

# **Digital Input and Output**

## **Self-diagnosis Program**

### **Application Note**

#### **Outlines**

This application note describes the self-diagnosis program for the digital input and output.

The self-diagnosis program in this document is the library which enables both the input and output of the ports and checks the status of the ports.

This library supports the sample program with the peripheral driver of TXZ series enclosed, and should be used after it is overwritten to the sample program.

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## 1. Preface

This application note describes the self-diagnosis program for the input and output ports.  
This library code should be used after it is added (overwritten) to the published sample program.

The explanation of this document uses the TPM4K Group (1).  
When the program is applied to a product, some appropriate modification may be necessary depending on the specifications of the product.

This sample program has been developed and evaluated under the conditions in the operation confirmation environment in “Self-diagnosis Program Application Note – Basic Setting”, and by using the TPM4K4A 1.0.0 sample program and the reference manual released in February in 2019.

## 2. Outline of Self-diagnosis Test Library

This self-diagnosis test library has been checked on the evaluation board.

The following self-test function is supported.

Name	Description
Digital input and output test	1: Both the input and the output of a port are enabled. The output signal of the port is input to the same port. When the port outputs High level, it is checked that the input data of the port is High. And when the port outputs Low level, it is checked that the input data of the port is Low. 2: Data (0/1) is input to a GPIO pin: It can be used as a switch input on the evaluation board. 3: A GPIO pin outputs data (0/1): It can be used as the output signal to the LED on the evaluation board.

### 2.1. Self-diagnosis Sample Project

In the "Project\Examples\Safety" folder, the following sample project for the self-diagnosis library is placed.

Project name	Operation	Utilized self-diagnosis library function
DIO_Sample	After the digital input and output test is done, the result is shown with the LED lighting. After that, the state of PE2 (switch) is output to PJ0 (LED).. The switch status is shown with the LED. The operation is executed infinitely.	safety_DigitalIO() safety_DIN_PE2() safety_DOUT_PJ0()

### 3. Details of Self-diagnosis Test Library

This section describes the details of the self-diagnosis test library function.  
 This sample program is a self-diagnosis program for the digital input and output.  
 The following setting is an example when a product in the TPM4K group (1) is used.

The source code (.c file) of the self-diagnosis library is in the “Libraries\Safety\src” folder, and the header file (.h file) is in the “Libraries\Safety\inc” folder.

#### 3.1. Digital Input and Output Test

Using the PL4, the port outputs a digital data and the data is input to the same port. The output data is set to 0 and 1. And the output data is read.

The port setting of the PL4 is changed during this test. So this test should be done before the start-up of the application software, or the port setting should be done again after the test.

The “safety\_DigitalIO” function does not use any interrupts.

Source file: safety\_digital\_io.c  
 Header file: safety\_digital\_io.h  
 Used library: txz\_gpio.c/.h and txz\_hal.c/.h

Function name	
bool safety_DigitalIO(uint32_t *result_word)	
Input parameter	
None.	-
Output parameter	
uint32_t *result_word	When an error occurs, one of the following bits is set. bit0: '0' output error bit1: '1' output error When an error is detected, the test is suspended and the remaining test is not executed.
Return value	
bool	Result (true: success, false: failure)

\* If the return value cannot be confirmed for several seconds, it is supposed the test is not executed correctly. The process for the test failure should be done.  
 When, however, the terminal I/O output display is used, it takes several seconds to complete the display. The judgment of the test failure should be done by checking the display.

The test result is shown with the LEDs after all the tests finish on the evaluation board which was used to develop this test program.

LED1 (PJ0) lighting: All tests are successful.

LED1 (PJ0) lights-out: The test fails.

### 3.2. Digital Input Test

The PE2 is set to the digital input to read the data.

The “safety\_DIN\_PE2” function does not use any interrupts.

Source file: safety\_digital\_io.c

Header file: safety\_digital\_io.h

Used library: txz\_gpio.c/h, txz\_hal.c/h

Function name	
int safety_DIN_PE2 (void)	
Input parameter	
None.	-
Output parameter	
None.	-
Return value	
int	Result of reading the PE2 (0: Low or 1: High) When the switch is not pushed down, the data is 1. And when it is pushed down, the data is 0.

When the evaluation board is used for the test, the LED1 (PJ0) shows the switch state.

PE2 data is High: the LED1 lights.

PE2 data is Low: the LED1 lights out.

**3.3. Digital Output Test**

The PJ0 (LED1) is set to the digital output to output 1 or 0.

The “safety\_DOUT\_PJ0” function does not use any interrupts.

Source file: safety\_digital\_io.c  
 Header file: safety\_digital\_io.h  
 Used library: txz\_gpio.c/.h, and txz\_hal.c/.h

Function name	
void safety_DOUT_PJ0 (int output)	
Input parameter	
int output	The data which is output to the PJ0. 0: Low level is output. Others: High is output. The LED1 lights when the output is High.
Output parameter	
None.	-
Return value	
None.	-

This test should be done at the same time as the digital input test.  
 PE2 data is High: The LED1 lights.  
 PE2 data is Low: The LED1 lights out.



## 4. List of Used Drivers

This test library uses the driver and the code in the project of the TPM4KxA\_v1.0.0 version.

### CMSIS library

Category	Source file name
Start-up	startup_TPM4KxA.s
System (Clock setting and others)	system_TPM4KxA.c

### Periph\_driver

Category	Source file name
GPIO	txz_gpio.c

### In the Project examples

Category	Source file name
BSP (Evaluation board support)	bsp.c
LED output	bsp_led.c

## 5. Reference Document

For development, refer to the following documents.

- Datasheet of each product
- Reference Manual
- Self-diagnosis Program Application Note - Basic Setting
- ARM® Cortex®-M4 Processor technical Reference Manual
- ARMv7-M Architecture Reference Manual

**6. Revision History**

<b>Revision</b>	<b>Date</b>	<b>Description</b>
1.0	2019-08-30	First release

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