

# Using the IEC 60730 Standard for Safe and Reliable Operation of Stellaris® Microcontrollers

## Application Note



## Copyright

Copyright © 2009 Texas Instruments, Inc. All rights reserved. Stellaris and StellarisWare are registered trademarks of Texas Instruments. ARM and Thumb are registered trademarks, and Cortex is a trademark of ARM Limited. Other names and brands may be claimed as the property of others.

Texas Instruments  
108 Wild Basin, Suite 350  
Austin, TX 78746  
Main: +1-512-279-8800  
Fax: +1-512-279-8879  
<http://www.luminarymicro.com>



# Table of Contents

Introduction ..... 4

Class B Compliance ..... 4

    Test Structures..... 4

    Test Components..... 5

IEC 60730 Class B Library ..... 5

Conclusion ..... 5

References ..... 6

## Introduction

The International Electrotechnical Commission (IEC) has introduced the IEC 60730 standard which requires manufacturers of household appliances to take additional steps to ensure safe and reliable operation of their products. The IEC 60730 standard covers mechanical, electrical, electronic, EMC, and abnormal operation of household appliances.

The IEC 60730 standard encompasses all aspects of appliance design, but Annex H of the standard covers the aspects most relevant to microcontrollers (MCUs). Annex H details the tests and diagnostics which are intended to ensure safe operation of embedded control hardware and software. Three software Classifications for automatic electronic controls are defined:

- Class A – Control functions which are not intended to be relied upon for safety of the equipment.
- Class B – Control functions intended to prevent unsafe operation of the controlled equipment.
- Class C – Control functions intended to prevent special hazards such as explosions.

The Class B Classification applies to most home appliances including washing machines, dishwashers, dryers, refrigerators, freezers, and cookers/stoves. This application note covers the Class B compliance requirements along with the IEC 60730 Class B Library provided by Texas Instruments intended to assist in Class B compliance for products controlled by Stellaris microcontrollers.

## Class B Compliance

The electronic controls of most home appliances are single MCU solutions. The IEC 60730 standard specifies two test structures for single MCU designs along with a checklist of MCU components to be tested.

### Test Structures

The two test structures specified by the IEC 60730 standard for single MCU solutions are:

- Single channel with functional test
- Single channel with periodic self-test

The single channel with functional test structure is the most commonly used structure today and is the easiest to implement. The functional test is performed prior to shipment to ensure that all critical features are performing safely and reliably. The drawback to this structure is that problems cannot be detected once the appliance is in the field.

Single channel with periodic self-test is the structure that most manufacturers are implementing when designing today's new products. As the name suggests, this test structure provides for the tests to be performed periodically. The self-test is built in with the application allowing the application to call the test at a regular interval. The benefit of this structure is that problems can be detected once the appliance is in the field. Single channel with periodic self-test offers the highest level of protection at a low cost.

## Test Components

To fulfill Class B compliance, manufacturers must test specific components of the design. Table H.11.12.7 in Annex H of the IEC 60730 standard lists the MCU components to be tested, the faults to be detected, and the appropriate reactive measures. The components include the CPU, interrupts, clocking, memory, external communications, analog-to-digital converters, and internal address and data paths.

## IEC 60730 Class B Library

Texas Instruments provides an IEC 60730 Class B Library to support its customers in the certification process. This library, along with an example application that uses the library, is provided in the accompanying ZIP file. The contents of this ZIP file should be extracted to the same directory to which StellarisWare™ was installed. For example, if the StellarisWare™ package was installed to the C:\ directory, then these ZIP files should also be extracted to the C:\ directory. This creates a C:\StellarisWare\AppNotes\sw01272 directory that contains the source code for the library and example application.

Table 1-1 shows the modules that comprise the IEC 60730 Class B Library along with a brief description of the tests performed by that module. See the software reference manual, SW01272-SRM-nnnn.pdf (where nnnn is replaced by the version number), found in the same directory as the source code for full details of the functions, global variables, defines, and so on, in the source code.

**Table 1-1. IEC 60730 Class B Library Modules**

Module	Description
Reset Handler	Performs basic register and memory test out of reset.
CPU Test	Performs stuck bit testing on the CPU PC and registers.
SRAM Test	Performs stuck bit testing on the SRAM.
Flash Test	Performs a CRC test on the Flash.
ADC Test	Performs a conversion test on an ADC channel connected to a known voltage reference.
	Performs ADC temperature sensor test.
GPIO Test	Performs GPIO input/output plausibility test.
Clock/Interrupt Test	Performs tests to check the clock frequency, interrupt handling, and execution.

## Conclusion

Manufacturers of household appliances must take steps to ensure safe and reliable operation of their products in order to meet the IEC 60730 standard. Annex H of this standard covers the aspects most relevant to microcontrollers including the three software classifications defined for automatic electronic controls. Most home appliances including washing machines, dryers, refrigerators, freezers, and cookers/stoves fall into the Class B classification. The IEC 60730 Class B Test Library is provided to support customers in the Class B certification process.

## References

Documents used in the generation of this application note include:

- *StellarisWare® Driver Library User's Manual*, publication number SW-DRL-UG

## Important Notice

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

### Products

Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
RF/IF and ZigBee® Solutions	<a href="http://www.ti.com/lprf">www.ti.com/lprf</a>

### Applications

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Broadband	<a href="http://www.ti.com/broadband">www.ti.com/broadband</a>
Digital Control	<a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Military	<a href="http://www.ti.com/military">www.ti.com/military</a>
Optical Networking	<a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Telephony	<a href="http://www.ti.com/telephony">www.ti.com/telephony</a>
Video & Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>
Wireless	<a href="http://www.ti.com/wireless">www.ti.com/wireless</a>

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2009, Texas Instruments Incorporated