolution. The digital portion of the ADC is provided internally. The analog voltage comparator must be provided externally as well as an external integrator circuit (resistor/capacitor) which is driven by the ADC output. A software interrupt is provided when the ADC measurement cycle is complete.

5.18 Flash Memory Card Interface

The interface is Sony MemoryStick and SecureDigital compatible. However, there is no hardware support for MagicGate.

5.19 I²C Module

The two-wire I²C bus interface, which is compliant with the Philips I²C bus standard, is a bidirectional serial bus that exchanges data between devices. The I²C bus minimizes the interconnection between devices in the end system and is best suited for applications that need occasional bursts of rapid communication over short distances among several devices. Bus capacitance and the number of unique addresses limit the maximum communication length and the number of devices that can be connected.

5.20 Chip-Selects

Two programmable chip-select outputs provide signals that enable glueless connection to external memory and peripheral circuits. The base address, access permissions and automatic wait-state insertion are programmable with configuration registers. These signals also interface to 16-bit ports.

CS0 is active after reset to provide boot-up from external FLASH/ROM.

5.21 GPIO Interface

A total of 44 General Purpose inputs and 46 General Purpose outputs are available. These are multiplexed with various other signals. Eight of the GPIO inputs have edge sensitive interrupt capability.

5.22 Interrupt Controller

The interrupt controller provides user-programmable control of a total of 57 interrupts. There are 49 internal interrupt sources. In addition, there are 8 GPIOs where interrupts can be generated on the rising or falling edge of the pin. All interrupts are autovectored and interrupt levels are programmable.

5.23 JTAG

To help with system diagnostics and manufacturing testing, the SCF5249 includes dedicated user-accessible test logic that complies with the IEEE 1149.1A standard for boundary scan testability, often referred to as Joint Test Action Group, or JTAG. For more information, refer to the IEEE 1149.1A standard. Freescale provides BSDL files for JTAG testing.

5.24 System Debug Interface

The ColdFire processor core debug interface supports real-time instruction trace and debug, plus background-debug mode. A background-debug mode (BDM) interface provides system debug.

In real-time instruction trace, four status lines provide information on processor activity in real time (PST pins). A four-bit wide debug data bus (DDATA) displays operand data and change-of-flow addresses, which helps track the machine's dynamic execution path.

5.25 Crystal and On-chip PLL

Typically, an external 16.92 Mhz or 33.86 Mhz clock input is used for CD R/W applications, while an 11.2896 MHz clock is more practical for Portable CD player applications. However, the on-chip programmable PLL, which generates the processor clock, allows the use of almost any low frequency external clock (5-35 Mhz).

Two clock outputs (MCLK1 and MCLK2) are provided for use as Audio Master Clock. The output frequencies of both outputs are programmable to F_{xtal} , $F_{xtal}/2$, $F_{xtal}/3$, and $F_{xtal}/4$. The $F_{xtal}/3$ option is only available when the 33.86 Mhz crystal is connected.

The SCF5249 supports VCO operation of the oscillator by means of a 16-bit pulse density modulation output. Using this mode, it is possible to lock the oscillator to the frequency of an incoming IEC958 or IIS signal. The maximum trim depends on the type and design of the oscillator. Typically a trim of ± 100 ppm can be achieved with a crystal oscillator and over ± 1000 ppm with an LC oscillator.

6 General Device Information

The SCF5249 is available in a 160-pin MAP BGA package, or a 144-pin QFP package.

7 Documentation

Table 3 lists the documents that provide a complete description of the SCF5249 and are required to design properly with the part. Documentation is available from a local Freescale distributor, a Freescale semiconductor sales office, a Freescale Literature Distribution Center, or through the Freescale DSP home page on the internet; <http://www.freescale.com/> (the source for the latest information).

Table 3. SCF5249 Documentation

Document Name	Description	Order Number
CFPRM/D	ColdFire Family Programmer's Reference Manual	CFPRM/D
ColdFire2UM	Version 2/2M ColdFire Core Processor User's Manual	ColdFire2UM/D
ColdFire2UMAD	Version 2/2M ColdFire Core Processor User's Manual Addendum	ColdFire2UMAD/D
SCF5249UM	SCF5249 User's Manual	SCF5249UM/D

8 Signal Descriptions

8.1 Introduction

This section describes the SCF5249 input and output signals. The signal descriptions as shown in [Table 4](#) are grouped according to relevant functionality.

