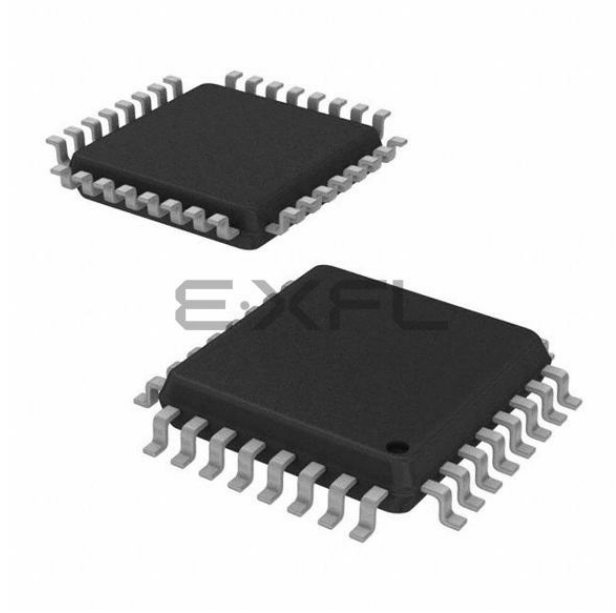

Welcome to E-XFL.COM

What is "Embedded - Microcontrollers"?

"Embedded - Microcontrollers" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

Applications of "Embedded - Microcontrollers"

Details	
Product Status	Obsolete
Core Processor	12V1
Core Size	16-Bit
Speed	25MHz
Connectivity	IrDA, LINbus, SCI, SPI
Peripherals	LVD, POR, PWM, WDT
Number of I/O	16
Program Memory Size	48KB (48K x 8)
Program Memory Type	FLASH
EEPROM Size	512 x 8
RAM Size	2K x 8
Voltage - Supply (Vcc/Vdd)	3.13V ~ 5.5V
Data Converters	A/D 2x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 105°C (TA)
Mounting Type	Surface Mount
Package / Case	32-LQFP
Supplier Device Package	32-LQFP (7x7)
Purchase URL	https://www.e-xfl.com/product-detail/nxp-semiconductors/s9s12vr48f2vlcr

- 6-pin port AD with pin interrupts and wakeup function; associated with 6 ADC channels
- 4-pin port L with pin interrupts and wakeup function; associated with 4 high-voltage inputs for digital or analog use with optional voltage divider bypass and open input detection

For S12VR32/16:

- 2-pin port E associated with the external oscillator
- 4-pin port T associated with 4 TIM channels and 2 PWM channels
- 2-pin port S associated with 1 SCI
- 2-pin port P with pin interrupts and wakeup function; associated with
  - $\overline{\text{XIRQ}}$ interrupt input
  - 2 PWM channels with one of those capable of driving up to 10 mA
  - One output with over-current protection and interrupt capable of supplying up to 20 mA to external devices such as Hall sensors
- 2-pin port AD with pin interrupts and wakeup function; associated with 2 ADC channels
- 4-pin port L with pin interrupts and wakeup function; associated with 4 high-voltage inputs for digital or analog use with optional voltage divider bypass and open input detection

Most I/O pins can be configured by register bits to select data direction and to enable and select pullup or pulldown devices.

2.1.2 Features

The PIM includes these distinctive registers:

- Data registers and data direction registers for Ports E, T, S, P and AD when used as general-purpose I/O
- Control registers to enable/disable pull devices and select pullups/pulldowns on Ports T, S, P, AD on per-pin basis
- Single control register to enable/disable pullups on Port E on per-port basis and on BKGD pin
- Control registers to enable/disable open-drain (wired-or) mode on Port S
- Control register to enable/disable reduced output drive on Port P high-current pins
- Interrupt flag register for pin interrupts on Port P, L and AD
- Control register to configure $\overline{\text{IRQ}}$ pin operation
- Control register to enable ECLK clock output
- Routing registers to support module port relocation and control internal module routings:
  - PWM and ETRIG to alternative pins
  - SPI $\overline{\text{SS}}$ and SCK to alternative pins (S12VR64/48 only)
  - SCI1 to alternative pins (S12VR64/48 only)
  - HSDRV and LSDRV control selection from PWM, TIM or related register bit
  - Various SCI0-LINPHY routing options supporting standalone use and conformance testing
  - Optional LINPHY to TIM link

Table 2-5. DDRE Register Field Descriptions

Field	Description
1-0 DDRE	**Data Direction Register port E —** This bit determines whether the associated pin is an input or output. 1 Associated pin is configured as output 0 Associated pin is configured as input

2.3.5 Port E, BKGD pin Pull Control Register (PUCR)

Address 0x000C Access: User read/write[1]

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

Figure 2-3. Port E, BKGD pin Pull Control Register (PUCR)

[1] Read:Anytime
Write:Anytime, except BKPUE, which is writable in special mode only

