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Coverage, Profiling & Performance, Debugging

DT+Trace

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HEARTLAND.DATA

DT+ Trace

DT+Trace는 CPU, OS에 상관없이 다양한 개발 환경에서 커버리지 측정, 코드 디버깅, 성능 측정이 가능한 통합 분석 솔루션입니다.

제품 사양

- Memory, Ethernet, JTAG/GPIO 등 다양한 인터페이스 지원
- C/C++/C#/JAVA/Python 지원

주요 기능

Coverage(코드 실행률)

- Statement, Branch, MC/DC 및 Call coverage 결과 측정

Profiling & Performance

- 함수 별 수행 시간 및 주기 측정을 통한 시스템 부하 위치 파악

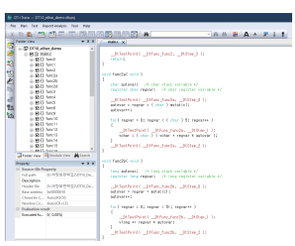
Debugging

- 장시간 소프트웨어 Trace를 통해 간헐적으로 생기는 버그 디버깅

동작 및 분석 원리

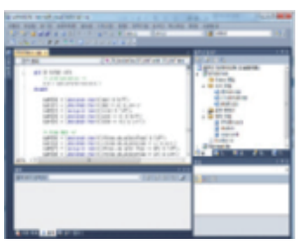
- 소스코드 내 함수의 입/출구, 분기 등 필요한 곳에 자동으로 Test Point 삽입
- 기존 개발 환경에서 컴파일 진행
- 타깃 실행 후 결과 값 수집

Test Point(Macro) 입력



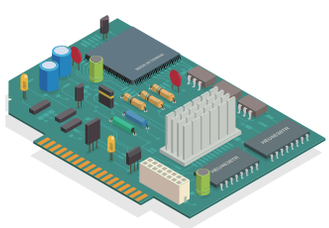
소스코드에 자동으로 삽입

기존 개발환경 사용



드라이버 추가 후 빌드

타깃의 움직임을 Trace



프로그램 수행 결과 수집

Data writing / Ethernet / JTAG/ UART / CAN

ASYNC / GPIO(4/2/1 pin)

USB 3.0

DT+ Trace DT+ FS

Coverage 분석(코드 실행률 측정)

- 소프트웨어의 품질 향상을 위해 Statement, Branch, MC/DC 및 Call coverage 분석을 지원합니다.

DT+ Trace — Statement / Branch Coverage

Coverage Report : Repo_221213_103628

Function	Source	TP setting number	Normal	Effective TP	Execution(...	Statement	Statement(Effective)	Number of Bra...	Passed Bra...	Branch(Effective)
func0	main.c	1	1	1	1	100.00%	100.00%	0	0	-
func1	main.c	2	2	2	2	100.00%	100.00%	0	0	-
func2	main.c	4	4	4	3	75.00%	75.00%	3	2	66.67%
func2a	main.c	3	3	3	3	100.00%	100.00%	1	1	100.00%
func2b	main.c	3	3	3	3	100.00%	100.00%	1	1	100.00%
func2d	main.c	3	3	3	3	100.00%	100.00%	1	1	100.00%
func3	main.c	1	1	1	1	100.00%	100.00%	0	0	-
func4	main.c	2	2	2	2	100.00%	100.00%	0	0	-
func5	main.c	2	2	2	2	100.00%	100.00%	0	0	-
func8	main.c	2	2	2	2	100.00%	100.00%	0	0	-
func9	main.c	4	4	4	4	100.00%	100.00%	2	2	100.00%
func10	main.c	35	35	35	35	100.00%	100.00%	33	33	100.00%
func11	main.c	11	11	11	11	100.00%	100.00%	7	7	100.00%
func12	main.c	2	2	2	0	0.00%	0.00%	0	0	-
func13	main.c	3	3	3	3	100.00%	100.00%	2	2	100.00%
func14	main.c	2	2	2	2	100.00%	100.00%	0	0	-
func15	main.c	2	2	2	2	100.00%	100.00%	0	0	-
func16	main.c	2	2	2	2	100.00%	100.00%	0	0	-