Table 4. SCF5249 Signal Index

Signal Name	Mnemonic	Function	Input/Output	Reset State
Address	A[23:1] A[25]/GPO8	23 address lines, address line 25 multiplexed with gpo8.	Out	X
Read-write control	RW_b	Bus write enable - indicates if read or write cycle in progress	Out	H
Output enable	OE	Output enable for asynchronous memories connected to chip selects	Out	negated
Data	D[31:16]	Data bus used to transfer word data	In/Out	Hi-Z
Synchronous row address strobe	SDRAS	Row address strobe for external SDRAM.	Out	negated
Synchronous column address strobe	SDCAS	Column address strobe for external SDRAM	Out	negated
SDRAM write enable	SDWE	Write enable for external SDRAM	Out	negated
SDRAM upper byte enable	SDUDQM	Indicates during write cycle if high byte is written	Out	
SDRAM lower byte enable	SDLDQM	Indicates during write cycle if low byte is written	Out	
SDRAM chip selects	SDRAMCS1	SDRAM chip select	Outt	negated
SDRAM chip selects	SDRAMCS2/GPIO7	SDRAM chip select	In/Out	negated
SDRAM clock enable	BCLKE	SDRAM clock enable	Out	
System clock	SCLK/GPIO10	SDRAM clock output	In/Out	

Table 4. SCF5249 Signal Index (continued)

Signal Name	Mnemonic	Function	Input/ Output	Reset State
ISA bus read strobes	CS2/IDE-DIOR/GPIO13 CS3/SRE/GPIO11	There are 2 ISA bus read strobes and 2 ISA bus write strobes. They allow connection of two independent ISA bus peripherals, e.g. an IDE slave device and a SmartMedia card.	In/Out	
ISA bus write strobes	IDE-DIOW/GPIO14 SWE/GPIO12		In/Out	
ISA bus wait signal	IDE-IORDY/GPIO16	ISA bus wait line - available for both busses	In/Out	
Chip Selects[1:0]	CS0 CS1/GPIO58	Enables peripherals at programmed addresses. CS[1:0]. CS[0] provides boot ROM selection	Out In/Out	negated
Buffer enable 1	BUFENB1/GPIO57	Two programmable buffer enables allow seamless steering of external buffers to split data and address bus in sections.	In/Out	
Buffer enable 2	BUFENB2/GPIO7		In/Out	
Transfer acknowledge	TA/GPIO20	Transfer Acknowledge signal	In/Out	
Serial Clock Line	SCL0/QSPI_CLK	Clock signal for first I ² C module operation Signal is also QSPI clock	In/Out	
Serial Data Line	SDA0/QSPI_DIN	Serial data port first I ² C module operation Signal is also QSPI data in	In/Out	
Serial Clock Line	SCL1_GPIO_3	Clock signal for second I ² C module operation	In/Out	
Serial Data Line	SDA1_GPIO55	Serial data port for second I ² C module operation	In/Out	
Receive Data	RXD1/GPI28/ADIN2 RXD0/GPI27	Signal is receive serial data input for DUART	In	
Transmit Data	TXD1/GPO28 TXD0/GPO27	Signal is transmit serial data output for DUART	Out	asserted
Request-To-Send	RTS1/GPO31 RTS2/GPO30	DUART signals a ready to receive data query	Out	negated
Clear-To-Send	CTS1/ADIN3/GPI31 CTS0/GPI30	Signals to DUART that data can be transmitted to peripheral CTS2 is multiplexed with an A/D input	In	
Timer Input	TIN0/GPI33 TIN1/GPIO23	Provides clock input to timer or provides trigger to timer value capture logic	In In/Out	
Timer Output	TOUT0/GPO33 TOUT1/ADOUT/GPO35	Capable of output waveform or pulse generation	Out	

Table 4. SCF5249 Signal Index (continued)