Table 2-6. PUCR Register Field Descriptions

Field	Description
6 BKPUE	**BKGD pin Pullup Enable** — Activate pullup device on pin This bit configures whether a pullup device is activated, if the pin is used as input. If a pin is used as output this bit has no effect. 1 Pullup device enabled 0 Pullup device disabled
4 PDPEE	Pull-Down Port E Enable — Activate pulldown devices on all port input pins This bit configures whether a pulldown device is activated on all associated port input pins. If a pin is used as output or used with the CPMU OSC function this bit has no effect. Out of reset the pulldown devices are enabled. 1 Pulldown devices enabled 0 Pulldown devices disabled

2.3.6 ECLK Control Register (ECLKCTL)

Address 0x001C Access: User read/write[1]

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

Figure 2-4. ECLK Control Register (ECLKCTL)

[1] Read: Anytime
Write: Anytime

Table 4-4. CPMUFLG Field Descriptions

Field	Description
7 RTIF	**Real Time Interrupt Flag** — RTIF is set to 1 at the end of the RTI period. This flag can only be cleared by writing a 1. Writing a 0 has no effect. If enabled (RTIE=1), RTIF causes an interrupt request. 0 RTI time-out has not yet occurred. 1 RTI time-out has occurred.
6 PORF	**Power on Reset Flag** — PORF is set to 1 when a power on reset occurs. This flag can only be cleared by writing a 1. Writing a 0 has no effect. 0 Power on reset has not occurred. 1 Power on reset has occurred.
5 LVRF	**Low Voltage Reset Flag** — LVRF is set to 1 when a low voltage reset occurs. This flag can only be cleared by writing a 1. Writing a 0 has no effect. 0 Low voltage reset has not occurred. 1 Low voltage reset has occurred.
4 LOCKIF	**PLL Lock Interrupt Flag** — LOCKIF is set to 1 when LOCK status bit changes. This flag can only be cleared by writing a 1. Writing a 0 has no effect.If enabled (LOCKIE=1), LOCKIF causes an interrupt request. 0 No change in LOCK bit. 1 LOCK bit has changed.
3 LOCK	**Lock Status Bit** — LOCK reflects the current state of PLL lock condition. Writes have no effect.While PLL is unlocked (LOCK=0) f_{PLL} is f_{VCO} / 4 to protect the system from high core clock frequencies during the PLL stabilization time tlock. 0 VCOCLK is not within the desired tolerance of the target frequency. $f_{PLL} = f_{VCO}/4$. 1 VCOCLK is within the desired tolerance of the target frequency. $f_{PLL} = f_{VCO}/(POSTDIV+1)$.
2 ILAF	**Illegal Address Reset Flag** — ILAF is set to 1 when an illegal address reset occurs.Refer to MMC chapter for details.This flag can only be cleared by writing a 1. Writing a 0 has no effect. 0 Illegal address reset has not occurred. 1 Illegal address reset has occurred.
1 OSCIF	**Oscillator Interrupt Flag** — OSCIF is set to 1 when UPOSC status bit changes. This flag can only be cleared by writing a 1. Writing a 0 has no effect.If enabled (OSCIE=1), OSCIF causes an interrupt request. 0 No change in UPOSC bit. 1 UPOSC bit has changed.
0 UPOSC	**Oscillator Status Bit** — UPOSC reflects the status of the oscillator. Writes have no effect. Entering Full Stop Mode UPOSC is cleared. 0 The oscillator is off or oscillation is not qualified by the PLL. 1 The oscillator is qualified by the PLL.

6.3.2.7.1 Debug State Control Register 1 (DBGSCR1)

Address: 0x0027

	7	6	5	4	3	2	1	0
R	0	0	0	0	SC3	SC2	SC1	SC0
W								
Reset	0	0	0	0	0	0	0	0

= Unimplemented or Reserved

Figure 6-9. Debug State Control Register 1 (DBGSCR1)

Read: If COMRV[1:0] = 00

Write: If COMRV[1:0] = 00 and DBG is not armed.

This register is visible at 0x0027 only with COMRV[1:0] = 00. The state control register 1 selects the targeted next state whilst in State1. The matches refer to the match channels of the comparator match control logic as depicted in Figure 6-1 and described in Section 6.3.2.8.1, “Debug Comparator Control Register (DBGXCTL). Comparators must be enabled by setting the comparator enable bit in the associated DBGXCTL control register.

Table 6-15. DBGSCR1 Field Descriptions

Field	Description
3–0 SC[3:0]	These bits select the targeted next state whilst in State1, based upon the match event.

Table 6-16. State1 Sequencer Next State Selection

SC[3:0]	Description (Unspecified matches have no effect)
0000	Any match to Final State
0001	Match1 to State3
0010	Match2 to State2
0011	Match1 to State2
0100	Match0 to State2..... Match1 to State3
0101	Match1 to State3.....Match0 to Final State
0110	Match0 to State2..... Match2 to State3
0111	Either Match0 or Match1 to State2
1000	Reserved
1001	Match0 to State3
1010	Reserved
1011	Reserved
1100	Reserved
1101	Either Match0 or Match2 to Final State.....Match1 to State2
1110	Reserved
1111	Reserved

The priorities described in Table 6-36 dictate that in the case of simultaneous matches, a match leading to final state has priority followed by the match on the lower channel number (0,1,2). Thus with SC[3:0]=1101 a simultaneous match0/match1 transitions to final state.

