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	Active
Core Processor	12V1
Core Size	16-Bit
Speed	25MHz
Connectivity	CANbus, IrDA, LINbus, SCI, SPI
Peripherals	LVD, POR, PWM, WDT
Number of I/O	86
Program Memory Size	128KB (128K x 8)
Program Memory Type	FLASH
EEPROM Size	4K x 8
RAM Size	8K x 8
Voltage - Supply (Vcc/Vdd)	3.13V ~ 5.5V
Data Converters	A/D 12x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 105°C (TA)
Mounting Type	Surface Mount
Package / Case	100-LQFP
Supplier Device Package	100-LQFP (14x14)
Purchase URL	https://www.e-xfl.com/pro/item?MUrl=&PartUrl=s9s12g128f0vllr

Chapter 6
Interrupt Module (S12SINTV1)

Chapter 7
Background Debug Module (S12SBDMV1)

1.7.2.15 PT[7:0] — Port TI/O Signals

PT[7:0] are general-purpose input or output signals. They can have a pull-up or pull-down device selected and enabled on per signal basis. Out of reset the pull devices are disabled .

1.7.2.16 AN[15:0] — ADC Input Signals

AN[15:0] are the analog inputs of the Analog-to-Digital Converter.

1.7.2.17 ACMP Signals

1.7.2.17.1 ACMPP — Non-Inverting Analog Comparator Input

ACMPP is the non-inverting input of the analog comparator.

1.7.2.17.2 ACMPM — Inverting Analog Comparator Input

ACMPM is the inverting input of the analog comparator.

1.7.2.17.3 ACMPO — Analog Comparator Output

ACMPO is the output of the analog comparator.

1.7.2.18 DAC Signals

1.7.2.18.1 DACU[1:0] Output Pins

These analog pins is used for the unbuffered analog output Voltages from the DAC0 and the DAC1 resistor network output, when the according mode is selected.

1.7.2.18.2 AMP[1:0] Output Pins

These analog pins are used for the buffered analog outputs Voltage from the operational amplifier outputs, when the according mode is selected.

1.7.2.18.3 AMPP[1:0] Input Pins

These analog input pins areused as input signals for the operational amplifiers positive input pins when the according mode is selected.

1.7.2.18.4 AMPM[1:0] Input Pins

These analog input pins are used as input signals for the operational amplifiers negative input pin when the according mode is selected.

Table 1-22. 100-Pin LQFP Pinout for S12G96 and S12G128

	Function <----lowest-----PRIORITY-----highest---->				Power Supply	Internal Pull Resistor	
Package Pin	Pin	2nd Func.	3rd Func.	4th Func.		CTRL	Reset State
28	PB3	—	—	—	V_{DDX}	PUCR/PUPBE	Disabled
29	PP0	KWP0	ETRIG0	PWM0	V_{DDX}	PERP/PPSP	Disabled
30	PP1	KWP1	ETRIG1	PWM1	V_{DDX}	PERP/PPSP	Disabled
31	PP2	KWP2	ETRIG2	PWM2	V_{DDX}	PERP/PPSP	Disabled
32	PP3	KWP3	ETRIG3	PWM3	V_{DDX}	PERP/PPSP	Disabled
33	PP4	KWP4	PWM4	—	V_{DDX}	PERP/PPSP	Disabled
34	PP5	KWP5	PWM5	—	V_{DDX}	PERP/PPSP	Disabled
35	PP6	KWP6	PWM6	—	V_{DDX}	PERP/PPSP	Disabled
36	PP7	KWP7	PWM7	—	V_{DDX}	PERP/PPSP	Disabled
37	VDDX3	—	—	—	—	—	—
38	VSSX3	—	—	—	—	—	—
39	PT7	IOC7	—	—	V_{DDX}	PERT/PPST	Disabled
40	PT6	IOC6	—	—	V_{DDX}	PERT/PPST	Disabled
41	PT5	IOC5	—	—	V_{DDX}	PERT/PPST	Disabled
42	PT4	IOC4	—	—	V_{DDX}	PERT/PPST	Disabled
43	PT3	IOC3	—	—	V_{DDX}	PERT/PPST	Disabled
44	PT2	IOC2	—	—	V_{DDX}	PERT/PPST	Disabled
45	PT1	IOC1	—	—	V_{DDX}	PERT/PPST	Disabled
46	PT0	IOC0	—	—	V_{DDX}	PERT/PPST	Disabled
47	PB4	$\overline{\text{IRQ}}$	—	—	V_{DDX}	PUCR/PUPBE	Disabled
48	PB5	$\overline{\text{XIRQ}}$	—	—	V_{DDX}	PUCR/PUPBE	Disabled
49	PB6	—	—	—	V_{DDX}	PUCR/PUPBE	Disabled
50	PB7	—	—	—	V_{DDX}	PUCR/PUPBE	Disabled
51	PC0	—	—	—	V_{DDA}	PUCR/PUPCE	Disabled
52	PC1	—	—	—	V_{DDA}	PUCR/PUPCE	Disabled
53	PC2	—	—	—	V_{DDA}	PUCR/PUPCE	Disabled
54	PC3	—	—	—	V_{DDA}	PUCR/PUPCE	Disabled
55	PAD0	KWAD0	AN0	—	V_{DDA}	PER1AD/PPS1AD	Disabled
56	PAD8	KWAD8	AN8	—	V_{DDA}	PER0AD/PPS0AD	Disabled

