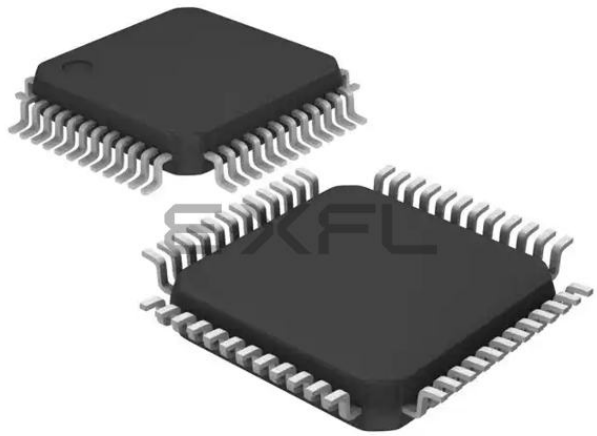

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Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	HCS12
Core Size	16-Bit
Speed	25MHz
Connectivity	CANbus, EBI/EMI, SCI, SPI
Peripherals	POR, PWM, WDT
Number of I/O	31
Program Memory Size	64KB (64K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	4K x 8
Voltage - Supply (Vcc/Vdd)	2.35V ~ 5.5V
Data Converters	A/D 8x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	48-LQFP
Supplier Device Package	48-LQFP (7x7)
Purchase URL	https://www.e-xfl.com/product-detail/nxp-semiconductors/mc9s12c64cfaer

Address	Name		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x0048	TCTL1	Read: Write:	OM7	OL7	OM6	OL6	OM5	OL5	OM4	OL4
0x0049	TCTL2	Read: Write:	OM3	OL3	OM2	OL2	OM1	OL1	OM0	OL0
0x004A	TCTL3	Read: Write:	EDG7B	EDG7A	EDG6B	EDG6A	EDG5B	EDG5A	EDG4B	EDG4A
0x004B	TCTL4	Read: Write:	EDG3B	EDG3A	EDG2B	EDG2A	EDG1B	EDG1A	EDG0B	EDG0A
0x004C	TIE	Read: Write:	C7I	C6I	C5I	C4I	C3I	C2I	C1I	C0I
0x004D	TSCR2	Read: Write:	TOI	0	0	0	TCRE	PR2	PR1	PR0
0x004E	TFLG1	Read: Write:	C7F	C6F	C5F	C4F	C3F	C2F	C1F	C0F
0x004F	TFLG2	Read: Write:	TOF	0	0	0	0	0	0	0
0x0050	TC0 (hi)	Read: Write:	Bit 15	14	13	12	11	10	9	Bit 8
0x0051	TC0 (lo)	Read: Write:	Bit 7	6	5	4	3	2	1	Bit 0
0x0052	TC1 (hi)	Read: Write:	Bit 15	14	13	12	11	10	9	Bit 8
0x0053	TC1 (lo)	Read: Write:	Bit 7	6	5	4	3	2	1	Bit 0
0x0054	TC2 (hi)	Read: Write:	Bit 15	14	13	12	11	10	9	Bit 8
0x0055	TC2 (lo)	Read: Write:	Bit 7	6	5	4	3	2	1	Bit 0
0x0056	TC3 (hi)	Read: Write:	Bit 15	14	13	12	11	10	9	Bit 8
0x0057	TC3 (lo)	Read: Write:	Bit 7	6	5	4	3	2	1	Bit 0
0x0058	TC4 (hi)	Read: Write:	Bit 15	14	13	12	11	10	9	Bit 8
0x0059	TC4 (lo)	Read: Write:	Bit 7	6	5	4	3	2	1	Bit 0
0x005A	TC5 (hi)	Read: Write:	Bit 15	14	13	12	11	10	9	Bit 8
0x005B	TC5 (lo)	Read: Write:	Bit 7	6	5	4	3	2	1	Bit 0
0x005C	TC6 (hi)	Read: Write:	Bit 15	14	13	12	11	10	9	Bit 8
0x005D	TC6 (lo)	Read: Write:	Bit 7	6	5	4	3	2	1	Bit 0
0x005E	TC7 (hi)	Read: Write:	Bit 15	14	13	12	11	10	9	Bit 8

1.3.4.6 PA[7:0] / ADDR[15:8] / DATA[15:8] — Port A I/O Pins

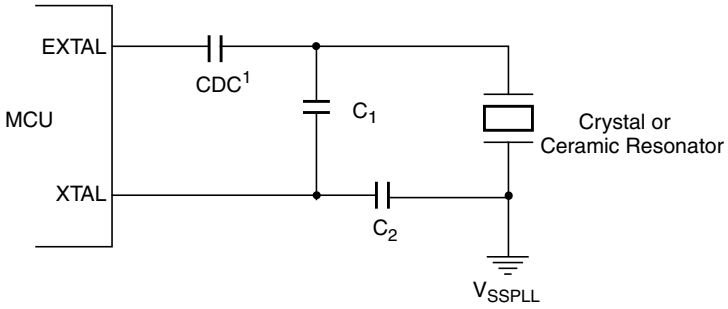
PA7–PA0 are general purpose input or output pins,. In MCU expanded modes of operation, these pins are used for the multiplexed external address and data bus. PA[7:1] pins are not available in the 48-pin package version. PA[7:3] are not available in the 52-pin package version.

1.3.4.7 PB[7:0] / ADDR[7:0] / DATA[7:0] — Port B I/O Pins

PB7–PB0 are general purpose input or output pins. In MCU expanded modes of operation, these pins are used for the multiplexed external address and data bus. PB[7:5] and PB[3:0] pins are not available in the 48-pin nor 52-pin package version.