6.3.2.7.2 Debug State Control Register 2 (DBGSCR2)

Address: 0x0027

	7	6	5	4	3	2	1	0
R	0	0	0	0	SC3	SC2	SC1	SC0
W								
Reset	0	0	0	0	0	0	0	0

= Unimplemented or Reserved

Figure 6-10. Debug State Control Register 2 (DBGSCR2)

Read: If COMRV[1:0] = 01

Write: If COMRV[1:0] = 01 and DBG is not armed.

This register is visible at 0x0027 only with COMRV[1:0] = 01. The state control register 2 selects the targeted next state whilst in State2. The matches refer to the match channels of the comparator match control logic as depicted in Figure 6-1 and described in Section 6.3.2.8.1, “Debug Comparator Control Register (DBGXCTL). Comparators must be enabled by setting the comparator enable bit in the associated DBGXCTL control register.

Table 6-17. DBGSCR2 Field Descriptions

Field	Description
3–0 SC[3:0]	These bits select the targeted next state whilst in State2, based upon the match event.

Table 6-18. State2 —Sequencer Next State Selection

SC[3:0]	Description (Unspecified matches have no effect)
0000	Match0 to State1..... Match2 to State3.
0001	Match1 to State3
0010	Match2 to State3
0011	Match1 to State3..... Match0 Final State
0100	Match1 to State1..... Match2 to State3.
0101	Match2 to Final State
0110	Match2 to State1..... Match0 to Final State
0111	Either Match0 or Match1 to Final State
1000	Reserved
1001	Reserved
1010	Reserved
1011	Reserved
1100	Either Match0 or Match1 to Final State.....Match2 to State3
1101	Reserved
1110	Reserved
1111	Either Match0 or Match1 to Final State.....Match2 to State1

The priorities described in Table 6-36 dictate that in the case of simultaneous matches, a match leading to final state has priority followed by the match on the lower channel number (0,1,2).

8.3.2.4 ATD Control Register 3 (ATDCTL3)

Writes to this register will abort current conversion sequence.

Module Base + 0x0003

	7	6	5	4	3	2	1	0
R W	DJM	S8C	S4C	S2C	S1C	FIFO	FRZ1	FRZ0
Reset	0	0	1	0	0	0	0	0

= Unimplemented or Reserved

Figure 8-6. ATD Control Register 3 (ATDCTL3)

Read: Anytime

Write: Anytime

Table 8-8. ATDCTL3 Field Descriptions

Field	Description
7 DJM	**Result Register Data Justification** — Result data format is always unsigned. This bit controls justification of conversion data in the result registers. 0 Left justified data in the result registers. 1 Right justified data in the result registers. Table 8-9 gives example ATD results for an input signal range between 0 and 5.12 Volts.
6–3 S8C, S4C, S2C, S1C	**Conversion Sequence Length** — These bits control the number of conversions per sequence. Table 8-10 shows all combinations. At reset, S4C is set to 1 (sequence length is 4). This is to maintain software continuity to HC12 family.
2 FIFO	**Result Register FIFO Mode** — If this bit is zero (non-FIFO mode), the A/D conversion results map into the result registers based on the conversion sequence; the result of the first conversion appears in the first result register (ATDDR0), the second result in the second result register (ATDDR1), and so on. If this bit is one (FIFO mode) the conversion counter is not reset at the beginning or end of a conversion sequence; sequential conversion results are placed in consecutive result registers. In a continuously scanning conversion sequence, the result register counter will wrap around when it reaches the end of the result register file. The conversion counter value (CC3-0 in ATDSTAT0) can be used to determine where in the result register file, the current conversion result will be placed. Aborting a conversion or starting a new conversion clears the conversion counter even if FIFO=1. So the first result of a new conversion sequence, started by writing to ATDCTL5, will always be place in the first result register (ATDDDR0). Intended usage of FIFO mode is continuos conversion (SCAN=1) or triggered conversion (ETRIG=1). Which result registers hold valid data can be tracked using the conversion complete flags. Fast flag clear mode may be useful in a particular application to track valid data. If this bit is one, automatic compare of result registers is always disabled, that is ADC12B6CV2 will behave as if ACMPIE and all CPME[*n*] were zero. 0 Conversion results are placed in the corresponding result register up to the selected sequence length. 1 Conversion results are placed in consecutive result registers (wrap around at end).
1–0 FRZ[1:0]	**Background Debug Freeze Enable** — When debugging an application, it is useful in many cases to have the ATD pause when a breakpoint (Freeze Mode) is encountered. These 2 bits determine how the ATD will respond to a breakpoint as shown in Table 8-11. Leakage onto the storage node and comparator reference capacitors may compromise the accuracy of an immediately frozen conversion depending on the length of the freeze period.