Table 9-4. Security Bits

SEC[1:0]	Security State
00	1 (secured)
01	1 (secured)
10	0 (unsecured)
11	1 (secured)

NOTE

Please refer to the Flash block guide for actual security configuration (in section “Flash Module Security”).

9.1.4 Operation of the Secured Microcontroller

By securing the device, unauthorized access to the EEPROM and Flash memory contents can be prevented. However, it must be understood that the security of the EEPROM and Flash memory contents also depends on the design of the application program. For example, if the application has the capability of downloading code through a serial port and then executing that code (e.g. an application containing bootloader code), then this capability could potentially be used to read the EEPROM and Flash memory contents even when the microcontroller is in the secure state. In this example, the security of the application could be enhanced by requiring a challenge/response authentication before any code can be downloaded.

Secured operation has the following effects on the microcontroller:

9.1.4.1 Normal Single Chip Mode (NS)

- Background debug module (BDM) operation is completely disabled.
- Execution of Flash and EEPROM commands is restricted. Please refer to the NVM block guide for details.
- Tracing code execution using the DBG module is disabled.

9.1.4.2 Special Single Chip Mode (SS)

- BDM firmware commands are disabled.
- BDM hardware commands are restricted to the register space.
- Execution of Flash and EEPROM commands is restricted. Please refer to the NVM block guide for details.
- Tracing code execution using the DBG module is disabled.

Special single chip mode means BDM is active after reset. The availability of BDM firmware commands depends on the security state of the device. The BDM secure firmware first performs a blank check of both the Flash memory and the EEPROM. If the blank check succeeds, security will be temporarily turned off and the state of the security bits in the appropriate Flash memory location can be changed If the blank check fails, security will remain active, only the BDM hardware commands will be enabled, and the accessible memory space is restricted to the peripheral register area. This will allow the BDM to be used

16.1.2 Modes of Operation

16.1.2.1 Conversion Modes

There is software programmable selection between performing **single** or **continuous conversion** on a **single channel** or **multiple channels**.

16.1.2.2 MCU Operating Modes

- **Stop Mode**
  Entering Stop Mode aborts any conversion sequence in progress and if a sequence was aborted restarts it after exiting stop mode. This has the same effect/consequences as starting a conversion sequence with write to ATDCTL5. So after exiting from stop mode with a previously aborted sequence all flags are cleared etc.
- **Wait Mode**
  ADC12B16C behaves same in Run and Wait Mode. For reduced power consumption continuous conversions should be aborted before entering Wait mode.
- **Freeze Mode**
  In Freeze Mode the ADC12B16C will either continue or finish or stop converting according to the FRZ1 and FRZ0 bits. This is useful for debugging and emulation.

