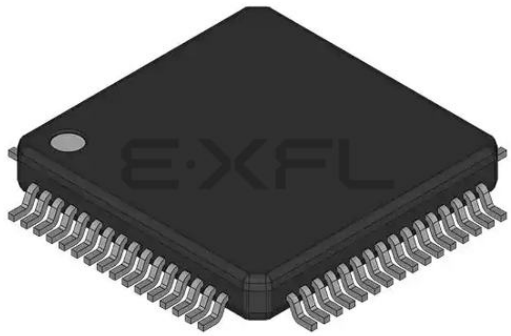

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Details	
Product Status	Active
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Speed	32MHz
Connectivity	CANbus, SCI, SPI
Peripherals	LVD, POR, PWM, WDT
Number of I/O	49
Program Memory Size	96KB (96K x 8)
Program Memory Type	FLASH
EEPROM Size	4K x 8
RAM Size	6K x 8
Voltage - Supply (Vcc/Vdd)	1.72V ~ 5.5V
Data Converters	A/D 10x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	64-LQFP
Supplier Device Package	64-LQFP (10x10)
Purchase URL	https://www.e-xfl.com/pro/item?MUrl=&PartUrl=s9s12p96j0mlh

Table 1-8. Pin-Out Summary[1]

Package Pin			Function			Power Supply	Internal Pull Resistor		Description
QFP 80	LQFP 64	QFN 48	Pin	2nd Func.	3rd Func.		CTRL	Reset State	
1	1	1	PP3	KWP3	PWM3	VDDX	PERP/PPSP	Disabled	Port P I/O, interrupt, PWM channel
2	2	2	PP2	KWP2	PWM2	VDDX	PERP/PPSP	Disabled	Port P I/O, interrupt, PWM channel
3	3	3	PP1	KWP1	PWM1	VDDX	PERP/PPSP	Disabled	Port P I/O, interrupt, PWM channel
4	4	-	PP0	KWP0	PWM0	VDDX	PERP/PPSP	Disabled	Port P I/O, interrupt, PWM/ channel
5	5	4	PT0	IOC0	PWM0	VDDX	PERT/PPST	Disabled	Port T I/O, TIM channel
6	6	5	PT1	IOC1	—	VDDX	PERT/PPST	Disabled	Port T I/O, TIM channel
7	7	6	PT2	IOC2	—	VDDX	PERT/PPST	Disabled	Port T I/O, TIM channel
8	8	7	PT3	IOC3	—	VDDX	PERT/PPST	Disabled	Port T I/O, TIM channel
9	9	-	PJ0	KWJ0	—	VDDX	PERJ/PPSJ	Up	Port J I/O, interrupt
10	10	-	PJ1	KWJ1	—	VDDX	PERJ/PPSJ	Up	Port J I/O, interrupt
11	11	8	PT4	IOC4	PWM4	VDDX	PERT/PPST	Disabled	Port T I/O, PWM/TIM channel
12	12	9	PT5	IOC5	PWM5 or API_EXTCLK	VDDX	PERT/PPST	Disabled	Port T I/O, PWM/TIM channel, API output
13	13	10	PT6	IOC6		VDDX	PERT/PPST	Disabled	Port T I/O, channel of TIM
14	14	11	PT7	IOC7		VDDX	PERT/PPST	Disabled	Port T I/O, channel of TIM
15	15	12	BKGD	MODC	—	VDDX	Always on	Up	Background debug

2.3.38 Port M Wired-Or Mode Register (WOMM)

Address 0x0256 Access: User read/write(1)

	7	6	5	4	3	2	1	0
R	0	0	WOMM5	WOMM4	WOMM3	WOMM2	WOMM1	WOMM0
W								
Reset	0	0	0	0	0	0	0	0

Figure 2-36. Port M Wired-Or Mode Register (WOMM)

1. Read: Anytime
   Write: Anytime

Table 2-34. WOMM Register Field Descriptions

Field	Description
5-0 WOMM	**Port M wired-or mode**—Enable open-drain functionality on output pin This bit configures an output pin as wired-or (open-drain) or push-pull. In wired-or mode a logic “0” is driven active low while a logic “1” remains undriven. This allows a multipoint connection of several serial modules. The bit has no influence on pins used as input. 1 Output buffer operates as open-drain output. 0 Output buffer operates as push-pull output.

2.3.39 PIM Reserved Register

Address 0x0257 Access: User read(1)

	7	6	5	4	3	2	1	0
R	0	0	0	0	0	0	0	0
W								
Reset	0	0	0	0	0	0	0	0

= Unimplemented or Reserved u = Unaffected by reset

Figure 2-37. PIM Reserved Register

1. Read: Always reads 0x00
   Write: Unimplemented

2.3.40 Port P Data Register (PTP)

Address 0x0258 Access: User read/write(1)

	7	6	5	4	3	2	1	0
R	PTP7	0	PTP5	PTP4	PTP3	PTP2	PTP1	PTP0
W								
Altern. Function	—	—	PWM5	PWM4	PWM3	PWM2	PWM1	PWM0
Reset	0	0	0	0	0	0	0	0

Figure 2-38. Port P Data Register (PTP)

1. Read: Anytime. The data source is depending on the data direction value.
   Write: Anytime

Table 2-35. PTP Register Field Descriptions

Field	Description
7 PTP	**Port P general purpose input/output data**—Data Register, pin interrupt input/output The associated pin can be used as general purpose I/O. In general purpose output mode the register bit value is driven to the pin. If the associated data direction bit is set to 1, a read returns the value of the port register bit, otherwise the buffered pin input state is read. • Pin interrupts can be generated if enabled in input or output mode.
5 PTP	**Port P general purpose input/output data**—Data Register, PWM input/output, pin interrupt input/output When not used with the alternative function, the associated pin can be used as general purpose I/O. In general purpose output mode the register bit value is driven to the pin. If the associated data direction bit is set to 1, a read returns the value of the port register bit, otherwise the buffered pin input state is read. • The PWM function takes precedence over the general purpose I/O function if the related channel or the emergency shut-down feature is enabled. • Pin interrupts can be generated if enabled in input or output mode.
4-0 PTP	**Port P general purpose input/output data**—Data Register, PWM output, pin interrupt input/output When not used with the alternative function, the associated pin can be used as general purpose I/O. In general purpose output mode the register bit value is driven to the pin. If the associated data direction bit is set to 1, a read returns the value of the port register bit, otherwise the buffered pin input state is read. • The PWM function takes precedence over the general purpose I/O function if the related channel is enabled. • Pin interrupts can be generated if enabled in input or output mode.