Signal Name	Mnemonic	Function	Input/ Output	Reset State
IEC958 inputs	EBUIN1/GPI36 EBUIN2/GPI37 EBUIN3/ADIN0/GPI38 EBUIN4/ADIN1/GPI39	Audio interfaces IEC958 inputs multiplexed with some A/D inputs	In	
IEC958 outputs	EBUOUT1/GPO36 EBUOUT2/GPO37	Audio interfaces IEC958 outputs	Out	
Serial data in	SDATAI1 SDATAI3/GPI41 SDATA14/GPI42	Audio interfaces serial data inputs	In	
Serial data out	SDATAO1/GPIO25 SDATAO2/GPO41	Audio interfaces serial data outputs	In/Out Out	
Word clock	LRCK1 LRCK2/GPIO44 LRCK3/GPIO45 LRCK4/GPIO46	Audio interfaces serial word clocks	In/Out	
Bit clock	SCLK1 SCLK2/GPIO48 SCLK3/GPIO49 SCLK4/GPIO50	Audio interfaces serial bit clocks	In/Out	
Serial input	EF/GPIO19	Error flag serial in	In/Out	
Serial input	CFLG/GPIO18	C-flag serial in	In/Out	
Subcode clock	RCK/GPIO51	Audio interfaces subcode clock	In/Out	
Subcode sync	SFSY/GPIO52	Audio interfaces subcode sync	In/Out	
Subcode data	SUBR/GPIO53	Audio interfaces subcode data	In/Out	
Clock frequency trim	XTRIM/GPO38	Clock trim control	Out	
Audio clocks out	MCLK1/GPIO39 MCLK2/GPIO42	DAC output clocks	Out	
MemoryStick/SecureDigital interface	CMDSDIO2/GPIO34	Secure Digital command lane MemoryStick interface 2 data i/o	In/Out	
	SCLKOUT/GPIO15	Clock out for both MemoryStick interfaces and for Secure Digital	In/Out	
	SDATA0_SDIO1/GPIO54	SecureDigital serial data bit 0 MemoryStick interface 1 data i/o	In/Out	
	SDATA1_BS1/GPIO9	SecureDigital serial data bit 1 MemoryStick interface 1 strobe	In/Out	
	RSTO/SDATA2_BS2	SecureDigital serial data bit 2 MemoryStick interface 2 strobe Reset output signal	In/Out	
	SDATA3/GPIO56	SecureDigital serial data bit 3	In/Out	

Table 4. SCF5249 Signal Index (continued)

Signal Name	Mnemonic	Function	Input/ Output	Reset State
ADC	EBUIN3/ADIN0/GPI38 EBUIN4/ADIN1/GPI39 RXD2/ADIN2/GPI28 CTS2/ADIN3/GPI31	Analog to Digital converter input signals	In/Out	
ADC	TOUT1/ADOUT/GPO35	Analog to digital convertor output signal.	In/Out	
QSPI clock	SCL/QSPI_CLK	QSPI clock signal	In/Out	
QSPI data in	SDA/QSPI_DIN	QSPI data input	In/Out	
QSPI data out	QSPIDOUT/GPIO26	QSPI data out	In/Out	
QSPI chip selects	QSPICS0/GPIO29 QSPICS1/GPIO24 QSPICS2/GPIO21 QSPICS3/GPIO22	QSPI chip selects	In/Out	
Crystal in	CRIN	Crystal input	In	
Reset In	RSTI	Processor Reset Input	In	
Freescale Test Mode	TEST[3:0]	Should always be low.	In	
High Impedance	HIZ	Assertion three-states all output signal pins.	In	
Debug Data	DDATA3/GPIO4 DDATA2/GPIO2 DDATA1/GPIO1 DDATA0/GPIO0	Displays captured processor data and break-point status.	In/Out	Hi-Z
Processor Status	PST3/GPIO62 PST2/GPIO61 PST1/GPIO60 PST0/GPIO59	Indicates internal processor status.	In/Out	Hi-Z
Processor clock	PSTCLK/GPO63	Processor clock output	Out	
Test Clock	TCK	Clock signal for IEEE 1149.1A JTAG.	In	
Test Reset/Development Serial Clock	TRST/DSCLK	Multiplexed signal that is asynchronous reset for JTAG controller. Clock input for debug module.	In	
Test Mode Select/ Break Point	TMS/BKPT	Multiplexed signal that is test mode select in JTAG mode and a hardware break-point in debug mode.	In	
Test Data Input / Development Serial Input	TDI/DSI	Multiplexed serial input for the JTAG or background debug module.	In	
Test Data Output/Development Serial Output	TDO/DSO	Multiplexed serial output for the JTAG or background debug module.	Out	
Note: The CMD_SDIO2, SDATA0_SDIO1, RSTO/SDATA2_BS2, A25, QSPI_CS1, QSPI_CS3, SDRAM_CS2, EBUOUT2, BUFENB2, SUBR, SFSY, RCK, SRE, LRCK3, SWE, and the SCLK3 signals are only used in the 160 MAPBGA package.				