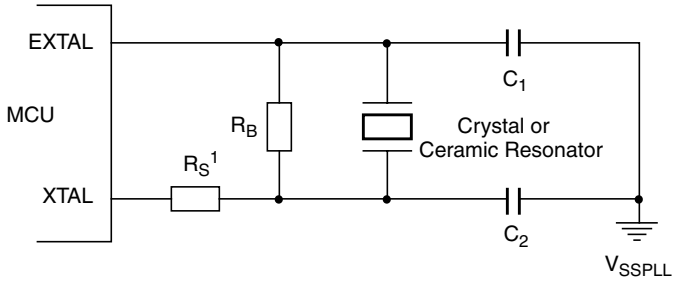
1.3.4.8 PE7 / NOACC / $\overline{\text{XCLKS}}$ — Port E I/O Pin 7

PE7 is a general purpose input or output pin. During MCU expanded modes of operation, the NOACC signal, when enabled, is used to indicate that the current bus cycle is an unused or “free” cycle. This signal will assert when the CPU is not using the bus.The $\overline{\text{XCLKS}}$ is an input signal which controls whether a crystal in combination with the internal Colpitts (low power) oscillator is used or whether Pierce oscillator/external clock circuitry is used. The state of this pin is latched at the rising edge of $\overline{\text{RESET}}$. If the input is a logic low the EXTAL pin is configured for an external clock drive or a Pierce oscillator. If input is a logic high a Colpitts oscillator circuit is configured on EXTAL and XTAL. Since this pin is an input with a pull-up device during reset, if the pin is left floating, the default configuration is a Colpitts oscillator circuit on EXTAL and XTAL.



1. Due to the nature of a translated ground Colpitts oscillator a DC voltage bias is applied to the crystal. Please contact the crystal manufacturer for crystal DC.

Figure 1-11. Colpitts Oscillator Connections (PE7 = 1)



1. RS can be zero (shorted) when used with higher frequency crystals, refer to manufacturer’s data.

Figure 1-12. Pierce Oscillator Connections (PE7 = 0)

Table 2-39. Port Reset State Summary

Port	Reset States				
	Data Direction	Pull Mode	Reduced Drive	Wired-OR Mode	Interrupt
T	Input	Hi-z	Disabled	n/a	n/a
S	Input	Pull up	Disabled	Disabled	n/a
M	Input	Pull up	Disabled	Disabled	n/a
P	Input	Hi-z	Disabled	n/a	Disabled
J	Input	Hi-z	Disabled	n/a	Disabled
A	Refer to MEBI Block Guide for details.				
B					
E					
BKGD pin	Refer to BDM Block Guide for details.				

2.6 Interrupts

Port P and J generate a separate edge sensitive interrupt if enabled.

2.6.1 Interrupt Sources

Table 2-40. Port Integration Module Interrupt Sources

Interrupt Source	Interrupt Flag	Local Enable	Global (CCR) Mask
Port P	PIFP[7:0]	PIEP[7:0]	I Bit
Port J	PIFJ[7:6]	PIEJ[7:6]	I Bit

NOTE

Vector addresses and their relative interrupt priority are determined at the MCU level.

2.6.2 Recovery from STOP

The PIM can generate wake-up interrupts from STOP on port P and J. For other sources of external interrupts please refer to the respective Block User Guide.

2.7 Application Information

It is not recommended to write PORTx and DDRx in a word access. When changing the register pins from inputs to outputs, the data may have extra transitions during the write access. Initialize the port data register before enabling the outputs.

Power consumption will increase the more the voltages on general purpose input pins deviate from the supply voltages towards mid-range because the digital input buffers operate in the linear region.

Table 3-10. MEMSIZ0 Field Descriptions

Field	Description
7:6 ROM_SW[1:0]	**Allocated System FLASH or ROM Physical Memory Space** — The allocated system FLASH or ROM physical memory space is as given in Table 3-11.
1:0 PAG_SW[1:0]	**Allocated Off-Chip FLASH or ROM Memory Space** — The allocated off-chip FLASH or ROM memory space size is as given in Table 3-12.

Table 3-11. Allocated FLASH/ROM Physical Memory Space

rom_sw1:rom_sw0	Allocated FLASH or ROM Space
00	0K byte
01	16K bytes
10	48K bytes(1)
11	64K bytes(1)

NOTES:

1. The ROMHM software bit in the MISC register determines the accessibility of the FLASH/ROM memory space. Please refer to Section 3.3.2.8, “Memory Size Register 1 (MEMSIZ1),” for a detailed functional description of the ROMHM bit.

Table 3-12. Allocated Off-Chip Memory Options

pag_sw1:pag_sw0	Off-Chip Space	On-Chip Space
00	876K bytes	128K bytes
01	768K bytes	256K bytes
10	512K bytes	512K bytes
11	0K byte	1M byte

NOTE

As stated, the bits in this register provide read visibility to the system memory space and on-chip/off-chip partitioning allocations defined at system integration. The actual array size for any given type of memory block may differ from the allocated size. Please refer to the device overview chapter for actual sizes.

vector spaces, expansion windows, and on-chip memory are mapped so that their address ranges do not overlap. The MMC will make only one select signal active at any given time. This activation is based upon the priority outlined in Table 3-15. If two or more blocks share the same address space, only the select signal for the block with the highest priority will become active. An example of this is if the registers and the RAM are mapped to the same space, the registers will have priority over the RAM and the portion of RAM mapped in this shared space will not be accessible. The expansion windows have the lowest priority. This means that registers, vectors, and on-chip memory are always visible to a program regardless of the values in the page select registers.

Table 3-15. Select Signal Priority

Priority	Address Space
Highest	BDM (internal to core) firmware or register space
...	Internal register space
...	RAM memory block
...	EEPROM memory block
...	On-chip FLASH or ROM
Lowest	Remaining external space

In expanded modes, all address space not used by internal resources is by default external memory space. The data registers and data direction registers for ports A and B are removed from the on-chip memory map and become external accesses. If the EME bit in the MODE register (see MEBI block description chapter) is set, the data and data direction registers for port E are also removed from the on-chip memory map and become external accesses.

In special peripheral mode, the first 16 registers associated with bus expansion are removed from the on-chip memory map (PORTA, PORTB, DDRA, DDRB, PORTE, DDRE, PEAR, MODE, PUCR, RDRIV, and the EBI reserved registers).