Table 18-3. CANCTL0 Register Field Descriptions (continued)

Field	Description
2 WUPE[3]	**Wake-Up Enable** — This configuration bit allows the MSCAN to restart from sleep mode or from power down mode (entered from sleep) when traffic on CAN is detected (see Section 18.4.5.5, “MSCAN Sleep Mode”). This bit must be configured before sleep mode entry for the selected function to take effect. 0 Wake-up disabled — The MSCAN ignores traffic on CAN 1 Wake-up enabled — The MSCAN is able to restart
1 SLPRQ[4]	**Sleep Mode Request** — This bit requests the MSCAN to enter sleep mode, which is an internal power saving mode (see Section 18.4.5.5, “MSCAN Sleep Mode”). The sleep mode request is serviced when the CAN bus is idle, i.e., the module is not receiving a message and all transmit buffers are empty. The module indicates entry to sleep mode by setting SLPAK = 1 (see Section 18.3.2.2, “MSCAN Control Register 1 (CANCTL1)”). SLPRQ cannot be set while the WUPIF flag is set (see Section 18.3.2.5, “MSCAN Receiver Flag Register (CANRFLG)”). Sleep mode will be active until SLPRQ is cleared by the CPU or, depending on the setting of WUPE, the MSCAN detects activity on the CAN bus and clears SLPRQ itself. 0 Running — The MSCAN functions normally 1 Sleep mode request — The MSCAN enters sleep mode when CAN bus idle
0 INITRQ[5,6]	**Initialization Mode Request** — When this bit is set by the CPU, the MSCAN skips to initialization mode (see Section 18.4.4.5, “MSCAN Initialization Mode”). Any ongoing transmission or reception is aborted and synchronization to the CAN bus is lost. The module indicates entry to initialization mode by setting INITAK = 1 (Section 18.3.2.2, “MSCAN Control Register 1 (CANCTL1)”). The following registers enter their hard reset state and restore their default values: CANCTL0[7], CANRFLG[8], CANRIER[9], CANTFLG, CANTIER, CANTARQ, CANTAAK, and CANTBSEL. The registers CANCTL1, CANBTR0, CANBTR1, CANIDAC, CANIDAR0-7, and CANIDMR0-7 can only be written by the CPU when the MSCAN is in initialization mode (INITRQ = 1 and INITAK = 1). The values of the error counters are not affected by initialization mode. When this bit is cleared by the CPU, the MSCAN restarts and then tries to synchronize to the CAN bus. If the MSCAN is not in bus-off state, it synchronizes after 11 consecutive recessive bits on the CAN bus; if the MSCAN is in bus-off state, it continues to wait for 128 occurrences of 11 consecutive recessive bits. Writing to other bits in CANCTL0, CANRFLG, CANRIER, CANTFLG, or CANTIER must be done only after initialization mode is exited, which is INITRQ = 0 and INITAK = 0. 0 Normal operation 1 MSCAN in initialization mode

1 See the Bosch CAN 2.0A/B specification for a detailed definition of transmitter and receiver states.

2 In order to protect from accidentally violating the CAN protocol, TXCAN is immediately forced to a recessive state when the CPU enters wait (CSWAI = 1) or stop mode (see Section 18.4.5.2, “Operation in Wait Mode” and Section 18.4.5.3, “Operation in Stop Mode”).

3 The CPU has to make sure that the WUPE register and the WUPIE wake-up interrupt enable register (see Section 18.3.2.6, “MSCAN Receiver Interrupt Enable Register (CANRIER)) is enabled, if the recovery mechanism from stop or wait is required.

4 The CPU cannot clear SLPRQ before the MSCAN has entered sleep mode (SLPRQ = 1 and SLPAK = 1).

5 The CPU cannot clear INITRQ before the MSCAN has entered initialization mode (INITRQ = 1 and INITAK = 1).

6 In order to protect from accidentally violating the CAN protocol, TXCAN is immediately forced to a recessive state when the initialization mode is requested by the CPU. Thus, the recommended procedure is to bring the MSCAN into sleep mode (SLPRQ = 1 and SLPAK = 1) before requesting initialization mode.

7 Not including WUPE, INITRQ, and SLPRQ.

8 TSTAT1 and TSTAT0 are not affected by initialization mode.

9 RSTAT1 and RSTAT0 are not affected by initialization mode.

18.3.2.2 MSCAN Control Register 1 (CANCTL1)

The CANCTL1 register provides various control bits and handshake status information of the MSCAN module as described below.

