FXLC95000CL Frequently Asked Questions

1 Introduction

This document contains frequently-asked-questions regarding theFXLC95000CL. The FXLC95000CL Intelligent, Motion-Sensing Platform is a breakthrough device with the integration of a 3-axis MEMS accelerometer and a low power 32-bit MCU that enables autonomous, high-precision sensing solutions with local computing and sensors management capability in an open, easy to use, architecture.

Contents

2 Applicable Parts

This document applies to the following Freescale sensors:

Part Number	Description
FXLC95000CL	Intelligent, Motion-Sensing Platform

3 Frequently Asked Questions

Q1: What is FXLC95000CL?

A1: Freescale intelligent motion-sensing platform FXLC95000CL combines a high-performance accelerometer with a low-power 32-bit MCU, on-chip memory, multiple peripherals and serial communication interfaces. Freescale also provides a flexible software framework and library to quickly turn the FXLC95000CL platform into an efficient sensor hub with embedded sensor fusion algorithms. The FXLC95000 Factsheet can provide more high level details as well.

Q2: What do I need to program the FXLC95000CL?

A2: The FXLC95000CL internal MCU is a Freescale ColdfireV1 core, equipped with a Background Debug mode (BDM) interface. The MCU can be programmed and debugged through the simple USB BDM Multilink Universal Interface (USB-ML-UNIVERSAL) from PEmicro. The MCU can also be programmed and debugged through more sophisticated interfaces, such as the USB Multilink Universal FX or Cyclone PRO. In addition, customers can take advantage of FXLC95000CL ROM functions to write directly to the FXLC95000CL flash memory via the slave communication interface in the field or in support of a production/test line. The Mailbox Tool application provides an easy-to-use graphical interface to this functionality and allows a user to erase and program the FXLC95000CL flash memory from a PC over the Evaluation Kit's USB interface.

Q3: What do I need to develop code for the FXLC95000CL?

A3: CodeWarrior development studio version 10.6 or newer is recommended to be used for FXLC95000CL embedded software development. This is a Freescale Eclipse-based standard Integrated Development Environment (IDE) available for download on the Freescale web site. On top of the base CodeWarrior 10.6, the ColdFire/Sensors Support Feature Group must be installed. In addition, the ISF1P195_INSTALLER installation package must be installed. The ISF installation package includes necessary tools, packages and documentation. This installation package can be found at freescale.com/ISF-FXLC95000CL.

Q4: What is ISF?

A4: The Intelligent Sensing Framework (ISF) is a software framework built on top of Freescale's MQX real-time operating system (RTOS). ISF offers an open programming model with library support for FXLC95000CL devices. Sensor Adapter libraries for a number of additional Freescale sensors are also available for download, enabling the FXLC95000CL to become a sensor hub. All necessary tools, packages and documentation can be found on the Freescale ISF website at freescale.com/ISF-FXLC95000CL.

Q5:   What if I don't want to use ISF? How can I develop code for the FXLC95000CL?

A5:   Technically, it is possible to use the FXLC95000CL without the ISF framework. Freescale is offering customers precompiled binaries, sample CodeWarrior applications, and a core library via ISF to enable customers to focus their attention on their applications rather than obtaining the sensor data. Again, software development debug and development is done with CodeWarrior 10.6 or newer.

Q6:   What development tools are available for the FXLC95000CL?

A6:   The Mailbox Tool, available for download at freescale.com/ISF-FXLC95000CL, is a simple Windows® Graphical User Interface (GUI) providing a means of communication between the host computer and a KITFXLC95000EVM Evaluation Kit. The demo kit includes a baseboard, which acts as a bridge between the host computer virtual serial port over USB, and an I^{2}C or SPI bus used by the FXLC95000CL. The demo kit has a daughter board, or DIP board with the FXLC9500CL device. The DIP board can be removed and wired into a user prototype system for evaluation. The mailbox tool opens a virtual serial port over a USB link and allows the user to read and write to the FXLC95000CL Slave interface mailboxes. Each of the ISF-provided applications has an included README file explaining the commands that can be used with the Mailbox Tool for the specific application. This tool can also be used to erase the flash memory of the device and program it with an S19 format firmware binary file. Go to the Software and Tools Section of the FXLC95000 page to find the latest tools.

Q7:   How is FXLC95000CL different from other products?

A7:   FXLC95000CL main benefits lie in the combination of many key features:
- High-precision, 3-axis accelerometer (up to 16 bits)
- Supports user-programmable, application-specific sensor fusion
- 32-bit MCU with flash, RAM and ROM
- Hardware MAC unit
- Rich connectivity (several Master and Slave, SPI and I^{2}C serial interfaces, multiple GPIOs)
- Powerful Software Development suite (CodeWarrior IDE, MQX, ISF, libraries)

Q8:   What is the FXLC95000CL's maximum bus speed for the I^{2}C?

A8:   Slave I^{2}C maximum baud rate is 2 MHz, which helps to reduce the communication time spent with the host MCU. Master I^{2}C supports Fast mode, such as a 400 kHz, Serial Clock frequency.

Q9:   What are the I^{2}C device address options for the FXLC95000CL?

A9:   The I^{2}C 7-bit slave address is user configurable and is set, by default, to 0x98 (hexadecimal value).

Q10: What is the input voltage range for the FXLC95000CL?

A10: Main supply voltage range is 1.8 V ±5%, but there is a dedicated supply rail for all digital IOs (pin VDDIO) to extend their range from 1.71 V to 3.6 V.

Q11: What is the bandwidth at the different selectable ODRs for the FXLC95000CL?