8.2 GPIO

Many pins have a GPIO as first or second function. If GPIO is second function, following rules apply:

- General purpose input is always active, regardless of state of pin.
- General purpose output or primary output is determined by value written to GPIO function select register.
- Power-on reset function is not GPIO.

8.3 SCF5249 Bus Signals

These signals provide the external bus interface to the SCF5249.

8.3.1 Address Bus

- The address bus provides the address of the byte or most significant byte of the word or longword being transferred. The address lines also serve as the DRAM address pins, providing multiplexed row and column address signals.
- Bits 23 down to 1 and 25 of the address are available. A25 is intended to be used with 256 Mbit DRAM's. Signals are named:
- A[23:1]
- A[25]/GPO8

8.3.2 Read-Write Control

This signal indicates during any bus cycle whether a read or write is in progress. A low is write cycle and a high is a read cycle.

8.3.3 Output Enable

The $\overline{\text{OE}}$ signal is intended to be connected to the output enable of asynchronous memories connected to chip selects. During bus read cycles, the ColdFire processor will drive $\overline{\text{OE}}$ low.

8.3.4 Data Bus

The data bus (D[31:16]) is bi-directional and non-multiplexed. Data is registered by the SCF5249 on the rising clock edge. The port width for each chip-select and DRAM bank are programmable. The data bus uses a default configuration if none of the chip-selects or DRAM bank match the address decode. All 16 bits of the data bus are driven during writes, regardless of port width or operand size.

8.3.5 Transfer Acknowledge

The $\overline{\text{TA}}$ /GPIO20 pin is the transfer acknowledge signal.

8.4 SDRAM Controller Signals

The following SDRAM signals provide a seamless interface to external SDRAM. An SDRAM width of 16 bits is supported and can access as much as 64 Mybtes of memory. ADRAMs are not supported.

Table 5. SDRAM Controller Signals

SDRAM Signal	Description
Synchronous DRAM row address strobe	The $\overline{\text{SDRAS}}$ active low pin provides a seamless interface to the RAS input on synchronous DRAM
Synchronous DRAM Column Address Strobe	The $\overline{\text{SDCAS}}$ active low pin provides a seamless interface to CAS input on synchronous DRAM.
Synchronous DRAM Write	The $\overline{\text{SDWE}}$ active-low pin is asserted to signify that a SDRAM write cycle is underway. This pin outputs logic '1' during read bus cycles.
Synchronous DRAM Chip Enable	The $\overline{\text{SD_CS1}}$ and The $\overline{\text{SDRAM_CS2/GPIO7}}$ active-low output signal is used during synchronous mode to route directly to the chip select of up to two SDRAM devices. The $\overline{\text{SDRAM_CS2/gpio7}}$ can be programmed to be gpio using the GPIO-FUNCTION register.
Synchronous DRAM UDQM and LDQM signals	The DRAM byte enables UDMQ and LDQM are driven by the SDUDQM and SLDQM byte enable outputs.
Synchronous DRAM clock	The DRAM clock is driven by the SCLK signal
Synchronous DRAM Clock Enable	The BCLKE active high output signal is used during synchronous mode to route directly to the SCKE signal of external SDRAMs. This signal provides the clock enable to the SDRAM.

NOTE

The SDRAM_CS2 signal is only used on the 160 MAPBGA package.

8.5 Chip Selects

There are two chip select outputs on the SCF5249 device. $\overline{\text{CS0}}$ and $\overline{\text{CS1/GPIO58}}$. The second signal is multiplexed with a GPIO signal. The active low chip selects can be used to access asynchronous memories. The interface is glueless.