Table 8-9. Examples of ideal decimal ATD Results

Input Signal VRL = 0 Volts VRH = 5.12 Volts	8-Bit Codes (resolution=20mV)	10-Bit Codes (resolution=5mV)
5.120 Volts	255	1023
...	...	...
0.022	1	4
0.020	1	4
0.018	1	4
0.016	1	3
0.014	1	3
0.012	1	2
0.010	1	2
0.008	0	2
0.006	0	1
0.004	0	1
0.003	0	1
0.002	0	0
0.000	0	0

Table 8-10. Conversion Sequence Length Coding

S8C	S4C	S2C	S1C	Number of Conversions per Sequence
0	0	0	0	6
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	6
1	0	0	0	6
1	0	0	1	6
1	0	1	0	6
1	0	1	1	6
1	1	0	0	6
1	1	0	1	6
1	1	1	0	6
1	1	1	1	6

Table 8-11. ATD Behavior in Freeze Mode (Breakpoint)

FRZ1	FRZ0	Behavior in Freeze Mode
0	0	Continue conversion
0	1	Reserved
1	0	Finish current conversion, then freeze

10.3.2 Register Descriptions

This section consists of register descriptions in address order. Each description includes a standard register diagram with an associated figure number. Writes to a reserved register locations do not have any effect and reads of these locations return a zero. Details of register bit and field function follow the register diagrams, in bit order.

Register Name		Bit 7	6	5	4	3	2	1	Bit 0
SCIBDH[1]	R	SBR15	SBR14	SBR13	SBR12	SBR11	SBR10	SBR9	SBR8
	W								
SCIBDL[1]	R	SBR7	SBR6	SBR5	SBR4	SBR3	SBR2	SBR1	SBR0
	W								
SCICR1[1]	R	LOOPS	SCISWAI	RSRC	M	WAKE	ILT	PE	PT
	W								
SCIASR1[2]	R	RXEDGIF	0	0	0	0	BERRV	BERRIF	BKDIF
	W								
SCIACR1[2]	R	RXEDGIE	0	0	0	0	0	BERRIE	BKDIE
	W								
SCIACR2[2]	R	IREN	TNP1	TNP0	0	0	BERRM1	BERRM0	BKDFE
	W								
SCICR2	R	TIE	TCIE	RIE	ILIE	TE	RE	RWU	SBK
	W								
SCISR1	R	TDRE	TC	RDRF	IDLE	OR	NF	FE	PF
	W								
SCISR2	R	AMAP	0	0	TXPOL	RXPOL	BRK13	TXDIR	RAF
	W								
SCIDRH	R	R8	T8	0	0	0	Reserved	Reserved	Reserved
	W								
SCIDRL	R	R7	R6	R5	R4	R3	R2	R1	R0
	W	T7	T6	T5	T4	T3	T2	T1	T0

1.These registers are accessible if the AMAP bit in the SCISR2 register is set to zero.

2,These registers are accessible if the AMAP bit in the SCISR2 register is set to one.