In emulation modes, if the EMK bit in the MODE register (see MEBI block description chapter) is set, the data and data direction registers for port K are removed from the on-chip memory map and become external accesses.

3.4.2.2 Emulation Chip Select Signal

When the EMK bit in the MODE register (see MEBI block description chapter) is set, port K bit 7 is used as an active-low emulation chip select signal, $\overline{\text{ECS}}$. This signal is active when the system is in emulation mode, the EMK bit is set and the FLASH or ROM space is being addressed subject to the conditions outlined in Section 3.4.3.2, “Extended Address (XAB19:14) and ECS Signal Functionality.” When the EMK bit is clear, this pin is used for general purpose I/O.

3.4.2.3 External Chip Select Signal

When the EMK bit in the MODE register (see MEBI block description chapter) is set, port K bit 6 is used as an active-low external chip select signal, $\overline{\text{XCS}}$. This signal is active only when the $\overline{\text{ECS}}$ signal described above is not active and when the system is addressing the external address space. Accesses to

These register locations are not used (reserved). All unused registers and bits in this block return logic 0s when read. Writes to these registers have no effect.

These registers are not in the on-chip map in special peripheral mode.

4.3.2.6 Port E Data Register (PORTE)

Module Base + 0x0008
Starting address location affected by INITRG register setting.

	7	6	5	4	3	2	1	0
R	Bit 7	6	5	4	3	2	Bit 1	Bit 0
W								
Reset	0	0	0	0	0	0	u	u
Alternate Pin Function	NOACC	MODB or IPIPE1 or CLKTO	MODA or IPIPE0	ECLK	$\overline{\text{LSTRB}}$ or $\overline{\text{TAGLO}}$	R/$\overline{\text{W}}$	$\overline{\text{IRQ}}$	$\overline{\text{XIRQ}}$

= Unimplemented or Reserved u = Unaffected by reset

Figure 4-10. Port E Data Register (PORTE)

Read: Anytime when register is in the map

Write: Anytime when register is in the map

Port E is associated with external bus control signals and interrupt inputs. These include mode select (MODB/IPIPE1, MODA/IPIPE0), E clock, size ($\overline{\text{LSTRB}}$/$\overline{\text{TAGLO}}$), read/write (R/$\overline{\text{W}}$), $\overline{\text{IRQ}}$, and $\overline{\text{XIRQ}}$. When not used for one of these specific functions, port E pins 7:2 can be used as general-purpose I/O and pins 1:0 can be used as general-purpose input. The port E assignment register (PEAR) selects the function of each pin and DDRE determines whether each pin is an input or output when it is configured to be general-purpose I/O. DDRE also determines the source of data for a read of PORTE.

Some of these pins have software selectable pull resistors. $\overline{\text{IRQ}}$ and $\overline{\text{XIRQ}}$ can only be pulled up whereas the polarity of the PE7, PE4, PE3, and PE2 pull resistors are determined by chip integration. Please refer to the device overview chapter (Signal Property Summary) to determine the polarity of these resistors. A single control bit enables the pull devices for all of these pins when they are configured as inputs.

This register is not in the on-chip map in special peripheral mode or in expanded modes when the EME bit is set. Therefore, these accesses will be echoed externally.

NOTE

It is unwise to write PORTE and DDRE as a word access. If you are changing port E pins from being inputs to outputs, the data may have extra transitions during the write. It is best to initialize PORTE before enabling as outputs.

4.4.3.1.2 Normal Expanded Wide Mode

In expanded wide modes, Ports A and B are configured as a 16-bit multiplexed address and data bus and Port E bit 4 is configured as the E clock output signal. These signals allow external memory and peripheral devices to be interfaced to the MCU.

Port E pins other than PE4/ECLK are configured as general purpose I/O pins (initially high-impedance inputs with internal pull resistors enabled). Control bits PIPOE, NECLK, LSTRE, and RDWE in the PEAR register can be used to configure Port E pins to act as bus control outputs instead of general purpose I/O pins.

It is possible to enable the pipe status signals on Port E bits 6 and 5 by setting the PIPOE bit in PEAR, but it would be unusual to do so in this mode. Development systems where pipe status signals are monitored would typically use the special variation of this mode.

The Port E bit 2 pin can be reconfigured as the R/$\overline{W}$ bus control signal by writing “1” to the RDWE bit in PEAR. If the expanded system includes external devices that can be written, such as RAM, the RDWE bit would need to be set before any attempt to write to an external location. If there are no writable resources in the external system, PE2 can be left as a general purpose I/O pin.

The Port E bit 3 pin can be reconfigured as the $\overline{LSTRB}$ bus control signal by writing “1” to the LSTRE bit in PEAR. The default condition of this pin is a general purpose input because the $\overline{LSTRB}$ function is not needed in all expanded wide applications.

The Port E bit 4 pin is initially configured as ECLK output with stretch. The E clock output function depends upon the settings of the NECLK bit in the PEAR register, the IVIS bit in the MODE register and the ESTR bit in the EBICTL register. The E clock is available for use in external select decode logic or as a constant speed clock for use in the external application system.

4.4.3.1.3 Normal Expanded Narrow Mode

This mode is used for lower cost production systems that use 8-bit wide external EPROMs or RAMs. Such systems take extra bus cycles to access 16-bit locations but this may be preferred over the extra cost of additional external memory devices.

Ports A and B are configured as a 16-bit address bus and Port A is multiplexed with data. Internal visibility is not available in this mode because the internal cycles would need to be split into two 8-bit cycles.

Since the PEAR register can only be written one time in this mode, use care to set all bits to the desired states during the single allowed write.

The PE3/$\overline{LSTRB}$ pin is always a general purpose I/O pin in normal expanded narrow mode. Although it is possible to write the LSTRE bit in PEAR to “1” in this mode, the state of LSTRE is overridden and Port E bit 3 cannot be reconfigured as the $\overline{LSTRB}$ output.