8.6 ISA Bus

The SCF5249 supports an ISA bus. (No ISA DMA channel). Using the ISA bus protocol, reads and writes to up to two ISA bus peripherals are possible. For the first peripheral, CS2/ $\overline{\text{IDE-DIOR}}$ /GPIO13 and $\overline{\text{IDE-DIOW}}$ /GPIO14 are the read and write strobe. For the second peripheral, CS3/ $\overline{\text{SRE}}$ /GPIO11 and $\overline{\text{SWE}}$ /GPIO12 are the read and write strobe. Either peripheral can insert wait states by pulling IDE-IORDY/GPIO16

8.7 Bus Buffer Signals

As the SCF5249 has a quite complicated slave bus, with the possibility to put DRAM on the bus, put asynchronous memories on the bus, and to put ISA bus peripherals on the bus, it may become necessary to introduce a bus buffer on the bus. The SCF5249 has a glueless interface to steer these bus buffers with 2 bus buffer output signals BUFENB1/GPIO57 and BUFENB2/GPIO7.

NOTE

The BUFENB2 signal is only used in the 160 MAPBGA package.

8.8 I²C Module Signals

There are two I²C interfaces on this device.

The I²C module acts as a quick two-wire, bidirectional serial interface between the SCF5249 processor and peripherals with an I²C interface (e.g., LED controller, A-to-D converter, D-to-A converter). When devices connected to the I²C bus drive the bus, they will either drive logic-0 or high-impedance. This can be accomplished with an open-drain output.

Table 6. I²C Module Signals

I ² C Module Signal	Description
I ² C Serial Clock	The SCL/QPSICLK and SCL2/GPIO3 bidirectional signals are the clock signal for first and second I ² C module operation. The I ² C module controls this signal when the bus is in master mode; all I ² C devices drive this signal to synchronize I ² C timing. Signals are multiplexed Function select is done via PLLCR register.
I ² C Serial Data	The SDA/QSPI_DIN and SDA2/GPIO55 bidirectional signals are the data input/output for the first and second serial I ² C interface. Signals are multiplexed Function select is done via PLLCR register.

8.9 Serial Module Signals

The following signals transfer serial data between the two UART modules and external peripherals.

All serial module signals can be used as gpi or gpo. The GPIO-FUNCTION and GPIO1-FUNCTION registers must be programmed to determine pin functions of the inputs and outputs. If used as gpo or gpi, UART functionality is lost.

Table 7. Serial Module Signals

Serial Module Signal	Description
Receive Data	The RXD1_GPI27 and RXD2/ADIN2/GPI28 are the inputs on which serial data is received by the DUART. Data is sampled on RxD[1:0] on the rising edge of the serial clock source, with the least significant bit received first.
Transmit Data	The DUART transmits serial data on the TXD1/GPO27 and TXD2/GPO28 output signals. Data is transmitted on the falling edge of the serial clock source, with the least significant bit transmitted (LSB) first. When no data is being transmitted or the transmitter is disabled, these two signals are held high. TxD[1:0] are also held high in local loopback mode.
Request To Send	The $\overline{\text{RTS1}}$ /GPO30 and $\overline{\text{RTS2}}$ /GPO31 request-to-send outputs indicate to the peripheral device that the DUART is ready to send data and requires a clear-to-send signal to initiate transfer.
Clear To Send	Peripherals drive the $\overline{\text{CTS1}}$ /GPI30 and $\overline{\text{CTS2}}$ /ADIN3/GPI31 inputs to indicate to the SCF5249 serial module that it can begin data transmission.

8.10 Timer Module Signals

The following signals are external interface to the two general-purpose SCF5249 timers. These 16-bit timers can capture timer values, trigger external events, or internal interrupts, or count external events. These pins can be reused as GPO or GPI. Registers GPIO-FUNCTION and GPIO1-FUNCTION must be programmed for this.

Table 8. Timer Module Signals

Serial Module Signal	Description
Timer Input	Users can program the TIN0/GPI33 and TIN1/GPIO23 inputs as clocks that cause events in the counter and prescalars. They can also cause capture on the rising edge, falling edge, or both edges.
Timer Output	The TOUT0/GPO33 and TOUT1/ADOUT/GPO35 programmable outputs pulse or toggle on various timer events.

8.11 Serial Audio Interface Signals

All serial audio interface signals can be programmed to serve as general purpose I/Os or as serial audio interface signals. The function is programmed using GPIO-FUNCTION and GPIO1-FUNCTION registers.