= Unimplemented or Reserved

Figure 10-2. SCI Register Summary

10.4.6 Receiver

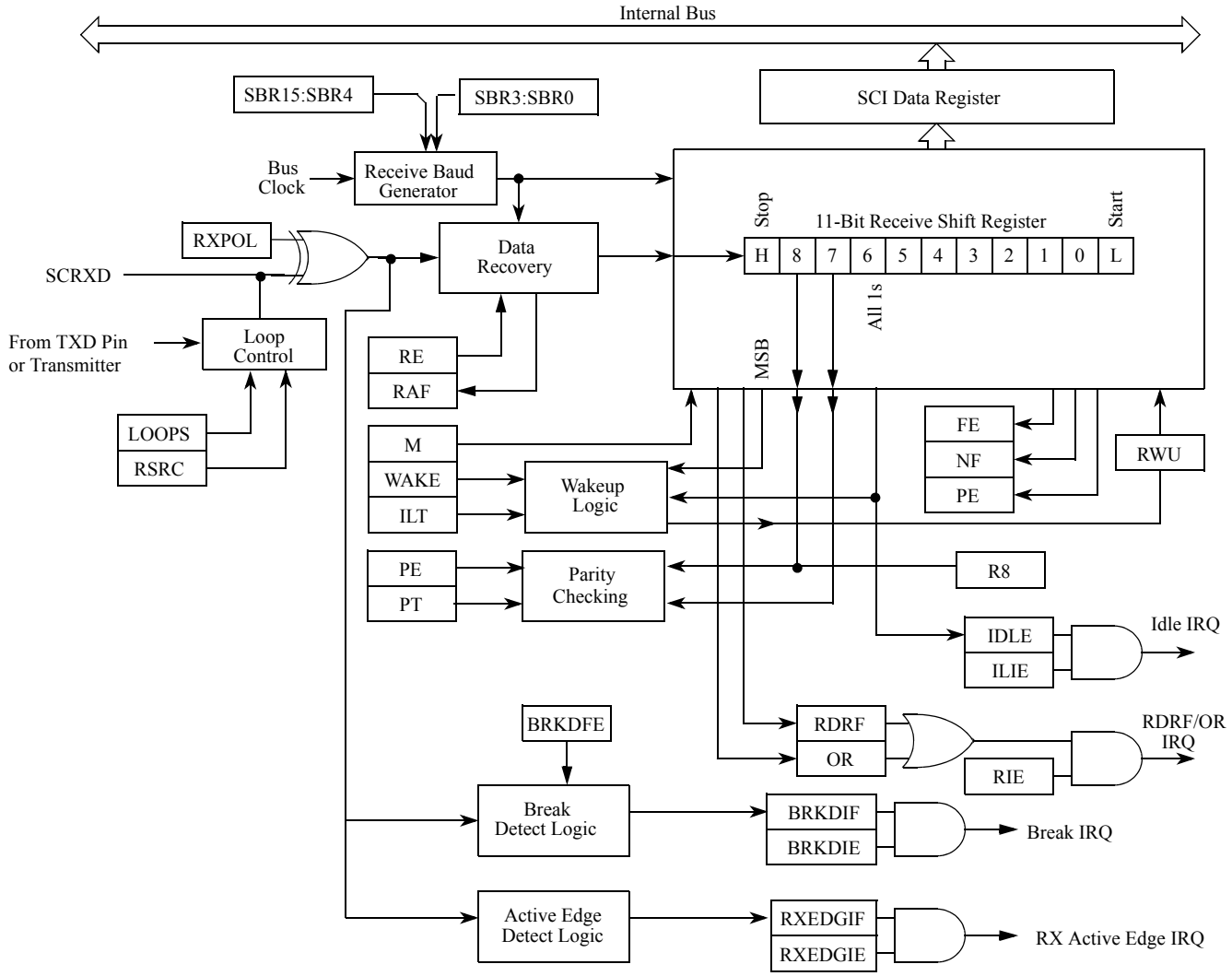

Figure 10-20. SCI Receiver Block Diagram

10.4.6.1 Receiver Character Length

The SCI receiver can accommodate either 8-bit or 9-bit data characters. The state of the M bit in SCI control register 1 (SCICR1) determines the length of data characters. When receiving 9-bit data, bit R8 in SCI data register high (SCIDRH) is the ninth bit (bit 8).

10.4.6.2 Character Reception

During an SCI reception, the receive shift register shifts a frame in from the RXD pin. The SCI data register is the read-only buffer between the internal data bus and the receive shift register.

After a complete frame shifts into the receive shift register, the data portion of the frame transfers to the SCI data register. The receive data register full flag, RDRF, in SCI status register 1 (SCISR1) becomes set,

Table 11-7. Example SPI Baud Rate Selection (25 MHz Bus Clock) (Sheet 2 of 3)

SPPR2	SPPR1	SPPR0	SPR2	SPR1	SPR0	Baud Rate Divisor	Baud Rate
0	0	1	0	1	0	16	1.5625 Mbit/s
0	0	1	0	1	1	32	781.25 kbit/s
0	0	1	1	0	0	64	390.63 kbit/s
0	0	1	1	0	1	128	195.31 kbit/s
0	0	1	1	1	0	256	97.66 kbit/s
0	0	1	1	1	1	512	48.83 kbit/s
0	1	0	0	0	0	6	4.16667 Mbit/s
0	1	0	0	0	1	12	2.08333 Mbit/s
0	1	0	0	1	0	24	1.04167 Mbit/s
0	1	0	0	1	1	48	520.83 kbit/s
0	1	0	1	0	0	96	260.42 kbit/s
0	1	0	1	0	1	192	130.21 kbit/s
0	1	0	1	1	0	384	65.10 kbit/s
0	1	0	1	1	1	768	32.55 kbit/s
0	1	1	0	0	0	8	3.125 Mbit/s
0	1	1	0	0	1	16	1.5625 Mbit/s
0	1	1	0	1	0	32	781.25 kbit/s
0	1	1	0	1	1	64	390.63 kbit/s
0	1	1	1	0	0	128	195.31 kbit/s
0	1	1	1	0	1	256	97.66 kbit/s
0	1	1	1	1	0	512	48.83 kbit/s
0	1	1	1	1	1	1024	24.41 kbit/s
1	0	0	0	0	0	10	2.5 Mbit/s
1	0	0	0	0	1	20	1.25 Mbit/s
1	0	0	0	1	0	40	625 kbit/s
1	0	0	0	1	1	80	312.5 kbit/s
1	0	0	1	0	0	160	156.25 kbit/s
1	0	0	1	0	1	320	78.13 kbit/s
1	0	0	1	1	0	640	39.06 kbit/s
1	0	0	1	1	1	1280	19.53 kbit/s
1	0	1	0	0	0	12	2.08333 Mbit/s
1	0	1	0	0	1	24	1.04167 Mbit/s
1	0	1	0	1	0	48	520.83 kbit/s
1	0	1	0	1	1	96	260.42 kbit/s
1	0	1	1	0	0	192	130.21 kbit/s
1	0	1	1	0	1	384	65.10 kbit/s
1	0	1	1	1	0	768	32.55 kbit/s
1	0	1	1	1	1	1536	16.28 kbit/s
1	1	0	0	0	0	14	1.78571 Mbit/s
1	1	0	0	0	1	28	892.86 kbit/s
1	1	0	0	1	0	56	446.43 kbit/s
1	1	0	0	1	1	112	223.21 kbit/s