It is possible to enable the pipe status signals on Port E bits 6 and 5 by setting the PIPOE bit in PEAR, but it would be unusual to do so in this mode. LSTRB would also be needed to fully understand system activity. Development systems where pipe status signals are monitored would typically use special expanded wide mode or occasionally special expanded narrow mode.

8.1.2.2 MCU Operating Modes

- **Stop Mode**

  Entering stop mode causes all clocks to halt and thus the system is placed in a minimum power standby mode. This aborts any conversion sequence in progress. During recovery from stop mode, there must be a minimum delay for the stop recovery time, t_{SR}, before initiating a new ATD conversion sequence.

- **Wait Mode**

  Entering wait mode the ATD conversion either continues or aborts for low power depending on the logical value of the AWAIT bit.

- **Freeze Mode**

  In freeze mode the ATD10B8C will behave according to the logical values of the FRZ1 and FRZ0 bits. This is useful for debugging and emulation.

8.1.3 Block Diagram

Figure 8-1 is a block diagram of the ATD.

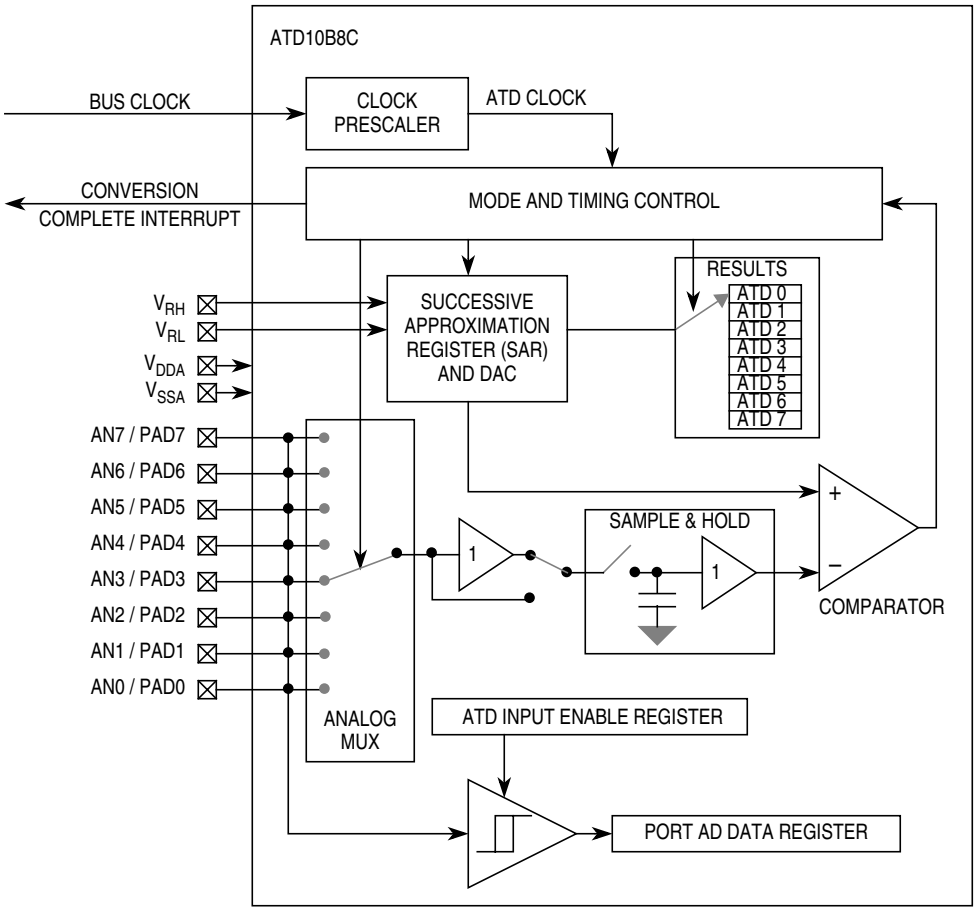


Figure 8-1. ATD10B8C Block Diagram

Address	Name		Bit 7	6	5	4	3	2	1	Bit 0
0x001E	ATDDR7H	R	BIT 9 MSB BIT 7 MSB	BIT 8 BIT 6	BIT 7 BIT 5	BIT 6 BIT 4	BIT 5 BIT 3	BIT 4 BIT 2	BIT 3 BIT 1	BIT 2 BIT 0
		W								
0x001F	ATDDR7L	R	BIT 1 u	BIT 0 u	0 0	0 0	0 0	0 0	0 0	0 0
		W								
Right Justified Result Data										
0x0010	ATDDR0H	R	0 0	0 0	0 0	0 0	0 0	0 0	BIT 9 MSB 0	BIT 8 0
		W								
0x0011	ATDDR0L	R	BIT 7 BIT 7 MSB	BIT 6 BIT 6	BIT 5 BIT 5	BIT 4 BIT 4	BIT 3 BIT 3	BIT 2 BIT 2	BIT 1 BIT 1	BIT 0 BIT 0
		W								
0x0012	ATDDR1H	R	0 0	0 0	0 0	0 0	0 0	0 0	BIT 9 MSB 0	BIT 8 0
		W								
0x0013	ATDDR1L	R	BIT 7 BIT 7 MSB	BIT 6 BIT 6	BIT 5 BIT 5	BIT 4 BIT 4	BIT 3 BIT 3	BIT 2 BIT 2	BIT 1 BIT 1	BIT 0 BIT 0
		W								
0x0014	ATDDR2H	R	0 0	0 0	0 0	0 0	0 0	0 0	BIT 9 MSB 0	BIT 8 0
		W								
0x0015	ATDDR2L	R	BIT 7 BIT 7 MSB	BIT 6 BIT 6	BIT 5 BIT 5	BIT 4 BIT 4	BIT 3 BIT 3	BIT 2 BIT 2	BIT 1 BIT 1	BIT 0 BIT 0
		W								
0x0016	ATDDR3H	R	0 0	0 0	0 0	0 0	0 0	0 0	BIT 9 MSB 0	BIT 8 0
		W								
0x0017	ATDDR3L	R	BIT 7 BIT 7 MSB	BIT 6 BIT 6	BIT 5 BIT 5	BIT 4 BIT 4	BIT 3 BIT 3	BIT 2 BIT 2	BIT 1 BIT 1	BIT 0 BIT 0
		W								
0x0018	ATDDR4H	R	0 0	0 0	0 0	0 0	0 0	0 0	BIT 9 MSB 0	BIT 8 0
		W								
0x0019	ATDDR4L	R	BIT 7 BIT 7 MSB	BIT 6 BIT 6	BIT 5 BIT 5	BIT 4 BIT 4	BIT 3 BIT 3	BIT 2 BIT 2	BIT 1 BIT 1	BIT 0 BIT 0
		W								
0x001A	ATDDR5H	R	0 0	0 0	0 0	0 0	0 0	0 0	BIT 9 MSB 0	BIT 8 0
		W								
0x001B	ATDDR5L	R	BIT 7 BIT 7 MSB	BIT 6 BIT 6	BIT 5 BIT 5	BIT 4 BIT 4	BIT 3 BIT 3	BIT 2 BIT 2	BIT 1 BIT 1	BIT 0 BIT 0
		W								

