

[White Paper]

Firmware vs Software

- What is the Testing
Difference ? -

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RESORT Code Analysis



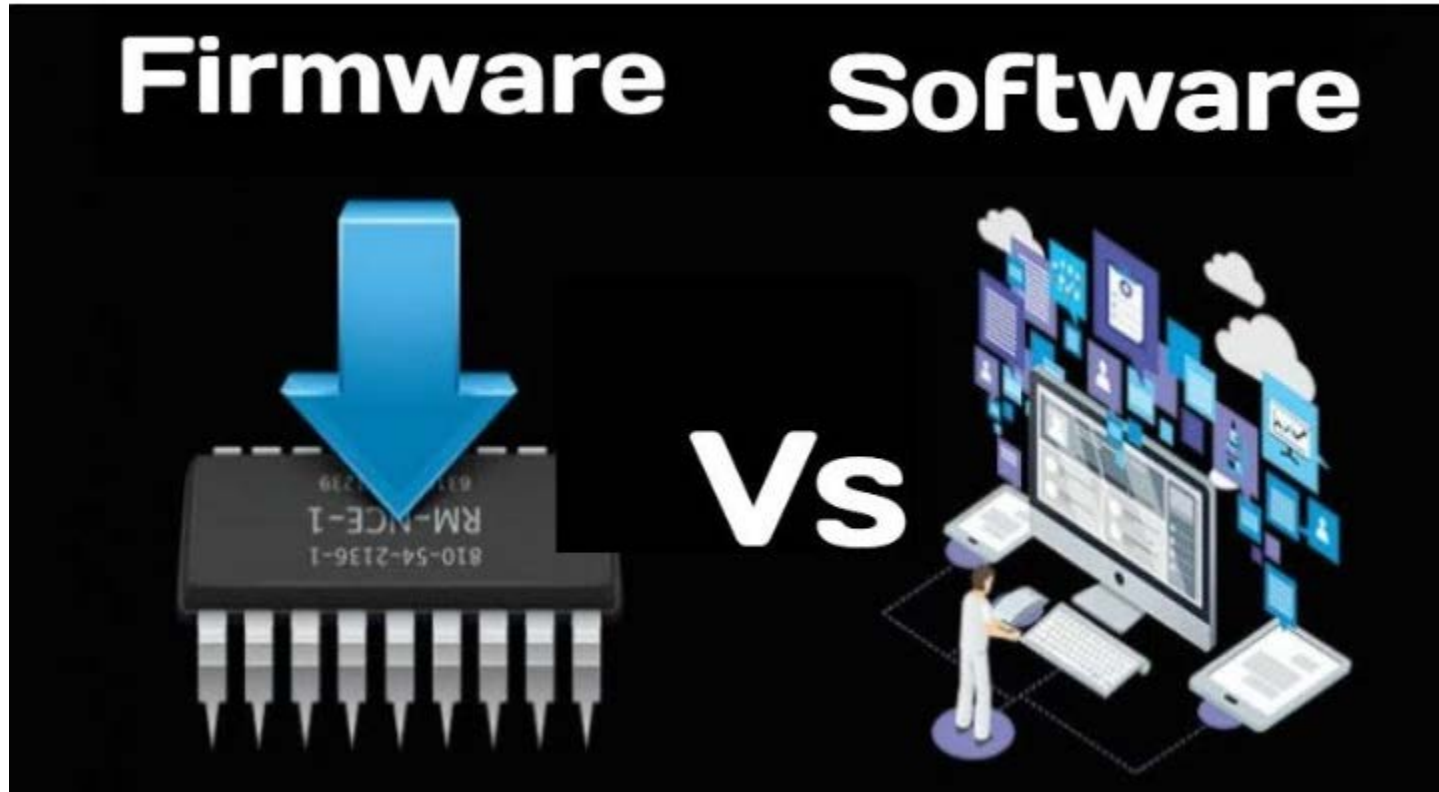
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www.soft4soft.com

+82-2-553-9464

1. Firmware vs Software



Firmware and software are both types of computer programs, but they serve different purposes and are stored and executed in different ways.

1. Understanding Software vs. Firmware



◆ What is Software?

- **Software is a program that enables a computer to perform a specific task**
 - ✓ Software runs on top of the operating system and has no direct interface with hardware
 - ✓ Storage: Software is typically stored on hard drives, SSDs, or other types of non-volatile storage
- Time: More time to create software than firmware



◆ What is Firmware (= FIRM softWARE) ?

- **Firmware is specialized software embedded into hardware devices**
 - ✓ Firmware is low-level software that stands between the hardware and the operating system.
 - ✓ Types of Firmware: Firmware can be found in various electronics, including televisions, washing machines, microwaves, and cameras
 - ✓ Storage: Firmware is stored in non-volatile and stable memory devices such as ROM, flash memory, or EPROM
- Cost: More cost to create firmware than software

2. Difference between Software vs. Firmware Testing



◆ Software Testing

- Software testing is a process of validating and verifying software products and applications
 - ✓ **Runs on: Software**
 - ✓ **Interaction: User**
- Software Test: Testing software on a specific platform
 - ✓ Testing System: Windows, Linux
 - ✓ Tested System: Windows, Linux, Web, Mobile apps, GUI Application, etc.