$$\text{BaudRateDivisor} = (\text{SPPR} + 1) \bullet 2^{(\text{SPR} + 1)} \qquad \textit{Eqn. 11-3}$$

When all bits are clear (the default condition), the SPI module clock is divided by 2. When the selection bits (SPR2–SPR0) are 001 and the preselection bits (SPPR2–SPPR0) are 000, the module clock divisor becomes 4. When the selection bits are 010, the module clock divisor becomes 8, etc.

When the preselection bits are 001, the divisor determined by the selection bits is multiplied by 2. When the preselection bits are 010, the divisor is multiplied by 3, etc. See Table 11-7 for baud rate calculations for all bit conditions, based on a 25 MHz bus clock. The two sets of selects allows the clock to be divided by a non-power of two to achieve other baud rates such as divide by 6, divide by 10, etc.

The baud rate generator is activated only when the SPI is in master mode and a serial transfer is taking place. In the other cases, the divider is disabled to decrease I_{DD} current.

NOTE

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

11.4.5 Special Features

11.4.5.1 $\overline{SS}$ Output

The $\overline{SS}$ output feature automatically drives the $\overline{SS}$ pin low during transmission to select external devices and drives it high during idle to deselect external devices. When $\overline{SS}$ output is selected, the $\overline{SS}$ output pin is connected to the $\overline{SS}$ input pin of the external device.

The $\overline{SS}$ output is available only in master mode during normal SPI operation by asserting SSOE and MODFEN bit as shown in Table 11-3.

The mode fault feature is disabled while $\overline{SS}$ output is enabled.

NOTE

Care must be taken when using the $\overline{SS}$ output feature in a multimaster system because the mode fault feature is not available for detecting system errors between masters.

11.4.5.2 Bidirectional Mode (MOMI or SISO)

The bidirectional mode is selected when the SPC0 bit is set in SPI control register 2 (see Table 11-11). In this mode, the SPI uses only one serial data pin for the interface with external device(s). The MSTR bit decides which pin to use. The MOSI pin becomes the serial data I/O (MOMI) pin for the master mode, and the MISO pin becomes serial data I/O (SISO) pin for the slave mode. The MISO pin in master mode and MOSI pin in slave mode are not used by the SPI.

13.3.2 Register Definition

13.3.3 Port HS Data Register (HSDR)

Module Base + 0x0000 Access: User read/write[1]

	7	6	5	4	3	2	1	0
R	0	0	0	0	0	0	HSDR1	HSDR0
W								
Altern. Read Function	—	—	—	—	—	—	OC[2]	OC[2]
	—	—	—	—	—	—	PWM[2]	PWM[2]
Reset	0	0	0	0	0	0	0	0

= Unimplemented

Figure 13-2. Port HS Data Register (HSDR)

1 Read: Anytime The data source (HSDRx or alternate function) depends on the HSE control bit settings.
Write: Anytime

2 See PIM chapter for detailed routing description.

Table 13-4. PTHS Register Field Descriptions

Field	Description
1-0 HSDRx	**Port HS Data Bits**—Data registers or routed timer outputs or routed PWM outputs These register bits can be used to control the high-side drivers if selected as control source. See PIM section for routing details. If the associated HSEx bit is set to 0, a read returns the value of the Port HS Data Register (HSDRx). If the associated HSEx bit is set to 1, a read returns the value of the selected control source for the driver. When entering in STOP mode the Port HS Data Register (HSDRx) is cleared. 0 High-side driver is turned off 1 High-side driver is turned on **NOTE** After enabling the high-side driver with the HSEx bit in HSCR register, the user must wait a minimum settling time $t_{HS\_settling}$ before turning on the high-side driver.

NOTE

The open-load detection is only active if the selected source (e.g. PWM, Timer, HSDR[HSDR0]) for the high-side driver is turned off.

14.4.3 Over-Current Shutdown

The high-side driver has an over-current shutdown feature with a current threshold of I_{OCTHSX}.

If an over-current is detected the interrupt flag is set in the HSDRV Interrupt Flag Register (HSIF). As long as the over-current interrupt flag remains set, the high-side driver is turned off to protect the circuit.