= Unimplemented or Reserved

Figure 8-2. ATD Register Summary (Sheet 3 of 4)

10.1.4 Modes of Operation

The following modes of operation are specific to the MSCAN. See Section 10.4, "Functional Description," for details.

- Listen-Only Mode
- MSCAN Sleep Mode
- MSCAN Initialization Mode
- MSCAN Power Down Mode

10.2 External Signal Description

The MSCAN uses two external pins:

10.2.1 RXCAN — CAN Receiver Input Pin

RXCAN is the MSCAN receiver input pin.

10.2.2 TXCAN — CAN Transmitter Output Pin

TXCAN is the MSCAN transmitter output pin. The TXCAN output pin represents the logic level on the CAN bus:

0 = Dominant state
1 = Recessive state

10.2.3 CAN System

A typical CAN system with MSCAN is shown in Figure 10-2. Each CAN station is connected physically to the CAN bus lines through a transceiver device. The transceiver is capable of driving the large current needed for the CAN bus and has current protection against defective CAN or defective stations.

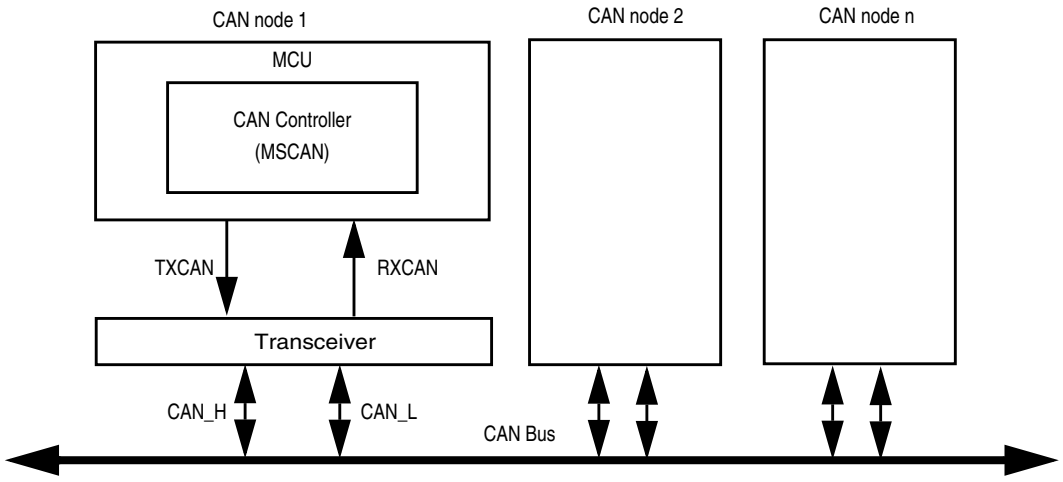


Figure 10-2. CAN System

The direction of each serial I/O pin depends on the BIDIROE bit. If the pin is configured as an output, serial data from the shift register is driven out on the pin. The same pin is also the serial input to the shift register.

The SCK is output for the master mode and input for the slave mode.

The $\overline{SS}$ is the input or output for the master mode, and it is always the input for the slave mode.

The bidirectional mode does not affect SCK and $\overline{SS}$ functions.

NOTE

In bidirectional master mode, with mode fault enabled, both data pins MISO and MOSI can be occupied by the SPI, though MOSI is normally used for transmissions in bidirectional mode and MISO is not used by the SPI. If a mode fault occurs, the SPI is automatically switched to slave mode, in this case MISO becomes occupied by the SPI and MOSI is not used. This has to be considered, if the MISO pin is used for other purpose.

14.4.6 Error Conditions

The SPI has one error condition:

- Mode fault error

14.4.6.1 Mode Fault Error

If the $\overline{SS}$ input becomes low while the SPI is configured as a master, it indicates a system error where more than one master may be trying to drive the MOSI and SCK lines simultaneously. This condition is not permitted in normal operation, the MODF bit in the SPI Status Register is set automatically provided the MODFEN bit is set.

In the special case where the SPI is in master mode and MODFEN bit is cleared, the $\overline{SS}$ pin is not used by the SPI. In this special case, the mode fault error function is inhibited and MODF remains cleared. In case the SPI system is configured as a slave, the $\overline{SS}$ pin is a dedicated input pin. Mode fault error doesn't occur in slave mode.

If a mode fault error occurs the SPI is switched to slave mode, with the exception that the slave output buffer is disabled. So SCK, MISO and MOSI pins are forced to be high impedance inputs to avoid any possibility of conflict with another output driver. A transmission in progress is aborted and the SPI is forced into idle state.

If the mode fault error occurs in the bidirectional mode for a SPI system configured in master mode, output enable of the MOMI (MOSI in bidirectional mode) is cleared if it was set. No mode fault error occurs in the bidirectional mode for SPI system configured in slave mode.