2.4.4 Pin interrupts

Ports P and J offer pin interrupt capability. The interrupt enable as well as the sensitivity to rising or falling edges can be individually configured on per-pin basis. All bits/pins in a port share the same interrupt vector. Interrupts can be used with the pins configured as inputs or outputs.

An interrupt is generated when a bit in the port interrupt flag register and its corresponding port interrupt enable bit are both set. The pin interrupt feature is also capable to wake up the CPU when it is in STOP or WAIT mode.

A digital filter on each pin prevents pulses (Figure 2-66) shorter than a specified time from generating an interrupt. The minimum time varies over process conditions, temperature and voltage (Figure 2-65 and Table 2-60).

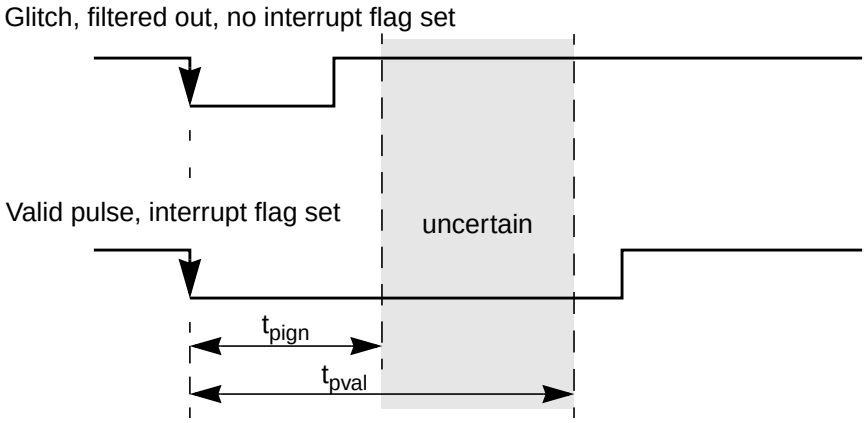

Figure 2-65. Interrupt Glitch Filter on Port P and J (PPS=0)

Table 2-60. Pulse Detection Criteria

Pulse	Mode		
	$\overline{\text{STOP}}$		STOP(1)
		Unit	
Ignored	$t_{pulse} \leq 3$	bus clocks	$t_{pulse} \leq t_{pign}$
Uncertain	$3 < t_{pulse} < 4$	bus clocks	$t_{pign} < t_{pulse} < t_{pval}$
Valid	$t_{pulse} \geq 4$	bus clocks	$t_{pulse} \geq t_{pval}$

1. These values include the spread of the oscillator frequency over temperature, voltage and process.

clock please make sure that the communication rate is adapted accordingly and a communication time-out (BDM soft reset) has occurred.

5.3 Memory Map and Register Definition

5.3.1 Module Memory Map

Table 5-1 shows the BDM memory map when BDM is active.

Table 5-1. BDM Memory Map

Global Address	Module	Size (Bytes)
0x3_FF00–0x3_FF0B	BDM registers	12
0x3_FF0C–0x3_FF0E	BDM firmware ROM	3
0x3_FF0F	Family ID (part of BDM firmware ROM)	1
0x3_FF10–0x3_FFFF	BDM firmware ROM	240

5.3.2 Register Descriptions

A summary of the registers associated with the BDM is shown in Figure 5-2. Registers are accessed by host-driven communications to the BDM hardware using READ_BD and WRITE_BD commands.

Global Address	Register Name		Bit 7	6	5	4	3	2	1	Bit 0
0x3_FF00	Reserved	R	X	X	X	X	X	X	0	0
		W								
0x3_FF01	BDMSTS	R	ENBDM	BDMACT	0	SDV	TRACE	0	UNSEC	0
		W								
0x3_FF02	Reserved	R	X	X	X	X	X	X	X	X
		W								
0x3_FF03	Reserved	R	X	X	X	X	X	X	X	X
		W								
0x3_FF04	Reserved	R	X	X	X	X	X	X	X	X
		W								

= Unimplemented, Reserved

= Implemented (do not alter)

X = Indeterminate

0 = Always read zero

Figure 5-2. BDM Register Summary

7.1.2.3 Stop Mode

This mode is entered by executing the CPU STOP instruction.

The voltage regulator is in Reduced Power Mode (RPM).

The API is available.

The Phase Locked Loop (PLL) is off.

The Internal Reference Clock (IRC1M) is off.

Core Clock, Bus Clock and BDM Clock are stopped.

Depending on the setting of the PSTP and the OSCE bit, Stop Mode can be differentiated between Full Stop Mode (PSTP = 0 or OSCE=0) and Pseudo Stop Mode (PSTP = 1 and OSCE=1).

- **Full Stop Mode (PSTP=0 or OSCE=0)**
  The external oscillator (OSCLCP) is disabled.
  After wake-up from Full Stop Mode the Core Clock and Bus Clock are running on PLLCLK (PLLSEL=1). After wake-up from Full Stop Mode COP and RTI are running on IRCCLK (COPOSCSEL=0, RTIOSCSEL=0).
- **Pseudo Stop Mode (PSTP=1 and OSCE=1)**
  The external oscillator (OSCLCP) continues torun. If the respective enable bits are set the COP and RTI will continue to run.
  The clock configuration bits PLLSEL, COPOSCSEL, RTIOSCSEL are unchanged.