NOTE

The LRCK3 and SCLK3 signals are only used in the 160 MAPBGA package..

Table 9. Serial Audio Interface Signals

Serial Module Signal	Description
Serial Audio Bit Clock	The SCLK1, SCLK2/GPIO48 and SCLK3/GPIO49, and SCLK4/GPIO50 multiplexed pins can serve as general purpose I/Os or serial audio bit clocks. As bit clocks, these bidirectional pins can be programmed as outputs to drive their associated serial audio (IIS) bit clocks. Alternately, these pins can be programmed as inputs when the serial audio bit clocks are driven internally. The functionality is programmed within the Audio module. During reset, these pins are configured as input serial audio bit clocks.
Serial Audio Word Clock	The LRCK1, LRCK2/GPIO44, LRCK3/GPIO45, and LRCK/GPIO46 multiplexed pins can serve as general purpose I/Os or serial audio word clocks. As word clocks, the bidirectional pins can be programmed as inputs to drive their associated serial audio word clock. Alternately, these pins can be programmed as outputs when the serial audio word clocks are derived internally. The functionality is programmed within the Audio module. During reset, these pins are configured as input serial audio word clocks.
Serial Audio Data In	The SDATAI1, SDATAI3/GPIO41, and SDATAI4/GPI42 multiplexed pins can serve as general purpose I/Os or serial audio inputs. As serial audio inputs the data is sent to interfaces 1 and 3 respectively. The functionality of these pins is programmed with the GPIO-FUNCTION and GPIO1-FUNCTION registers. During reset, the pins are configured as serial data inputs.
Serial Audio Data Out	The SDATAO1/GPIO25 AND SDATAO2/GPI41 multiplexed pins can serve as general purpose I/Os or serial audio outputs. The functionality of these pins is programmed with registers GPIO-FUNCTION and GPIO1-FUNCTION. During reset, the pins are configured as serial data outputs..
Serial audio error flag	The EF/GPIO19 multiplexed pin can serve as general purpose I/Os or error flag input. As error flag input, this pin will input the error flag delivered by the CD-DSP. EF/GPIO19 is only relevant for serial interface interface 1.
Serial audio CFLG	The CFLG/GPIO18 multiplexed pin can serve as general purpose I/O or CFLG input. As CFLG input, the pin will input the CFLG flag delivered by the CD-DSP. CFLG/GPIO18 is only relevant for serial interface 1.

8.12 Digital Audio Interface Signals

Table 10. Digital Audio Interface Signals

Serial Module Signal	Description
Digital Audio In	The EBUIN1/GPI36, EBUIN2/GPI37, EBUIN3/ADIN0/GPI38, and EBUIN4/ADIN1/GPI39 multiplexed signals can serve as general purpose input or can be driven by various digital audio (IEC958) input sources. Both functionalities are always active. Input chosen for IEC958 receiver is programmed within the audio module. Input value on the 4 pins can always be read from the appropriate gpio register..
Digital Audio Out	The EBUOUT1_GPO36 and EBUOUT2_GPO37 multiplexed pins can serve as general purpose I/O or as digital audio (IEC958) output. EBUOUT1 is digital audio out for consumer mode, EBUOUT2 is digital audio out for professional mode. The functionality of the pins is programmed with the GPIO-FUNCTION and GPIO1-FUNCTION register. During reset, the pin is configured as a digital audio output.

NOTE

The EBUOUT2 signal is only used on the 160 MAPBGA package.

8.13 Subcode Interface

There is a 3-line subcode interface on the SCF5249. This 3-line subcode interface allows the device to format and transmit subcode in EIAJ format to a CD channel encoder device. The three signals are described in [Table 11](#).

Table 11. Subcode Interface Signal

Signal name	Description
RCK/GPIO51	Subcode clock input. When pin is used as subcode clock, this pin is driven by the CD channel encoder.
SFSY/GPIO52	Subcode sync output This signal is driven high if a subcode sync needs to be inserted in the EFM stream.
SUBR/GPIO53	Subcode data output This signal is a subcode data out pin.

NOTE

The SUBR, SFSY, and the RCK signals are only used in the 160 MAPBGA package.