The mode fault flag is cleared automatically by a read of the SPI Status Register (with MODF set) followed by a write to SPI Control Register 1. If the mode fault flag is cleared, the SPI becomes a normal master or slave again.

Note: in Table 15-11, the IOS7 and IOSx should be set to 1

IOSx is the register TIOS bit x,

OC7Mx is the register OC7M bit x,

TCx is timer Input Capture/Output Compare register,

IOCx is channel x,

OMx/OLx is the register TCTL1/TCTL2,

OC7Dx is the register OC7D bit x.

IOCx = OC7Dx+ OMx/OLx, means that both OC7 event and OCx event will change channel x value.

Figure 17-9 illustrates all possible protection scenarios. Although the protection scheme is loaded from the Flash array after reset, it is allowed to change in normal modes. This protection scheme can be used by applications requiring re-programming in single chip mode while providing as much protection as possible if no re-programming is required.

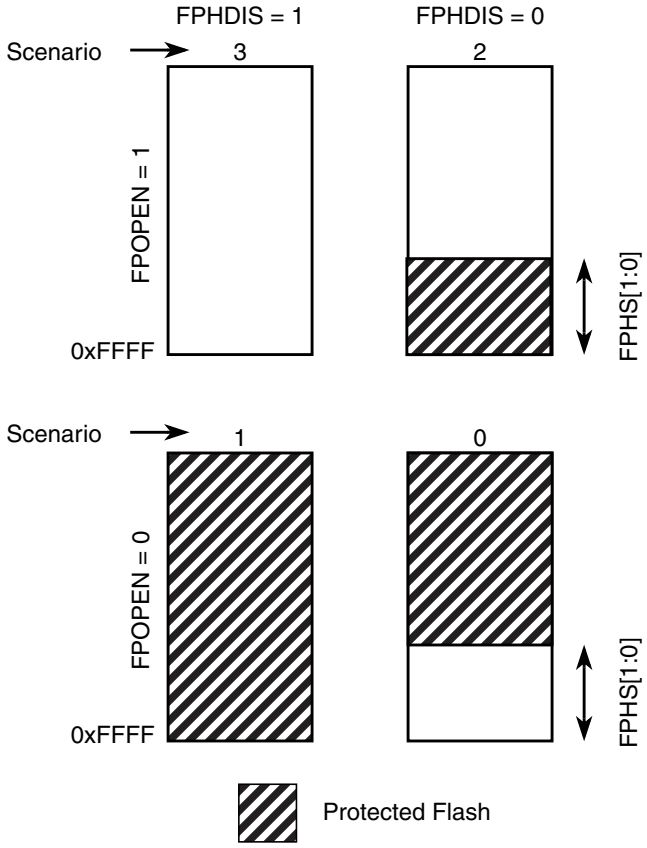


Figure 17-9. Flash Protection Scenarios

17.3.2.5.1 Flash Protection Restrictions

The general guideline is that protection can only be added, not removed. All valid transitions between Flash protection scenarios are specified in Table 17-11. Any attempt to write an invalid scenario to the FPROT register will be ignored and the FPROT register will remain unchanged. The contents of the FPROT register reflect the active protection scenario.

Table 17-11. Flash Protection Scenario Transitions

From Protection Scenario	To Protection Scenario[1]			
	0	1	2	3
0	X	X		
1		X		
2		X	X	

Table 18-4. FSEC Field Descriptions

Field	Description
7–6 KEYEN[1:0]	**Backdoor Key Security Enable Bits** — The KEYEN[1:0] bits define the enabling of the backdoor key access to the Flash module as shown in Table 18-5.
5–2 NV[5:2]	**Nonvolatile Flag Bits** — The NV[5:2] bits are available to the user as nonvolatile flags.
1–0 SEC[1:0]	**Flash Security Bits** — The SEC[1:0] bits define the security state of the MCU as shown in Table 18-6. If the Flash module is unsecured using backdoor key access, the SEC[1:0] bits are forced to 1:0.

Table 18-5. Flash KEYEN States

KEYEN[1:0]	Status of Backdoor Key Access
00	DISABLED
01(1)	DISABLED
10	ENABLED
11	DISABLED

1. Preferred KEYEN state to disable Backdoor Key Access.

Table 18-6. Flash Security States

SEC[1:0]	Status of Security
00	Secured
01(1)	Secured
10	Unsecured
11	Secured

1. Preferred SEC state to set MCU to secured state.

The security function in the Flash module is described in Section 18.4.3, “Flash Module Security”.

18.3.2.3 RESERVED1

This register is reserved for factory testing and is not accessible to the user.