NOTE

When starting up the external oscillator (either by programming OSCE bit to 1 or on exit from Full Stop Mode with OSCE bit already 1) the software must wait for a minimum time equivalent to the startup-time of the external oscillator t_{UPOSC} before entering Pseudo Stop Mode.

7.3.2.20 S12CPMU IRC1M Trim Registers (CPMUIRCTRIMH / CPMUIRCTRIML)

0x02F8

	15	14	13	12	11	10	9	8
R	TCTRIM[3:0]				0	0	IRCTRIM[9:8]	
W								
Reset	F	F	F	F	0	0	F	F

After de-assert of System Reset a factory programmed trim value is automatically loaded from the Flash memory to provide trimmed Internal Reference Frequency f_{IRC1M_TRIM}.

Figure 7-24. S12CPMU IRC1M Trim High Register (CPMUIRCTRIMH)

0x02F9

	7	6	5	4	3	2	1	0
R	IRCTRIM[7:0]							
W								
Reset	F	F	F	F	F	F	F	F

After de-assert of System Reset a factory programmed trim value is automatically loaded from the Flash memory to provide trimmed Internal Reference Frequency f_{IRC1M_TRIM}.

Figure 7-25. S12CPMU IRC1M Trim Low Register (CPMUIRCTRIML)

Read: Anytime

Write: If PROT=0 (CPMUPROT register), then write anytime. Else write has no effect

NOTE

Writes to these registers while PLLSEL=1 clears the LOCK and UPOSC status bits.

Table 7-20. CPMUIRCTRIMH/L Field Descriptions

Field	Description
15-12 TCTRIM[3:0]	**IRC1M temperature coefficient Trim Bits** Trim bits for the Temperature Coefficient (TC) of the IRC1M frequency. Table 7-21 shows the influence of the bits TCTRIM3:0] on the relationship between frequency and temperature. Figure 7-27 shows an approximate TC variation, relative to the nominal TC of the IRC1M (i.e. for TCTRIM[3:0]=0000 or 1000).
9-0 IRCTRIM[9:0]	**IRC1M Frequency Trim Bits** — Trim bits for Internal Reference Clock After System Reset the factory programmed trim value is automatically loaded into these registers, resulting in a Internal Reference Frequency f_{IRC1M_TRIM}. See device electrical characteristics for value of f_{IRC1M_TRIM}. The frequency trimming consists of two different trimming methods: A rough trimming controlled by bits IRCTRIM[9:6] can be done with frequency leaps of about 6% in average. A fine trimming controlled by the bits IRCTRIM[5:0] can be doe with frequency leaps of about 0.3% (this trimming determines the precision of the frequency setting of 0.15%, i.e. 0.3% is the distance between two trimming values). Figure 7-26 shows the relationship between the trim bits and the resulting IRC1M frequency.

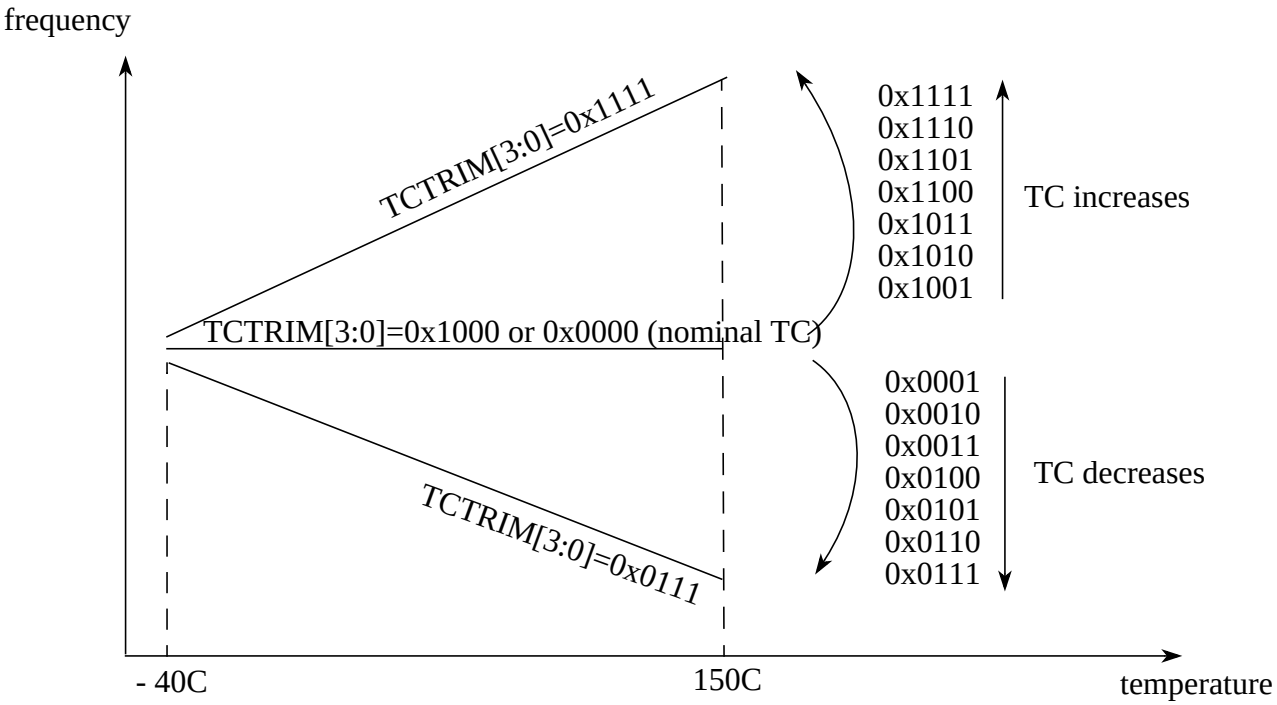

Figure 7-27. Influence of TCTRIM[3:0] on the Temperature Coefficient

NOTE

The frequency is not necessarily linear with the temperature (in most cases it will not be). The above diagram is meant only to give the direction (positive or negative) of the variation of the TC, relative to the nominal TC.