Table 18-26. Message Buffer Organization

Offset Address	Register	Access
0x00X0	IDR0 — Identifier Register 0	R/W
0x00X1	IDR1 — Identifier Register 1	R/W
0x00X2	IDR2 — Identifier Register 2	R/W
0x00X3	IDR3 — Identifier Register 3	R/W
0x00X4	DSR0 — Data Segment Register 0	R/W
0x00X5	DSR1 — Data Segment Register 1	R/W
0x00X6	DSR2 — Data Segment Register 2	R/W
0x00X7	DSR3 — Data Segment Register 3	R/W
0x00X8	DSR4 — Data Segment Register 4	R/W
0x00X9	DSR5 — Data Segment Register 5	R/W
0x00XA	DSR6 — Data Segment Register 6	R/W
0x00XB	DSR7 — Data Segment Register 7	R/W
0x00XC	DLR — Data Length Register	R/W
0x00XD	TBPR — Transmit Buffer Priority Register[1]	R/W
0x00XE	TSRH — Time Stamp Register (High Byte)	R
0x00XF	TSRL — Time Stamp Register (Low Byte)	R

[1] Not applicable for receive buffers

Figure 18-24 shows the common 13-byte data structure of receive and transmit buffers for extended identifiers. The mapping of standard identifiers into the IDR registers is shown in Figure 18-25.

All bits of the receive and transmit buffers are ‘x’ out of reset because of RAM-based implementation[1]. All reserved or unused bits of the receive and transmit buffers always read ‘x’.

1. Exception: The transmit buffer priority registers are 0 out of reset.

18.4.5.7 Disabled Mode

The MSCAN is in disabled mode out of reset (CANE=0). All module clocks are stopped for power saving, however the register map can still be accessed as specified.

18.4.5.8 Programmable Wake-Up Function

The MSCAN can be programmed to wake up from sleep or power down mode as soon as CAN bus activity is detected (see control bit WUPE in MSCAN Control Register 0 (CANCTL0). The sensitivity to existing CAN bus action can be modified by applying a low-pass filter function to the RXCAN input line (see control bit WUPM in Section 18.3.2.2, “MSCAN Control Register 1 (CANCTL1)”).

This feature can be used to protect the MSCAN from wake-up due to short glitches on the CAN bus lines. Such glitches can result from—for example—electromagnetic interference within noisy environments.

18.4.6 Reset Initialization

The reset state of each individual bit is listed in Section 18.3.2, “Register Descriptions,” which details all the registers and their bit-fields.

18.4.7 Interrupts

This section describes all interrupts originated by the MSCAN. It documents the enable bits and generated flags. Each interrupt is listed and described separately.

18.4.7.1 Description of Interrupt Operation

The MSCAN supports four interrupt vectors (see Table 18-39), any of which can be individually masked (for details see Section 18.3.2.6, “MSCAN Receiver Interrupt Enable Register (CANRIER)” to Section 18.3.2.8, “MSCAN Transmitter Interrupt Enable Register (CANTIER)”).

Refer to the device overview section to determine the dedicated interrupt vector addresses.

Table 18-39. Interrupt Vectors

Interrupt Source	CCR Mask	Local Enable
Wake-Up Interrupt (WUPIF)	I bit	CANRIER (WUPIE)
Error Interrupts Interrupt (CSCIF, OVRIF)	I bit	CANRIER (CSCIE, OVRIE)
Receive Interrupt (RXF)	I bit	CANRIER (RXFIE)
Transmit Interrupts (TXE[2:0])	I bit	CANTIER (TXEIE[2:0])

18.4.7.2 Transmit Interrupt

At least one of the three transmit buffers is empty (not scheduled) and can be loaded to schedule a message for transmission. The TXEx flag of the empty message buffer is set.

To determine the value of a data bit and to detect noise, recovery logic takes samples at RT8, RT9, and RT10. Table 20-18 summarizes the results of the data bit samples.