Module Base + 0x0002

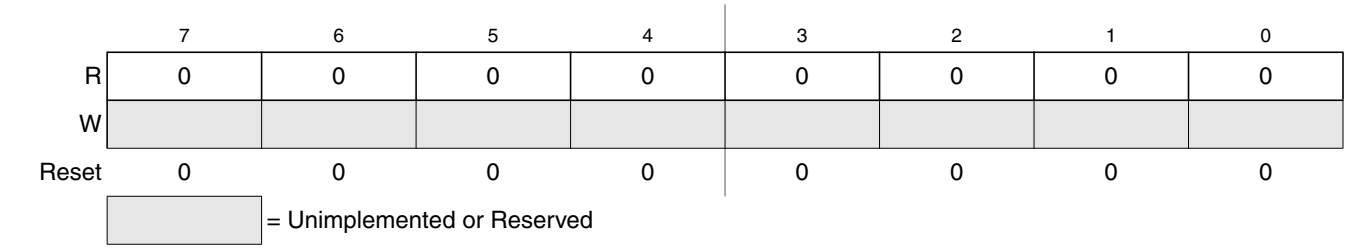
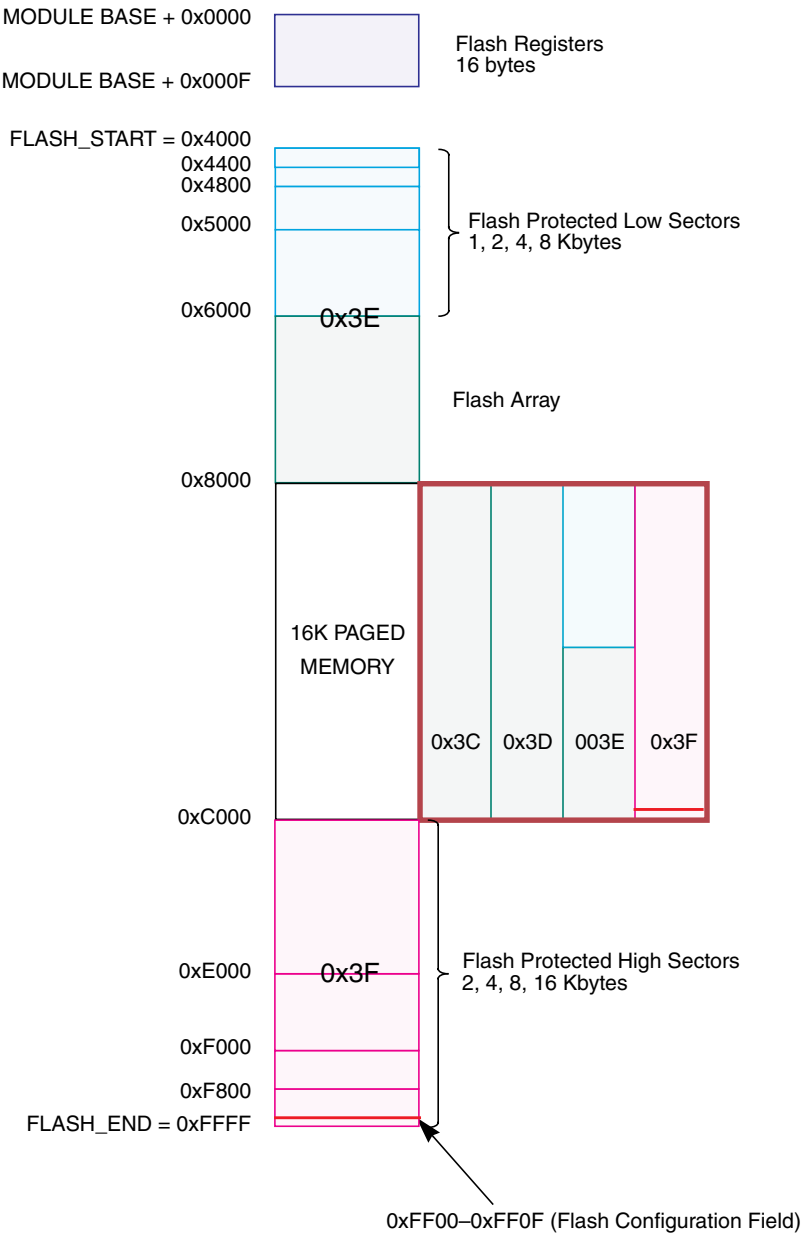


Figure 18-6. RESERVED1

All bits read 0 and are not writable.



Note: 0x3C–0x3F correspond to the PPAGE register content

Figure 19-4. Flash Memory Map

address 0x8000 to 0xBFFF to any physical 16K byte page in the Flash array memory.[1] The FPROT register (see Section 20.3.2.5) can be set to globally protect the entire Flash array. Three separate areas, one starting from the Flash array starting address (called lower) towards higher addresses, one growing downward from the Flash array end address (called higher), and the remaining addresses, can be activated for protection. The Flash array addresses covered by these protectable regions are shown in Figure 20-3Figure 20-4. The higher address area is mainly targeted to hold the boot loader code since it covers the vector space. The lower address area can be used for EEPROM emulation in an MCU without an EEPROM module since it can be left unprotected while the remaining addresses are protected from program or erase. Default protection settings as well as security information that allows the MCU to restrict access to the Flash module are stored in the Flash configuration field described in Table 20-1.

Table 20-1. Flash Configuration Field

Flash Address	Size (bytes)	Description
0xFF00–0xFF07	8	Backdoor Key to unlock security
0xFF08–0xFF0C	5	Reserved
0xFF0D	1	Flash Protection byte Refer to Section 20.3.2.5, “Flash Protection Register (FPROT)”
0xFF0E	1	Reserved
0xFF0F	1	Flash Security/Options byte Refer to Section 20.3.2.2, “Flash Security Register (FSEC)”

1. By placing 0x3E/0x3F in the HCS12 Core PPAGE register, the bottom/top fixed 16 Kbyte pages can be seen twice in the MCU memory map.

Table 20-2. Flash Array Memory Map Summary

MCU Address Range	PPAGE	Protectable Low Range	Protectable High Range	Array Relative Address[1]
0x0000–0x3FFF[2]	Unpaged (0x3D)	N.A.	N.A.	0x14000–0x17FFF
0x4000–0x7FFF	Unpaged (0x3E)	0x4000–0x43FF 0x4000–0x47FF 0x4000–0x4FFF 0x4000–0x5FFF	N.A.	0x18000–0x1BFFF
0x8000–0xBFFF	0x38	N.A.	N.A.	0x00000–0x03FFF
	0x39	N.A.	N.A.	0x04000–0x07FFF
	0x3A	N.A.	N.A.	0x08000–0x0BFFF
	0x3B	N.A.	N.A.	0x0C000–0x0FFFF
	0x3C	N.A.	N.A.	0x10000–0x13FFF
	0x3D	N.A.	N.A.	0x14000–0x17FFF
	0x3E	0x8000–0x83FF 0x8000–0x87FF 0x8000–0x8FFF 0x8000–0x9FFF	N.A.	0x18000–0x1BFFF
	0x3F	N.A.	0xB800–0xBFFF 0xB000–0xBFFF 0xA000–0xBFFF 0x8000–0xBFFF	0x1C000–0x1FFFF
0xC000–0xFFFF	Unpaged (0x3F)	N.A.	0xF800–0xFFFF 0xF000–0xFFFF 0xE000–0xFFFF 0xC000–0xFFFF	0x1C000–0x1FFFF