A11: Total system bandwidth for the accelerometer data is a combination of several contributors. The first one to play a role is the MEMS device, whose mechanical bandwidth limits the measurement

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bandwidth (continuous-time low pass filter effect with a cut-off frequency of about 3 kHz). Then, a low-noise signal-processing chain adds additional filtering prior to final conversion by the A/D. The additional filtering also creates potential spectral aliasing, or folding, due to its discrete-time operation nature. The digital accelerometer signal bandwidth is bounded by Nyquist Frequency, which corresponds to half of the sampling frequency (ODR/2). For applications requesting high quality and low noise accelerometer data, we recommend increasing the sampling frequency and performing digital filtering/averaging. This digital data processing will reduce measurement noise and lower the system bandwidth by the same amount while reducing the lowest frequency spectral aliasing.

Q12: Can you describe the Active mode and Standby mode for the FXLC95000CL?

A12: Active mode corresponds to the RUN Fast Clock state and is also referred to as the *Digital Operational phase* in the FXLC95000CL Hardware Reference Manual, Chapter 8. In this mode, CPU and peripherals are active and an on-chip oscillator is running in high speed mode (16 MHz frequency). Standby mode or Sleep phase corresponds to "STOP No Clock" state where no clocks are present, reducing current consumption to the bare minimum. Issuing a Slave Port interrupt, an external IRQ interrupt, or a Power on Reset (POR) are the only ways to exit the Standby mode.
A third mode of interest is the "STOP Slow Clock" state referred to as the *Idle Operational phase* in the FXLC95000CL Hardware Reference Manual, Chapter 8. During this mode, the CPU is inactive and an on-chip oscillator is running in low-speed mode, such as 62.5 kHz frequency. The inactivity of the CPU and the low speed of the oscillator contribute to a drastic reduction in current consumption, while still allowing clocked interrupts to be issued.

Q13: What is the expected duration for the FXLC95000CL to go from OFF to Active mode?

A13: The time duration required by FXLC95000CL to transition from an Off state (part is not powered) to a part-ready state (Active mode) equates approximately to the Power on Reset (POR) + boot time. Whenever a POR occurs, there is approximately a 500 µs delay before the CPU and peripherals are reset and released. Note that this delay is reduced to a few µs only for other reset sources such as the ResetB pin or SW reset. After this delay, the CPU starts executing the ROM boot loader code and performs all necessary initialization steps before control is eventually transferred to the user program in flash memory. This boot and initialization phase takes about 1.2 ms.

Q14: What is the expected duration for the FXLC95000CL to go from Standby to Active mode?

A14: The transition from Standby mode (STOP No Clock) to Active mode (RUN Fast Clock) necessitates only a few Fast Clock cycles, therefore it can be considered as immediate. This is also the case for the reverse transition.

Q15: What is the expected duration for the FXLC95000CL to go from Active to Standby mode?

A15: When switching from RUN mode into any STOP mode, high-speed operation is continued for a minimum of three clock cycles into STOP and may resume up to three cycles prior to exiting STOP. See System Integration Module (SIM), Chapter 9, in the FXLC95000CL Hardware Reference Manual. The entire cycle is at low speed or high speed. The two modes are not mixed within a cycle. Transitions from one mode to the next take place on the falling edge of the oscillator. See On-Chip Oscillator (CLKGEN), Chapter 11, in the FXLC95000CL Hardware Reference Manual.

Q16: What is the sensitivity of the FXLC95000CL?

A16: The sensitivity of the FXLC95000CL internal accelerometer depends only on the range selection. The 10-, 12-, 14-, or 16-bit trimmed ADC data representing accelerometer measurement is always left-justified as a 16-bit word that spans over the selected peak-to-peak *g*-range. Consequently,

$$\text{sensitivity} = \frac{(\text{g-range pk-to-pk})}{2^{16}}$$

As an example, if selected full-range = ±8 *g*, such as 16 *g* peak-to-peak, then

$$\text{sensitivity} = \frac{16}{65536 \ g/\text{LSB}} = 0.244 \ \text{mg/LSB}$$

Note that sensor sensitivity refers to the gain or scaling factor, and this formula provides the scaling factor used to translate the digital data into acceleration measurement in *g*-units. This sensitivity value does not imply that the part can detect such a small change in acceleration.

Q17: What is the operating temperature range of the FXLC95000CL?

A17: The FXLC95000CL device operation is guaranteed over the full –40 °C to +85 °C industrial temperature range.

Q18: Can I use a different MQX version with CW10.6?

A18: Yes, multiple installations of MQX can coexist on the same computer. They shall be located in different directories, and each CodeWarrior project has its own MQX_ROOT_DIR variable that points to the directory to use. A custom distribution of MQX 3.7.0 is used to run FXLC95000 ISF software. This version includes the necessary BSP/PSP to support FXLC95000CL hardware features.

Q19: Can I use FreeRTOS with the FXLC95000CL?

A19: While it is technically possible to use any RTOS on the FXLC95000CL with a board support package (BSP) produced for the device, Freescale provides MQX and a specific MQX BSP for the FXLC95000CL.

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4 References

Document number	Title
FXLC95000CL	FXLC95000CL Intelligent, Motion-Sensing Platform Data sheet
FXLC95000CLHWRM	FXLC95000CL Intelligent Motion-Sensing Platform Hardware Reference Manual
ISF1P195K_SW_REFERENCE_RM	Intelligent Sensing Framework v1.1 Software Reference Manual
ISF1P195K_API_REFERENCE_RM.zip	API Reference Manual for the ISF v1.1 for the FXLC95000. (Unzip and open ISF_1.1_API_Reference.html)