8.14 Analog to Digital Converter (ADC)

The single output on the TOUT1/ADOUT/GPO35 pin provides the reference voltage in PDM format therefore this output requires an external integrator circuit (resistor/capacitor) to convert it to a DC level to be used by the external comparator circuit. Four external comparators compare the DC level obtained after filtering TOUT1/ADOUT/GPO35 with the relevant input signals. The outputs of the comparators are fed to the 4 ADIN inputs on the SCF5249: EBUIN3/ADIN0/GPI38, EBUIN4/ADIN1/GPI39, RXD2/ADIN2/GPI38 and CTS2/ADIN3/GPI31. Selection of function for pin TOUT1/ADOUT/GPO35 is done by writing GPIO function select register (determines if function is GPIO or not), and differentiation between timer and adout functions is done in the ADCONFIG Register.

8.15 Secure Digital/ MemoryStick Card Interface

The device has a versatile flash card interface that supports both SecureDigital and MemoryStick cards. The interface can either support one SecureDigital or two MemoryStick cards. No mixing of card types is possible. [Table 12](#) gives the pin descriptions.

Table 12. Flash Memory Card Signals

Flash Memory Signal	Description
SCLKOUT/GPIO15	Clock out for both MemoryStick interfaces and for SecureDigital
CMD_SDIO2/GPIO34	Secure Digital command line MemoryStick interface 2 data i/o
SDATA0_SDIO1/GPIO54	SecureDigital serial data bit 0 MemoryStick interface 1 data i/o
SDATA1_BS1/GPIO9	SecureDigital serial data bit 1 MemoryStick interface 1 strobe
RSTO/SDATA2_BS2	SecureDigital serial data bit 2 MemoryStick interface 2 strobe Reset output signal Selection between Reset function and SDATA2_BS2 is done by programming PLLCR register.
SDATA3/GPIO57	SecureDigital serial data bit 3

NOTE

The SDATA0_SDIO1 and RSTO/SDATA2_BS2 signals are only used in the 160 MAPBGA package.

8.16 Queued Serial Peripheral Interface (QSPI)

Table 13. Queued Serial Peripheral Interface (QSPI) Signals

Serial Module Signal	Description
SCL_QSPICLK	Multiplexed signal IIC interface clock or QSPI clock output Function select is done via PLLCR register.
SDA_QSPIDIN	Multiplexed signal IIC interface data or QSPI data input. Function select is done via PLLCR register.
QSPIDOUT_GPIO26	QSPI data output
QSPICS0_GPIO29	4 different QSPI chip selects
QSPICS1_GPIO24	
QSPICS2_GPIO21	
QSPICS3_GPIO22	

NOTE

The QSPI interface is a high-speed serial interface allowing transmit and receive of serial data.

8.17 Crystal Trim

The XTRIM_GPIO38 output produces a pulse-density modulated phase/frequency difference signal to be used after low-pass filtering to control varicap-voltage to control crystal oscillation frequency. This will lock the crystal to the incoming digital audio signal.

8.18 Clock Out

The MCLK1/GPO39 and /MCLK2/GPO42 can serve as general purpose I/Os or as DAC clock outputs. When programmed as DAC clock outputs, these signals are directly derived from the crystal.

8.19 Debug and Test Signals

These signals interface with external I/O to provide processor status signals.

8.19.1 Test Mode

The TEST[3:0] inputs are used for various manufacturing and debug tests. For normal mode these inputs should be always be tied low. Use TEST0 to switch between background debug mode and JTAG mode. Drive TEST0 high for debug mode.

8.19.2 High Impedance

The assertion of $\overline{\text{HI_Z}}$ will force all output drivers to a high-impedance state. The timing on $\overline{\text{HI_Z}}$ is independent of the clock.

NOTE

JTAG operation will override the $\overline{\text{HI_Z}}$ pin.

8.19.3 Processor Clock Output

The internal PLL generates this PSTCLK/GPO63 and output signal, and is the processor clock output that is used as the timing reference for the Debug bus timing (DDATA[3:0] and PST[3:0]). The PSTCLK/GPO63 is at the same frequency as the core processor and cache memory. The frequency will be twice the bus clock (SCLK) frequency.

8.19.4 Debug Data

The debug data pins, DDATA0_GPIO0, DDATA1_GPIO1, DDATA2_GPIO2, and DDATA3_GPIO4, are four bits wide. This nibble-wide bus displays captured processor data and break-point status.