Table 20-18. Data Bit Recovery

RT8, RT9, and RT10 Samples	Data Bit Determination	Noise Flag
000	0	0
001	0	1
010	0	1
011	1	1
100	0	1
101	1	1
110	1	1
111	1	0

NOTE

The RT8, RT9, and RT10 samples do not affect start bit verification. If any or all of the RT8, RT9, and RT10 start bit samples are logic 1s following a successful start bit verification, the noise flag (NF) is set and the receiver assumes that the bit is a start bit (logic 0).

To verify a stop bit and to detect noise, recovery logic takes samples at RT8, RT9, and RT10. Table 20-19 summarizes the results of the stop bit samples.

Table 20-19. Stop Bit Recovery

RT8, RT9, and RT10 Samples	Framing Error Flag	Noise Flag
000	1	0
001	1	1
010	1	1
011	0	1
100	1	1
101	0	1
110	0	1
111	0	0

In Figure 20-22 the verification samples RT3 and RT5 determine that the first low detected was noise and not the beginning of a start bit. The RT clock is reset and the start bit search begins again. The noise flag is not set because the noise occurred before the start bit was found.

23.3.2 Register Descriptions

This section consists of register descriptions in address order. Each description includes a standard register diagram with an associated figure number. Details of register bit and field function follow the register diagrams, in bit order.

Only bits related to implemented channels are valid.

Register Name		Bit 7	6	5	4	3	2	1	Bit 0
0x0000 TIOS	R	IOS7	IOS6	IOS5	IOS4	IOS3	IOS2	IOS1	IOS0
	W								
0x0001 CFORC	R	0	0	0	0	0	0	0	0
	W	FOC7	FOC6	FOC5	FOC4	FOC3	FOC2	FOC1	FOC0
0x0002 OC7M	R	OC7M7	OC7M6	OC7M5	OC7M4	OC7M3	OC7M2	OC7M1	OC7M0
	W								
0x0003 OC7D	R	OC7D7	OC7D6	OC7D5	OC7D4	OC7D3	OC7D2	OC7D1	OC7D0
	W								
0x0004 TCNTH	R	TCNT15	TCNT14	TCNT13	TCNT12	TCNT11	TCNT10	TCNT9	TCNT8
	W								
0x0005 TCNTL	R	TCNT7	TCNT6	TCNT5	TCNT4	TCNT3	TCNT2	TCNT1	TCNT0
	W								
0x0006 TSCR1	R	TEN	TSWAI	TSFRZ	TFFCA	PRNT	0	0	0
	W								
0x0007 TTOV	R	TOV7	TOV6	TOV5	TOV4	TOV3	TOV2	TOV1	TOV0
	W								
0x0008 TCTL1	R	OM7	OL7	OM6	OL6	OM5	OL5	OM4	OL4
	W								
0x0009 TCTL2	R	OM3	OL3	OM2	OL2	OM1	OL1	OM0	OL0
	W								
0x000A TCTL3	R	EDG7B	EDG7A	EDG6B	EDG6A	EDG5B	EDG5A	EDG4B	EDG4A
	W								
0x000B TCTL4	R	EDG3B	EDG3A	EDG2B	EDG2A	EDG1B	EDG1A	EDG0B	EDG0A
	W								
0x000C TIE	R	C7I	C6I	C5I	C4I	C3I	C2I	C1I	C0I
	W								
0x000D TSCR2	R	TOI	0	0	0	TCRE	PR2	PR1	PR0
	W								
0x000E TFLG1	R	C7F	C6F	C5F	C4F	C3F	C2F	C1F	C0F
	W								
0x000F TFLG2	R	TOF	0	0	0	0	0	0	0
	W								
0x0010–0x001F TCxH–TCxL[1]	R	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
	W								
	R	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	W								
0x0020 PACTL	R	0	PAEN	PAMOD	PEDGE	CLK1	CLK0	PAOVI	PAI
	W								

Figure 23-5. TIM16B8CV3 Register Summary (Sheet 1 of 2)

Chapter 24
16 KByte Flash Module (S12FTMRG16K1V1)