Clearing the related over-current interrupt flag returns back the control to the selected source in the PIM module.The over-current detection and driver shutdown can be masked for an initial T_{HSOCM} after switching the driver on. This can be achieved by setting the HSCR[HSOCME0] register bit. HSCR[HSOCME0] is only writable while the driver is disabled (HSCR[HSE0]=0).

14.4.4 Interrupts

This section describes the interrupt generated by HSDRV1C module. The interrupt is only available in MCU run mode. Entering and exiting MCU stop mode has no effect on the interrupt flags.

The interrupt generated by HSDRV1C module is shown in Table 14-11. Vector addresses and interrupt priorities are defined at MCU level.

14.4.4.1 HSDRV1C Over Current Interrupt (HSOCI)

Table 14-11. HSDRV1C Interrupt Sources

Module Interrupt Source	Module Internal Interrupt Source	Local Enable
HSDRV1C Interrupt (HSI)	HSDRV1C Over-Current Interrupt (HSOCI)	HSOCIE = 1

If an over-current is detected the related interrupt flag HSOCIFx asserts. Depending on the setting of the HSDRV1C Error Interrupt Enable (HSOCIE) bit an interrupt is requested.

Chapter 17
Supply Voltage Sensor - (BATSV2)

Table 17-1. Revision History Table

Rev. No. (Item No.)	Data	Sections Affected	Substantial Change(s)
V01.00	15 Dec 2010	all	Initial Version
V02.00	16 Mar 2011	17.3.2.1 17.4.2.1	- added BVLS[1] to support four voltage level - moved BVHS to register bit 6

17.1 Introduction

The BATS module provides the functionality to measure the voltage of the battery supply pin VSENSE or of the chip supply pin VSUP.

17.1.1 Features

Either One of the voltage present on the VSENSE or VSUP pin can be routed via an internal divider to the internal Analog to Digital Converter. Independent of the routing to the Analog to Digital Converter, it is possible to route one of these voltages to a comparator to generate a low or a high voltage interrupt to alert the MCU.

17.1.2 Modes of Operation

The BATS module behaves as follows in the system power modes:

1. Run mode

   The activation of the VSENSE Level Sense Enable (BSESE=1) or ADC connection Enable (BSEAE=1) closes the path from the VSENSE pin through the resistor chain to ground and enables the associated features if selected.

   The activation of the VSUP Level Sense Enable (BSUSE=1) or ADC connection Enable (BSUAE=1) closes the path from VSUP pin through the resistor chain to ground and enables the associated features if selected.

   BSESE takes precedence over BSUSE. BSEAE takes precedence over BSUAE.

2. Stop mode

   During stop mode operation the path from the VSENSE pin through the resistor chain to ground is opened and the low voltage sense features are disabled.

The following subsections describe these security-related subjects:

- Unsecuring the MCU using Backdoor Key Access
- Unsecuring the MCU in Special Single Chip Mode using BDM
- Mode and Security Effects on Flash Command Availability

18.5.1 Unsecuring the MCU using Backdoor Key Access

The MCU may be unsecured by using the backdoor key access feature which requires knowledge of the contents of the backdoor keys (four 16-bit words programmed at addresses 0x3_FF00-0x3_FF07). If the KEYEN[1:0] bits are in the enabled state (see Section 18.3.2.2 Flash Security Register (FSEC)), the Verify Backdoor Access Key command (see Section 18.4.6.11 Verify Backdoor Access Key Command) allows the user to present four prospective keys for comparison to the keys stored in the Flash memory via the Memory Controller. If the keys presented in the Verify Backdoor Access Key command match the backdoor keys stored in the Flash memory, the SEC bits in the FSEC register (see Table 18-11) will be changed to unsecure the MCU. Key values of 0x0000 and 0xFFFF are not permitted as backdoor keys. While the Verify Backdoor Access Key command is active, P-Flash memory and EEPROM memory will not be available for read access and will return invalid data.

The user code stored in the P-Flash memory must have a method of receiving the backdoor keys from an external stimulus. This external stimulus would typically be through one of the on-chip serial ports.

If the KEYEN[1:0] bits are in the enabled state (see Section 18.3.2.2 Flash Security Register (FSEC)), the MCU can be unsecured by the backdoor key access sequence described below:

1. Follow the command sequence for the Verify Backdoor Access Key command as explained in Section 18.4.6.11 Verify Backdoor Access Key Command
2. If the Verify Backdoor Access Key command is successful, the MCU is unsecured and the SEC[1:0] bits in the FSEC register are forced to the unsecure state of 10

The Verify Backdoor Access Key command is monitored by the Memory Controller and an illegal key will prohibit future use of the Verify Backdoor Access Key command. A reset of the MCU is the only method to re-enable the Verify Backdoor Access Key command. The security as defined in the Flash security byte (0x3_FF0F) is not changed by using the Verify Backdoor Access Key command sequence. The backdoor keys stored in addresses 0x3_FF00-0x3_FF07 are unaffected by the Verify Backdoor Access Key command sequence. The Verify Backdoor Access Key command sequence has no effect on the program and erase protections defined in the Flash protection register, FPROT.