Setting TCTRIM[3:0] to 0x0000 or 0x1000 does not mean that the temperature coefficient will be zero. These two combinations basically switch off the TC compensation module, which results in the nominal TC of the IRC1M.

Register Name		Bit 7	6	5	4	3	2	1	Bit 0
0x000E CANRXERR	R	RXERR7	RXERR6	RXERR5	RXERR4	RXERR3	RXERR2	RXERR1	RXERR0
	W								
0x000F CANTXERR	R	TXERR7	TXERR6	TXERR5	TXERR4	TXERR3	TXERR2	TXERR1	TXERR0
	W								
0x0010–0x0013 CANIDAR0–3	R	AC7	AC6	AC5	AC4	AC3	AC2	AC1	AC0
	W								
0x0014–0x0017 CANIDMRx	R	AM7	AM6	AM5	AM4	AM3	AM2	AM1	AM0
	W								
0x0018–0x001B CANIDAR4–7	R	AC7	AC6	AC5	AC4	AC3	AC2	AC1	AC0
	W								
0x001C–0x001F CANIDMR4–7	R	AM7	AM6	AM5	AM4	AM3	AM2	AM1	AM0
	W								
0x0020–0x002F CANRXFG	R	See Section 8.3.3, "Programmer's Model of Message Storage"							
	W								
0x0030–0x003F CANTXFG	R	See Section 8.3.3, "Programmer's Model of Message Storage"							
	W								

= Unimplemented or Reserved

Figure 8-3. MSCAN Register Summary (continued)

8.3.2 Register Descriptions

This section describes in detail all the registers and register bits in the MSCAN module. Each description includes a standard register diagram with an associated figure number. Details of register bit and field function follow the register diagrams, in bit order. All bits of all registers in this module are completely synchronous to internal clocks during a register read.

8.3.2.1 MSCAN Control Register 0 (CANCTL0)

The CANCTL0 register provides various control bits of the MSCAN module as described below.

Module Base + 0x00X2

	7	6	5	4	3	2	1	0
R W	ID14	ID13	ID12	ID11	ID10	ID9	ID8	ID7
Reset:	x	x	x	x	x	x	x	x

Figure 8-28. Identifier Register 2 (IDR2) — Extended Identifier Mapping

Table 8-29. IDR2 Register Field Descriptions — Extended

Field	Description
7-0 ID[14:7]	**Extended Format Identifier —** The identifiers consist of 29 bits (ID[28:0]) for the extended format. ID28 is the most significant bit and is transmitted first on the CAN bus during the arbitration procedure. The priority of an identifier is defined to be highest for the smallest binary number.

Module Base + 0x00X3

	7	6	5	4	3	2	1	0
R W	ID6	ID5	ID4	ID3	ID2	ID1	ID0	RTR
Reset:	x	x	x	x	x	x	x	x

Figure 8-29. Identifier Register 3 (IDR3) — Extended Identifier Mapping

Table 8-30. IDR3 Register Field Descriptions — Extended

Field	Description
7-1 ID[6:0]	**Extended Format Identifier —** The identifiers consist of 29 bits (ID[28:0]) for the extended format. ID28 is the most significant bit and is transmitted first on the CAN bus during the arbitration procedure. The priority of an identifier is defined to be highest for the smallest binary number.
0 RTR	**Remote Transmission Request** — This flag reflects the status of the remote transmission request bit in the CAN frame. In the case of a receive buffer, it indicates the status of the received frame and supports the transmission of an answering frame in software. In the case of a transmit buffer, this flag defines the setting of the RTR bit to be sent. 0 Data frame 1 Remote frame

Read: Anytime

Write: Anytime (No effect on (CC3, CC2, CC1, CC0))

Table 9-16. ATDSTAT0 Field Descriptions

Field	Description
7 SCF	**Sequence Complete Flag** — This flag is set upon completion of a conversion sequence. If conversion sequences are continuously performed (SCAN=1), the flag is set after each one is completed. This flag is cleared when one of the following occurs: A) Write “1” to SCF B) Write to ATDCTL5 (a new conversion sequence is started) C) If AFFC=1 and read of a result register 0 Conversion sequence not completed 1 Conversion sequence has completed
5 ETORF	**External Trigger Overrun Flag** — While in edge trigger mode (ETRIGLE=0), if additional active edges are detected while a conversion sequence is in process the overrun flag is set. This flag is cleared when one of the following occurs: A) Write “1” to ETORF B) Write to ATDCTL0,1,2,3,4, ATDCMPE or ATDCMPHT (a conversion sequence is aborted) C) Write to ATDCTL5 (a new conversion sequence is started) 0 No External trigger over run error has occurred 1 External trigger over run error has occurred
4 FIFOR	**Result Register Over Run Flag** — This bit indicates that a result register has been written to before its associated conversion complete flag (CCF) has been cleared. This flag is most useful when using the FIFO mode because the flag potentially indicates that result registers are out of sync with the input channels. However, it is also practical for non-FIFO modes, and indicates that a result register has been over written before it has been read (i.e. the old data has been lost). This flag is cleared when one of the following occurs: A) Write “1” to FIFOR B) Write to ATDCTL0,1,2,3,4, ATDCMPE or ATDCMPHT (a conversion sequence is aborted) C) Write to ATDCTL5 (a new conversion sequence is started) 0 No over run has occurred 1 Overrun condition exists (result register has been written while associated CCFx flag was still set)
3–0 CC[3:0]	**Conversion Counter** — These 4 read-only bits are the binary value of the conversion counter. The conversion counter points to the result register that will receive the result of the current conversion. E.g. CC3=0, CC2=1, CC1=1, CC0=0 indicates that the result of the current conversion will be in ATD Result Register 6. If in non-FIFO mode (FIFO=0) the conversion counter is initialized to zero at the begin and end of the conversion sequence. If in FIFO mode (FIFO=1) the register counter is not initialized. The conversion counters wraps around when its maximum value is reached. Aborting a conversion or starting a new conversion clears the conversion counter even if FIFO=1.