Table 24-1. Revision History

Revision Number	Revision Date	Sections Affected	Description of Changes
V01.04	17 Jun 2010	24.4.6.1/24-795 24.4.6.2/24-796 24.4.6.3/24-796 24.4.6.14/24-806	Clarify Erase Verify Commands Descriptions related to the bits MGSTAT[1:0] of the register FSTAT.
V01.05	20 aug 2010	24.4.6.2/24-796 24.4.6.12/24-803 24.4.6.13/24-805	Updated description of the commands RD1BLK, MLOADU and MLOADF
Rev.1.27	31 Jan 2011	24.3.2.9/24-781	Updated description of protection on Section 24.3.2.9

24.1 Introduction

The FTMRG16K1 module implements the following:

- 16Kbytes of P-Flash (Program Flash) memory
- 512 bytes of EEPROM memory

The Flash memory is ideal for single-supply applications allowing for field reprogramming without requiring external high voltage sources for program or erase operations. The Flash module includes a memory controller that executes commands to modify Flash memory contents. The user interface to the memory controller consists of the indexed Flash Common Command Object (FCCOB) register which is written to with the command, global address, data, and any required command parameters. The memory controller must complete the execution of a command before the FCCOB register can be written to with a new command.

CAUTION

A Flash word or phrase must be in the erased state before being programmed. Cumulative programming of bits within a Flash word or phrase is not allowed.

The Flash memory may be read as bytes and aligned words. Read access time is one bus cycle for bytes and aligned words. For misaligned words access, the CPU has to perform twice the byte read access command. For Flash memory, an erased bit reads 1 and a programmed bit reads 0.

24.3.2.10 EEPROM Protection Register (EEPROT)

The EEPROT register defines which EEPROM sectors are protected against program and erase operations.

Offset Module Base + 0x0009

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

= Unimplemented or Reserved

Figure 24-14. EEPROM Protection Register (EEPROT)

1 Loaded from IFR Flash configuration field, during reset sequence.

The (unreserved) bits of the EEPROT 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, fields DPOPEN and DPS of the EEPROT register are loaded with the contents of the EEPROM protection byte in the Flash configuration field at global address 0x3_FF0D located in P-Flash memory (see Table 24-4) as indicated by reset condition F in Table 24-21. To change the EEPROM protection that will be loaded during the reset sequence, the P-Flash sector containing the EEPROM protection byte must be unprotected, then the EEPROM protection byte must be programmed. If a double bit fault is detected while reading the P-Flash phrase containing the EEPROM protection byte during the reset sequence, the DPOPEN bit will be cleared and DPS bits will be set to leave the EEPROM memory fully protected.

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

Table 24-20. EEPROT Field Descriptions

Field	Description
7 DPOPEN	EEPROM Protection Control 0 Enables EEPROM memory protection from program and erase with protected address range defined by DPS bits 1 Disables EEPROM memory protection from program and erase
4–0 DPS[4:0]	**EEPROM Protection Size** — The DPS[4:0] bits determine the size of the protected area in the EEPROM memory as shown inTable 24-21 .

- Fast sector erase and phrase program operation
- Ability to read the P-Flash memory while programming a word in the EEPROM memory
- Flexible protection scheme to prevent accidental program or erase of P-Flash memory

26.1.2.2 EEPROM Features

- 1.5Kbytes of EEPROM memory composed of one 1.5Kbyte Flash block divided into 384 sectors of 4 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 EEPROM memory
- Ability to program up to four words in a burst sequence

26.1.2.3 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

Table 26-25. FOPT Field Descriptions

Field	Description
7–0 NV[7:0]	**Nonvolatile Bits** — The NV[7:0] bits are available as nonvolatile bits. Refer to the device user guide for proper use of the NV bits.

26.3.2.17 Flash Reserved5 Register (FRSV5)

This Flash register is reserved for factory testing.

Offset Module Base + 0x0011

	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

Figure 26-23. Flash Reserved5 Register (FRSV5)

All bits in the FRSV5 register read 0 and are not writable.

26.3.2.18 Flash Reserved6 Register (FRSV6)

This Flash register is reserved for factory testing.

Offset Module Base + 0x0012

	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

Figure 26-24. Flash Reserved6 Register (FRSV6)

All bits in the FRSV6 register read 0 and are not writable.