1. Inside Flash block.
2. If allowed by MCU.

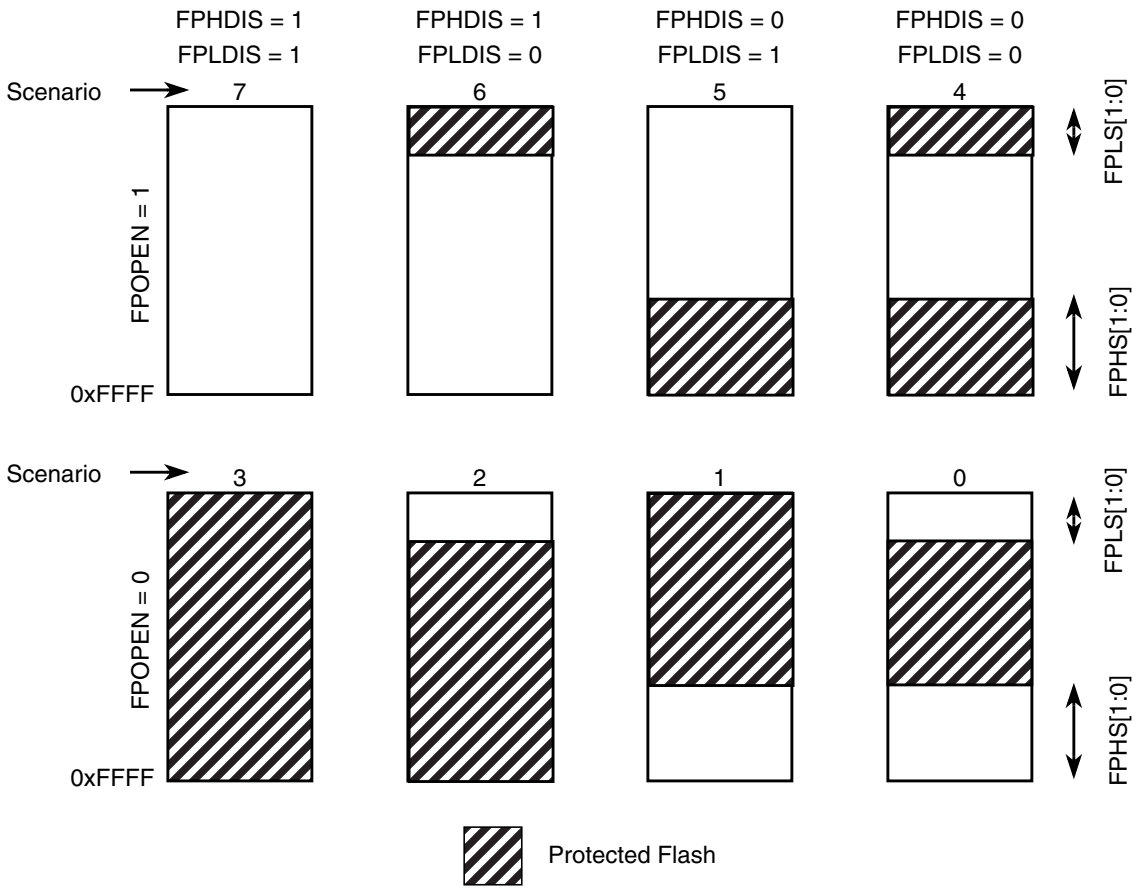


Figure 20-11. Flash Protection Scenarios

20.3.2.5.1 Flash Protection Restrictions

The general guideline is that protection can only be added, not removed. All valid transitions between Flash protection scenarios are specified in Table 20-13. Any attempt to write an invalid scenario to the FPROT register will be ignored and the FPROT register will remain unchanged. The contents of the FPROT register reflect the active protection scenario.

Table 20-13. Flash Protection Scenario Transitions

From Protection Scenario	To Protection Scenario[1]							
	0	1	2	3	4	5	6	7
0	X	X	X	X				
1		X		X				
2			X	X				
3				X				
4				X	X			
5			X	X	X	X		

Table 21-2. Flash Array Memory Map Summary

MCU Address Range	PPAGE	Protectable Low Range	Protectable High Range	Array Relative Address[1]
0x0000–0x3FFF[2]	Unpaged (0x3D)	N.A.	N.A.	0x14000–0x17FFF
0x4000–0x7FFF	Unpaged (0x3E)	0x4000–0x43FF 0x4000–0x47FF 0x4000–0x4FFF 0x4000–0x5FFF	N.A.	0x18000–0x1BFFF
0x8000–0xBFFF	0x38	N.A.	N.A.	0x00000–0x03FFF
	0x39	N.A.	N.A.	0x04000–0x07FFF
	0x3A	N.A.	N.A.	0x08000–0x0BFFF
	0x3B	N.A.	N.A.	0x0C000–0x0FFFF
	0x3C	N.A.	N.A.	0x10000–0x13FFF
	0x3D	N.A.	N.A.	0x14000–0x17FFF
	0x3E	0x8000–0x83FF 0x8000–0x87FF 0x8000–0x8FFF 0x8000–0x9FFF	N.A.	0x18000–0x1BFFF
	0x3F	N.A.	0xB800–0xBFFF 0xB000–0xBFFF 0xA000–0xBFFF 0x8000–0xBFFF	0x1C000–0x1FFFF
0xC000–0xFFFF	Unpaged (0x3F)	N.A.	0xF800–0xFFFF 0xF000–0xFFFF 0xE000–0xFFFF 0xC000–0xFFFF	0x1C000–0x1FFFF

1. Inside Flash block.
2. If allowed by MCU.

Appendix C
Package Information

C.1 General

This section provides the physical dimensions of the packages 48LQFP, 52LQFP, 80QFP.