9.3.2.8 ATD Compare Enable Register (ATDCMPE)

Writes to this register will abort current conversion sequence.

Read: Anytime

Write: Anytime

Table 9-18. ATDSTAT2 Field Descriptions

Field	Description
9–0 CCF[9:0]	**Conversion Complete Flag *n* (*n*= 9, 8, 7, 6, 5, 4, 3, 2, 1, 0) (*n conversion number, NOT channel number!)***— A conversion complete flag is set at the end of each conversion in a sequence. The flags are associated with the conversion position in a sequence (and also the result register number). Therefore in non-fifo mode, CCF[8] is set when the ninth conversion in a sequence is complete and the result is available in result register ATDDR8; CCF[9] is set when the tenth conversion in a sequence is complete and the result is available in ATDDR9, and so forth. If automatic compare of conversion results is enabled (CMPE[*n*]=1 in ATDCMPE), the conversion complete flag is only set if comparison with ATDDR*n* is true and if ACMPIE=1 a compare interrupt will be requested. In this case, as the ATDDR*n* result register is used to hold the compare value, the result will not be stored there at the end of the conversion but is lost. A flag CCF[*n*] is cleared when one of the following occurs: A) Write to ATDCTL5 (a new conversion sequence is started) B) If AFFC=0, write “1” to CCF[*n*] C) If AFFC=1 and CMPE[*n*]=0, read of result register ATDDR*n* D) If AFFC=1 and CMPE[*n*]=1, write to result register ATDDR*n* In case of a concurrent set and clear on CCF[*n*]: The clearing by method A) will overwrite the set. The clearing by methods B) or C) or D) will be overwritten by the set. 0 Conversion number *n* not completed or successfully compared 1 If (CMPE[*n*]=0): Conversion number *n* has completed. Result is ready in ATDDR*n*. If (CMPE[*n*]=1): Compare for conversion result number *n* with compare value in ATDDR*n*, using compare operator CMPGT[*n*] is true. (No result available in ATDDR*n*)

9.3.2.10 ATD Input Enable Register (ATDDIEN)

Module Base + 0x000C

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R	0	0	0	0	0	0	IEN[9:0]									
W																
Reset	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

= Unimplemented or Reserved

Figure 9-12. ATD Input Enable Register (ATDDIEN)

Read: Anytime

Write: Anytime

Table 9-19. ATDDIEN Field Descriptions

Field	Description
9–0 IEN[9:0]	**ATD Digital Input Enable on channel *x* (*x*= 9, 8, 7, 6, 5, 4, 3, 2, 1, 0)** — This bit controls the digital input buffer from the analog input pin (AN*x*) to the digital data register. 0 Disable digital input buffer to AN*x* pin 1 Enable digital input buffer on AN*x* pin. **Note:** Setting this bit will enable the corresponding digital input buffer continuously. If this bit is set while simultaneously using it as an analog port, there is potentially increased power consumption because the digital input buffer maybe in the linear region.

9.6 Interrupts

The interrupts requested by the ADC12B10C are listed in Table 9-23. Refer to MCU specification for related vector address and priority.

Table 9-23. ATD Interrupt Vectors

Interrupt Source	CCR Mask	Local Enable
Sequence Complete Interrupt	I bit	ASCIE in ATDCTL2
Compare Interrupt	I bit	ACMPIE in ATDCTL2

See Section 9.3.2, “Register Descriptions” for further details.

12.3.2.3 SPI Baud Rate Register (SPIBR)

Module Base +0x0002

	7	6	5	4	3	2	1	0
R	0	SPPR2	SPPR1	SPPR0	0	SPR2	SPR1	SPR0
W								
Reset	0	0	0	0	0	0	0	0

= Unimplemented or Reserved

Figure 12-5. SPI Baud Rate Register (SPIBR)

Read: Anytime

Write: Anytime; writes to the reserved bits have no effect

Table 12-6. SPIBR Field Descriptions

Field	Description
6–4 SPPR[2:0]	**SPI Baud Rate Preselection Bits** — These bits specify the SPI baud rates as shown in Table 12-7. In master mode, a change of these bits will abort a transmission in progress and force the SPI system into idle state.
2–0 SPR[2:0]	**SPI Baud Rate Selection Bits** — These bits specify the SPI baud rates as shown in Table 12-7. In master mode, a change of these bits will abort a transmission in progress and force the SPI system into idle state.

The baud rate divisor equation is as follows:

$$\text{BaudRateDivisor} = (\text{SPPR} + 1) \bullet 2^{(\text{SPR} + 1)} \qquad \textit{Eqn. 12-1}$$

The baud rate can be calculated with the following equation:

$$\text{Baud Rate} = \text{BusClock} / \text{BaudRateDivisor} \qquad \textit{Eqn. 12-2}$$

NOTE

For maximum allowed baud rates, please refer to the SPI Electrical Specification in the Electricals chapter of this data sheet.

Table 12-7. Example SPI Baud Rate Selection (25 MHz Bus Clock) (Sheet 1 of 3)

SPPR2	SPPR1	SPPR0	SPR2	SPR1	SPR0	Baud Rate Divisor	Baud Rate
0	0	0	0	0	0	2	12.5 Mbit/s
0	0	0	0	0	1	4	6.25 Mbit/s
0	0	0	0	1	0	8	3.125 Mbit/s
0	0	0	0	1	1	16	1.5625 Mbit/s
0	0	0	1	0	0	32	781.25 kbit/s
0	0	0	1	0	1	64	390.63 kbit/s
0	0	0	1	1	0	128	195.31 kbit/s
0	0	0	1	1	1	256	97.66 kbit/s
0	0	1	0	0	0	4	6.25 Mbit/s
0	0	1	0	0	1	8	3.125 Mbit/s
0	0	1	0	1	0	16	1.5625 Mbit/s
0	0	1	0	1	1	32	781.25 kbit/s