26.3.2.19 Flash Reserved7 Register (FRSV7)

This Flash register is reserved for factory testing.

Table 26-36. Erase Verify P-Flash Section Command FCCOB Requirements

CCOBIX[2:0]	FCCOB Parameters	
000	0x03	Global address [17:16] of a P-Flash block
001	Global address [15:0] of the first phrase to be verified	
010	Number of phrases to be verified	

Upon clearing CCIF to launch the Erase Verify P-Flash Section command, the Memory Controller will verify the selected section of Flash memory is erased. The CCIF flag will set after the Erase Verify P-Flash Section operation has completed. If the section is not erased, it means blank check failed, both MGSTAT bits will be set.

Table 26-37. Erase Verify P-Flash Section Command Error Handling

Register	Error Bit	Error Condition
FSTAT	ACCERR	Set if CCOBIX[2:0] != 010 at command launch
		Set if command not available in current mode (see Table 26-27)
		Set if an invalid global address [17:0] is supplied see Table 26-3)
		Set if a misaligned phrase address is supplied (global address [2:0] != 000)
		Set if the requested section crosses a the P-Flash address boundary
	FPVIOL	None
	MGSTAT1	Set if any errors have been encountered during the read or if blank check failed.
	MGSTAT0	Set if any non-correctable errors have been encountered during the read or if blank check failed.

26.4.6.4 Read Once Command

The Read Once command provides read access to a reserved 64 byte field (8 phrases) located in the nonvolatile information register of P-Flash. The Read Once field is programmed using the Program Once command described in Section 26.4.6.6. The Read Once command must not be executed from the Flash block containing the Program Once reserved field to avoid code runaway.

Table 26-38. Read Once Command FCCOB Requirements

CCOBIX[2:0]	FCCOB Parameters	
000	0x04	Not Required
001	Read Once phrase index (0x0000 - 0x0007)	
010	Read Once word 0 value	
011	Read Once word 1 value	
100	Read Once word 2 value	
101	Read Once word 3 value	

Table 28-59. 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 28-27)
		Set if an invalid FlashBlockSelectionCode[1:0] is supplied (See Table 28-34)[1]
		Set if an invalid margin level setting is supplied
	FPVIOL	None
	MGSTAT1	None
	MGSTAT0	None

1 As defined by the memory map for FTMRG96K1.

CAUTION

Field margin levels must only be used during verify of the initial factory programming.

NOTE

Field margin levels can be used to check that Flash memory contents have adequate margin for data retention at the normal level setting. If unexpected results are encountered when checking Flash memory contents at field margin levels, the Flash memory contents should be erased and reprogrammed.

28.4.6.14 Erase Verify EEPROM Section Command

The Erase Verify EEPROM Section command will verify that a section of code in the EEPROM is erased. The Erase Verify EEPROM Section command defines the starting point of the data to be verified and the number of words.

Table 28-60. Erase Verify EEPROM Section Command FCCOB Requirements

CCOBIX[2:0]	FCCOB Parameters	
000	0x10	Global address [17:16] to identify the EEPROM block
001	Global address [15:0] of the first word to be verified	
010	Number of words to be verified	

Upon clearing CCIF to launch the Erase Verify EEPROM Section command, the Memory Controller will verify the selected section of EEPROM memory is erased. The CCIF flag will set after the Erase Verify EEPROM Section operation has completed. If the section is not erased, it means blank check failed, both MGSTAT bits will be set.

indicated by reset condition F in Figure 29-6. If a double bit fault is detected while reading the P-Flash phrase containing the Flash security byte during the reset sequence, all bits in the FSEC register will be set to leave the Flash module in a secured state with backdoor key access disabled.

Table 29-9. FSEC Field Descriptions

Field	Description
7–6 KEYEN[1:0]	**Backdoor Key Security Enable Bits** — The KEYEN[1:0] bits define the enabling of backdoor key access to the Flash module as shown in Table 29-10.
5–2 RNV[5:2]	**Reserved Nonvolatile Bits** — The RNV bits should remain in the erased state for future enhancements.
1–0 SEC[1:0]	**Flash Security Bits** — The SEC[1:0] bits define the security state of the MCU as shown in Table 29-11. If the Flash module is unsecured using backdoor key access, the SEC bits are forced to 10.