◆ Firmware Testing

- Firmware testing is the process of testing software that provides control of the hardware
 - ✓ **Runs on: Software + Hardware**
 - ✓ **Interaction: Communication protocol between devices**
- Firmware Test: Testing software embedded into hardware devices
 - ✓ Testing System: Windows
 - ✓ Tested System: ROM, Flash Memory, etc.

3. RESORT Firmware Test



- ◆ (Target) Firmware Test (SW+HW+UART)
 - Verify the functional safety of firmware running on the target ECU/MCU processor
 - Integration with IAR Embedded Workbench: Uninterrupted Workflow
 - ✓ Perform firmware testing in the same environment as firmware development

Firmware Test Methods	Commercial Tools: Black-box Test Tool	RESORT: Firmware Test Tool	Manufacturer: System Test	Remarks
Runs on	SW(program)	SW(Exe)+HW(Chip Processor)+(UART)	Electronic Products	Chip Processor: MCU, ECU, etc.
Test Environment	Host	Target	Target	Tool vendor dependency: (Target)no vs. (Host)compile
	Simulation	N/A	N/A	Tool vendor dependency
Test Design	Test Case Design	Communication Protocol Test UI	Control System	Writing Test Case: Time & Effort Test UI Testing Time: 10~100x Faster
Test Execution	Controller Specification Analysis	UART protocol Scenario Analysis	Product Functionality	Protocol Test based on UART (RS-232, 422, 485)
Test Results	Unit/Integration	Unit/Integration	Response Time	Coverage Analysis
Safety Verification	Non-verification	SW & HW Safety	HW Safety	Functional safety
Responsibility Verification	Non-verification	SW Responsibility	HW Responsibility	Real-time Response Time
IAR Workflow	Interrupted	Uninterrupted	N/A	Interrupted Workflow: Time & Effort
Test Case Design: (Host) Tool Platform (Test Case) vs. (Target) MCU/ECU Platform (no Test Case)				

3. RESORT Firmware Test



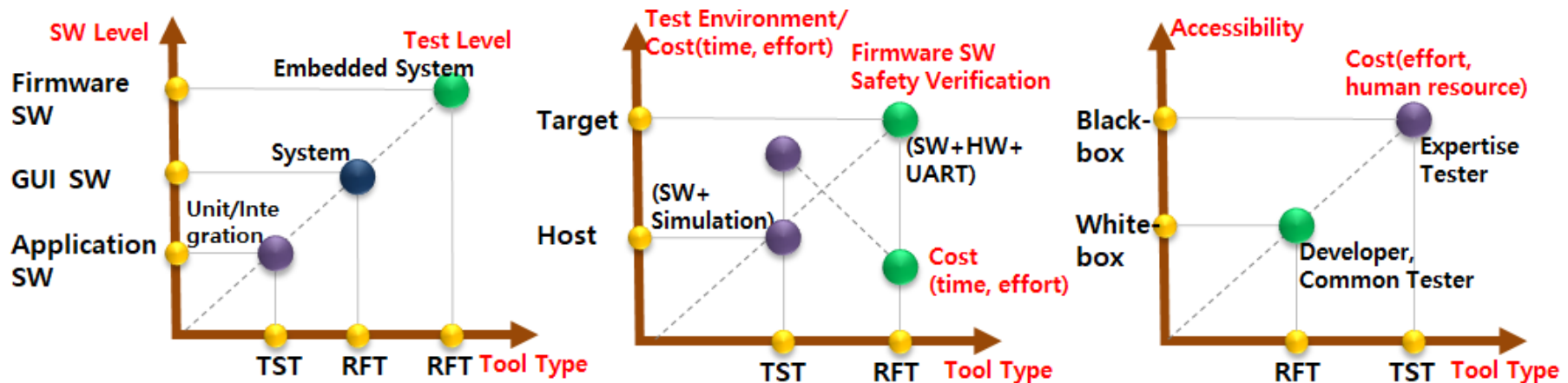
◆ Comparison of Firmware Test

➤ Importance of Firmware Software Testing?

- ✓ The application of ECU/MCU firmware is expanding to the role of weight reduction and automation in electronic products
- ✓ Therefore, ECU/MCU firmware needs to be tested for the functional safety of software and hardware on the HW device environment

➤ Comparison of Main Features of Firmware Test

- ✓ RESORT Firmware Test (RFT: white-box test, Target: SW + HW + UART) vs.
- ✓ Traditional Software Test(TST: black-box test, Host: SW + Simulation)



If you cannot MEASURE it, you cannot IMPROVE it



(주)소프트4소프트

본사: 서울 서초구 서운로1길 34 한국산업기술보호협회 3층
R&D: 대전광역시 유성구 가정북로 96 대전일자리경제진흥원 308호

Tel : 02-553-9464

기술 및 일반 문의 : info@soft4soft.com

www.soft4soft.com