13.1.2 Features

13.1.2.1 P-Flash Features

- 128 Kbytes of P-Flash memory composed of one 128 Kbyte Flash block divided into 256 sectors of 512 bytes
- Single bit fault correction and double bit fault detection within a 32-bit double word during read operations
- Automated program and erase algorithm with verify and generation of ECC parity bits
- Fast sector erase and phrase program operation
- Ability to read the P-Flash memory while programming a word in the D-Flash memory
- Flexible protection scheme to prevent accidental program or erase of P-Flash memory

13.1.2.2 D-Flash Features

- 4 Kbytes of D-Flash memory composed of one 4 Kbyte Flash block divided into 16 sectors of 256 bytes
- Single bit fault correction and double bit fault detection within a word during read operations
- Automated program and erase algorithm with verify and generation of ECC parity bits
- Fast sector erase and word program operation
- Protection scheme to prevent accidental program or erase of D-Flash memory
- Ability to program up to four words in a burst sequence

13.1.2.3 Other Flash Module Features

- No external high-voltage power supply required for Flash memory program and erase operations
- Interrupt generation on Flash command completion and Flash error detection
- Security mechanism to prevent unauthorized access to the Flash memory

13.1.3 Block Diagram

The block diagram of the Flash module is shown in Figure 13-1.

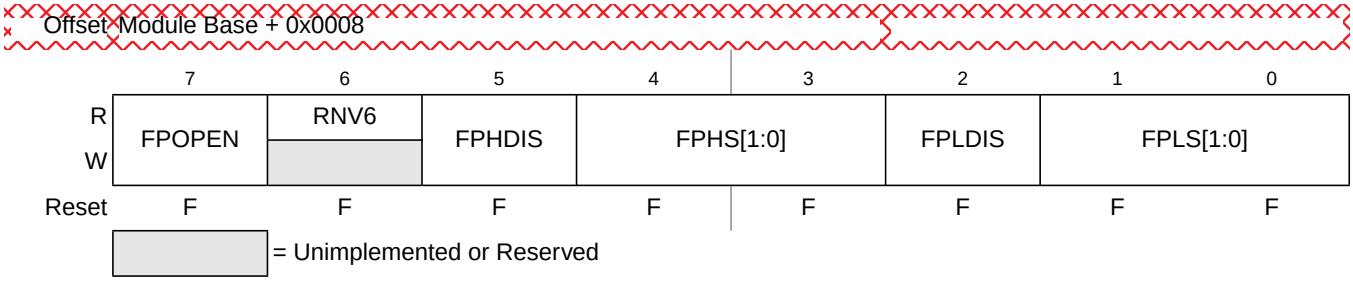

Figure 13-13. Flash Protection Register (FPROT)

The (unreserved) bits of the FPROT register are writable with the restriction that the size of the protected region can only be increased (see Section 13.3.2.9.1, “P-Flash Protection Restrictions,” and Table 13-20).

During the reset sequence, the FPROT register is loaded with the contents of the P-Flash protection byte in the Flash configuration field at global address 0x3_FF0C located in P-Flash memory (see Table 13-3) as indicated by reset condition ‘F’ in Figure 13-13. To change the P-Flash protection that will be loaded during the reset sequence, the upper sector of the P-Flash memory must be unprotected, then the P-Flash protection byte must be reprogrammed. If a double bit fault is detected while reading the P-Flash phrase containing the P-Flash protection byte during the reset sequence, the FPOPEN bit will be cleared and remaining bits in the FPROT register will be set to leave the P-Flash memory fully protected.

Trying to alter data in any protected area in the P-Flash memory will result in a protection violation error and the FPVIOL bit will be set in the FSTAT register. The block erase of a P-Flash block is not possible if any of the P-Flash sectors contained in the same P-Flash block are protected.

Table 13-16. FPROT Field Descriptions

Field	Description
7 FPOPEN	**Flash Protection Operation Enable** — The FPOPEN bit determines the protection function for program or erase operations as shown in Table 13-17 for the P-Flash block. 0 When FPOPEN is clear, the FPHDIS and FPLDIS bits define unprotected address ranges as specified by the corresponding FPHS and FPLS bits 1 When FPOPEN is set, the FPHDIS and FPLDIS bits enable protection for the address range specified by the corresponding FPHS and FPLS bits
6 RNV[6]	**Reserved Nonvolatile Bit** — The RNV bit should remain in the erased state for future enhancements.
5 FPHDIS	**Flash Protection Higher Address Range Disable** — The FPHDIS bit determines whether there is a protected/unprotected area in a specific region of the P-Flash memory ending with global address 0x3_FFFF. 0 Protection/Unprotection enabled 1 Protection/Unprotection disabled
4–3 FPHS[1:0]	**Flash Protection Higher Address Size** — The FPHS bits determine the size of the protected/unprotected area in P-Flash memory as shown inTable 13-18. The FPHS bits can only be written to while the FPHDIS bit is set.
2 FPLDIS	**Flash Protection Lower Address Range Disable** — The FPLDIS bit determines whether there is a protected/unprotected area in a specific region of the P-Flash memory beginning with global address 0x3_8000. 0 Protection/Unprotection enabled 1 Protection/Unprotection disabled
1–0 FPLS[1:0]	**Flash Protection Lower Address Size** — The FPLS bits determine the size of the protected/unprotected area in P-Flash memory as shown in Table 13-19. The FPLS bits can only be written to while the FPLDIS bit is set.

13.3.2.9.1 P-Flash Protection Restrictions

The general guideline is that P-Flash protection can only be added and not removed. Table 13-20 specifies all valid transitions between P-Flash protection scenarios. Any attempt to write an invalid scenario to the FPROT register will be ignored. The contents of the FPROT register reflect the active protection scenario. See the FPHS and FPLS bit descriptions for additional restrictions.