Table 29-10. Flash KEYEN States

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

1 Preferred KEYEN state to disable backdoor key access.

Table 29-11. Flash Security States

SEC[1:0]	Status of Security
00	SECURED
01	SECURED[1]
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 29.5.

29.3.2.3 Flash CCOB Index Register (FCCOBIX)

The FCCOBIX register is used to index the FCCOB register for Flash memory operations.

Offset Module Base + 0x0002

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

= Unimplemented or Reserved

Figure 29-7. FCCOB Index Register (FCCOBIX)

Table 30-46. Erase Flash Block Command FCCOB Requirements

CCOBIX[2:0]	FCCOB Parameters	
000	0x09	Global address [17:16] to identify Flash block
001	Global address [15:0] in Flash block to be erased	

Upon clearing CCIF to launch the Erase Flash Block command, the Memory Controller will erase the selected Flash block and verify that it is erased. The CCIF flag will set after the Erase Flash Block operation has completed.

Table 30-47. Erase Flash Block 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 30-27)
		Set if an invalid global address [17:16] is supplied
		Set if the supplied P-Flash address is not phrase-aligned or if the EEPROM address is not word-aligned
	FPVIOL	Set if an area of the selected Flash block is protected
	MGSTAT1	Set if any errors have been encountered during the verify operation
	MGSTAT0	Set if any non-correctable errors have been encountered during the verify operation

30.4.6.9 Erase P-Flash Sector Command

The Erase P-Flash Sector operation will erase all addresses in a P-Flash sector.

Table 30-48. Erase P-Flash Sector Command FCCOB Requirements

CCOBIX[2:0]	FCCOB Parameters	
000	0x0A	Global address [17:16] to identify P-Flash block to be erased
001	Global address [15:0] anywhere within the sector to be erased. Refer to Section 30.1.2.1 for the P-Flash sector size.	

Upon clearing CCIF to launch the Erase P-Flash Sector command, the Memory Controller will erase the selected Flash sector and then verify that it is erased. The CCIF flag will be set after the Erase P-Flash Sector operation has completed.

This device contains circuitry protecting against damage due to high static voltage or electrical fields; however, it is advised that normal precautions be taken to avoid application of any voltages higher than maximum-rated voltages to this high-impedance circuit. Reliability of operation is enhanced if unused inputs are tied to an appropriate logic voltage level (e.g., either V_{SS35} or V_{DD35}).

Table A-1. Absolute Maximum Ratings[1]

Num	Rating	Symbol	Min	Max	Unit
1	I/O, regulator and analog supply voltage	V_{DD35}	–0.3	6.0	V
2	Voltage difference V_{DDX} to V_{DDA}	Δ_{VDDX}	–6.0	0.3	V
3	Voltage difference V_{SSX} to V_{SSA}	Δ_{VSSX}	–0.3	0.3	V
4	Digital I/O input voltage	V_{IN}	–0.3	6.0	V
5	Analog reference	V_{RH}	–0.3	6.0	V
6	EXTAL, XTAL	V_{ILV}	–0.3	2.16	V
7	Instantaneous maximum current Single pin limit for all digital I/O pins[2]	I_D	–25	+25	mA
8	Instantaneous maximum current Single pin limit for EXTAL, XTAL	I_{DL}	–25	+25	mA
9	Maximum current Single pin limit for power supply pins	I_{DV}	–60	+60	mA
10	Storage temperature range	T_{stg}	–65	155	°C

1 Beyond absolute maximum ratings device might be damaged.

2 All digital I/O pins are internally clamped to V_{SSX} and V_{DDX}, or V_{SSA} and V_{DDA}.

A.1.6 ESD Protection and Latch-up Immunity

All ESD testing is in conformity with CDF-AEC-Q100 stress test qualification for automotive grade integrated circuits. During the device qualification ESD stresses were performed for the Human Body Model (HBM) and the Charge Device Model.

A device will be defined as a failure if after exposure to ESD pulses the device no longer meets the device specification. Complete DC parametric and functional testing is performed per the applicable device specification at room temperature followed by hot temperature, unless specified otherwise in the device specification.