After the backdoor keys have been correctly matched, the MCU will be unsecured. After the MCU is unsecured, the sector containing the Flash security byte can be erased and the Flash security byte can be reprogrammed to the unsecure state, if desired. In the unsecure state, the user has full control of the contents of the backdoor keys by programming addresses 0x3_FF00-0x3_FF07 in the Flash configuration field.

Chapter 19
32 KByte Flash Module (S12FTMRG32K128V1) for S12VR32

Table 19-1. Revision History

Revision Number	Revision Date	Sections Affected	Description of Changes
V01.00	28 Jan 2014		Initial version

NOTE

When the EEPROM block is targeted, the EEPROM user margin levels are applied only to the EEPROM reads. However, when the P-Flash block is targeted, the P-Flash user margin levels are applied to both P-Flash and EEPROM reads. It is not possible to apply user margin levels to the P-Flash block only.

Valid margin level settings for the Set User Margin Level command are defined in Table 19-55.

Table 19-55. Valid Set User Margin Level Settings

CCOB (CCOBIX=001)	Level Description
0x0000	Return to Normal Level
0x0001	User Margin-1 Level[1]
0x0002	User Margin-0 Level[2]

1 Read margin to the erased state

2 Read margin to the programmed state

Table 19-56. Set User Margin Level Command Error Handling

Register	Error Bit	Error Condition
FSTAT	ACCERR	Set if CCOBIX[2:0] != 001 at command launch
		Set if command not available in current mode (see Table 19-27)
		Set if an invalid FlashBlockSelectionCode[1:0] is supplied (See Table 19-34)
		Set if an invalid margin level setting is supplied
	FPVIOL	None
	MGSTAT1	None
	MGSTAT0	None

NOTE

User margin levels can be used to check that Flash memory contents have adequate margin for normal level read operations. If unexpected results are encountered when checking Flash memory contents at user margin levels, a potential loss of information has been detected.

19.4.6.13 Set Field Margin Level Command

The Set Field Margin Level command, valid in special modes only, causes the Memory Controller to set the margin level specified for future read operations of the P-Flash or EEPROM block.

Upon clearing CCIF to launch the Set Field Margin Level command, the Memory Controller will set the

Table 19-57. Set Field Margin Level Command FCCOB Requirements

CCOBIX[2:0]	FCCOB Parameters	
000	0x0E	Flash block selection code [1:0]. See Table 19-34
001	Margin level setting.	

field margin level for the targeted block and then set the CCIF flag.

NOTE

When the EEPROM block is targeted, the EEPROM field margin levels are applied only to the EEPROM reads. However, when the P-Flash block is targeted, the P-Flash field margin levels are applied to both P-Flash and EEPROM reads. It is not possible to apply field margin levels to the P-Flash block only.

Valid margin level settings for the Set Field Margin Level command are defined in Table 19-58.

Table 19-58. Valid Set Field Margin Level Settings

CCOB (CCOBIX=001)	Level Description
0x0000	Return to Normal Level
0x0001	User Margin-1 Level[1]
0x0002	User Margin-0 Level[2]
0x0003	Field Margin-1 Level[1]
0x0004	Field Margin-0 Level[2]

1 Read margin to the erased state

2 Read margin to the programmed state

Table 19-59. Set Field Margin Level Command Error Handling

Register	Error Bit	Error Condition
FSTAT	ACCERR	Set if CCOBIX[2:0] != 001 at command launch
		Set if command not available in current mode (see Table 19-27)
		Set if an invalid FlashBlockSelectionCode[1:0] is supplied (See Table 19-34)
		Set if an invalid margin level setting is supplied
	FPVIOL	None
	MGSTAT1	None
	MGSTAT0	None

J.2 Pin Interrupt Characteristics

Table J-3. Pin Interrupt Characteristics

Characteristics are 5.5V ≤ VSUP ≤ 18 V, -40°C ≤ T_J ≤ 150°C[1] junction temperature from –40°C to +150°C unless otherwise noted.						
Num	**Rating**	**Symbol**	**Min**	**Typ**	**Max**	**Unit**
1	Port L, P, AD interrupt input pulse filtered (STOP)[2]	t_{P_MASK}	—	—	3	µs
2	Port L, P, AD interrupt input pulse passed (STOP)[2]	t_{P_PASS}	10	—	—	µs
3	Port L, P, AD interrupt input pulse filtered ($\overline{STOP}$) in number of bus clock cycles of period $1/f_{bus}$	n_{P_MASK}	—	—	3	
4	Port L, P, AD interrupt input pulse passed ($\overline{STOP}$) in number of bus clock cycles of period $1/f_{bus}$	n_{P_PASS}	4	—	—	
5	$\overline{IRQ}$ pulse width, edge-sensitive mode ($\overline{STOP}$) in number of bus clock cycles of period $1/f_{bus}$	n_{IRQ}	1	—	—	

1 T_J: Junction Temperature

2 Parameter only applies in stop or pseudo stop mode.