Table 13-20. P-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		
6		X		X	X		X	
7	X	X	X	X	X	X	X	X

1. Allowed transitions marked with X, see Figure 13-14 for a definition of the scenarios.

13.3.2.10 D-Flash Protection Register (DFPROT)

The DFPROT register defines which D-Flash sectors are protected against program and erase operations.

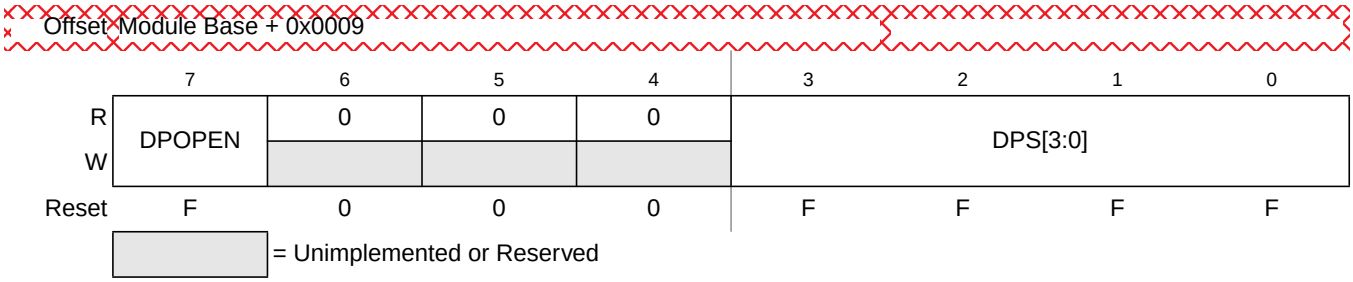

Figure 13-15. D-Flash Protection Register (DFPROT)

The (unreserved) bits of the DFPROT register are writable with the restriction that protection can be added but not removed. Writes must increase the DPS value and the DPOPEN bit can only be written from 1 (protection disabled) to 0 (protection enabled). If the DPOPEN bit is set, the state of the DPS bits is irrelevant.

During the reset sequence, the DFPROT register is loaded with the contents of the D-Flash protection byte in the Flash configuration field at global address 0x3_FF0D located in P-Flash memory (see Table 13-3) as indicated by reset condition F in Figure 13-15. To change the D-Flash protection that will be loaded during the reset sequence, the P-Flash sector containing the D-Flash protection byte must be unprotected, then the D-Flash protection byte must be programmed. If a double bit fault is detected while reading the

P-Flash phrase containing the D-Flash protection byte during the reset sequence, the DPOPEN bit will be cleared and DPS bits will be set to leave the D-Flash memory fully protected.

Trying to alter data in any protected area in the D-Flash memory will result in a protection violation error and the FPVIOL bit will be set in the FSTAT register. Block erase of the D-Flash memory is not possible if any of the D-Flash sectors are protected.

Table 13-21. DFPROT Field Descriptions

Field	Description
7 DPOPEN	**D-Flash Protection Control** 0 Enables D-Flash memory protection from program and erase with protected address range defined by DPS bits 1 Disables D-Flash memory protection from program and erase
3–0 DPS[3:0]	**D-Flash Protection Size** — The DPS[3:0] bits determine the size of the protected area in the D-Flash memory as shown in Table 13-22.

Table 13-22. D-Flash Protection Address Range

DPS[3:0]	Global Address Range	Protected Size
0000	0x0_4400 – 0x0_44FF	256 bytes
0001	0x0_4400 – 0x0_45FF	512 bytes
0010	0x0_4400 – 0x0_46FF	768 bytes
0011	0x0_4400 – 0x0_47FF	1024 bytes
0100	0x0_4400 – 0x0_48FF	1280 bytes
0101	0x0_4400 – 0x0_49FF	1536 bytes
0110	0x0_4400 – 0x0_4AFF	1792 bytes
0111	0x0_4400 – 0x0_4BFF	2048 bytes
1000	0x0_4400 – 0x0_4CFF	2304 bytes
1001	0x0_4400 – 0x0_4DFF	2560 bytes
1010	0x0_4400 – 0x0_4EFF	2816 bytes
1011	0x0_4400 – 0x0_4FFF	3072 bytes
1100	0x0_4400 – 0x0_50FF	3328 bytes
1101	0x0_4400 – 0x0_51FF	3584 bytes
1110	0x0_4400 – 0x0_52FF	3840 bytes
1111	0x0_4400 – 0x0_53FF	4096 bytes

13.3.2.11 Flash Common Command Object Register (FCCOB)

The FCCOB is an array of six words addressed via the CCOBIX index found in the FCCOBIX register. Byte wide reads and writes are allowed to the FCCOB register.

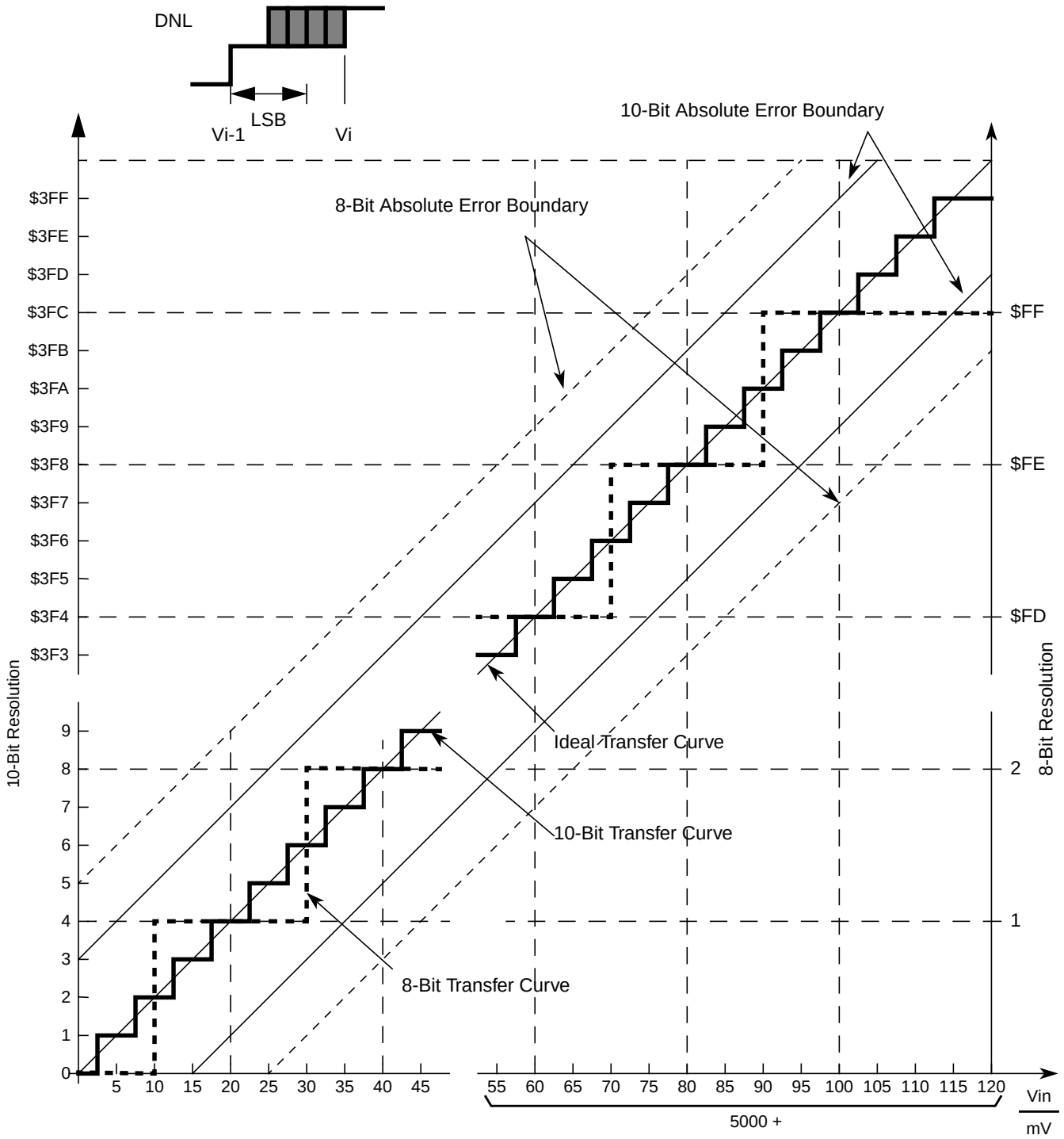

Figure A-1. ATD Accuracy Definitions

NOTE

Figure A-1 shows only definitions, for specification values refer to Table A-16 and Table A-17.

freescale semiconductor

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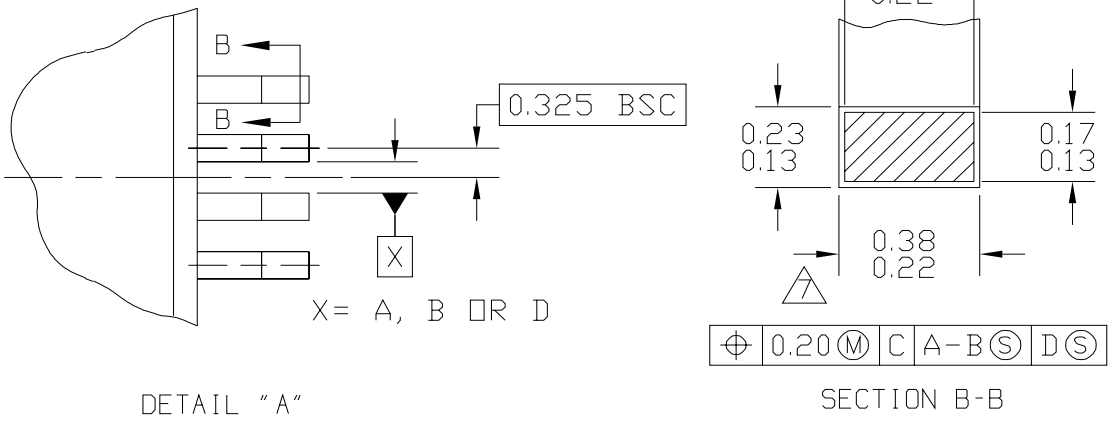

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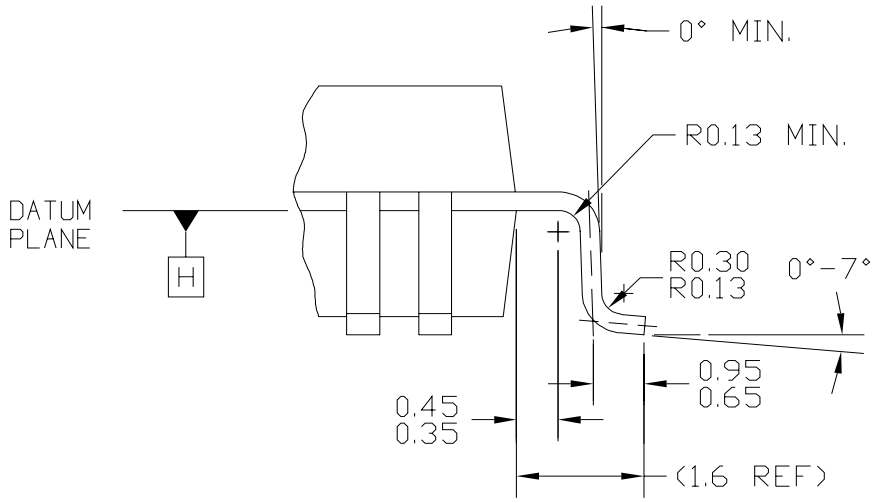

DETAIL "C"

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	STANDARD: NON-JEDEC	
	PACKAGE CODE: 6020	SHEET: 2 OF 4