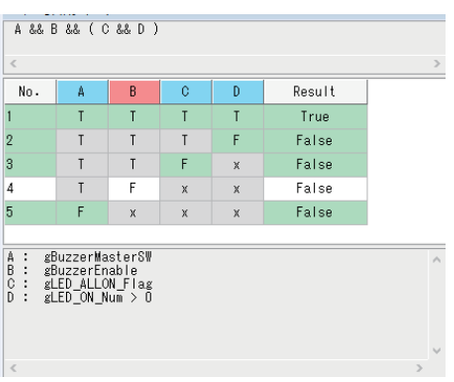
Coverage Report : Repo_221213_103628 | Test Report : Repo_221213_103628

DT+ Trace — Function Coverage

Function Coverage Report : Repo_201225_141003

Source	Function	Execute...	Coverage
DisplayRenderer.c	7	5	71.43%
Task_Buzzer.c	1	1	100.00%
Task_Display.c	1	1	100.00%
Task_Hardware.c	11	8	72.73%
Task_LED.c	1	1	100.00%
Task_RGB-LED.c	1	1	100.00%
tasks.c	2	0	0.00%

DT+ FS — MC/DC Coverage



DT+ FS — Function Call Coverage

Task_Buzzer	Task_Buzzer.c	5	4	80.00%
procHardware_LED_AD	Task_Hardware.c	26	25	96.15%
DRenderer_Init	DisplayRenderer.c	4	4	100.00%
DRenderer_SetDisplayString	DisplayRenderer.c	3	3	100.00%
DRenderer_BeginScene	DisplayRenderer.c	2	2	100.00%
DRenderer_EndScene	DisplayRenderer.c	1	1	100.00%
DRenderer_DrawDeviceFor...	DisplayRenderer.c	1	1	100.00%
DRenderer_Present	DisplayRenderer.c	5	5	100.00%
Task_Display	Task_Display.c	18	18	100.00%
initHardware	Task_Hardware.c	3	3	100.00%
Task_Hardware	Task_Hardware.c	4	4	100.00%
initHardware_LED_AD	Task_Hardware.c	8	8	100.00%
initHardware_PWM_DISP	Task_Hardware.c	26	26	100.00%
Task_LED	Task_LED.c	5	5	100.00%

setBuzzerPitch	Task_Hardware.c	2	1	50.00%
DRenderer_Init	DisplayRenderer.c	1	1	100.00%
DRenderer_SetDisplayString	DisplayRenderer.c	1	1	100.00%
DRenderer_BeginScene	DisplayRenderer.c	2	2	100.00%
DRenderer_EndScene	DisplayRenderer.c	2	2	100.00%
DRenderer_DrawDeviceFor...	DisplayRenderer.c	6	6	100.00%
DRenderer_Present	DisplayRenderer.c	1	1	100.00%
getDistance	Task_Hardware.c	3	3	100.00%
getDMSVoltage	Task_Hardware.c	1	1	100.00%
setLEDState	Task_Hardware.c	2	2	100.00%
getColorVolume	Task_Hardware.c	1	1	100.00%
setRGBLEDColor	Task_Hardware.c	2	2	100.00%

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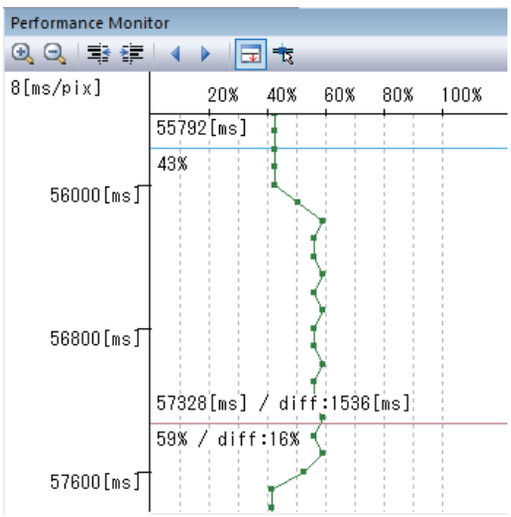
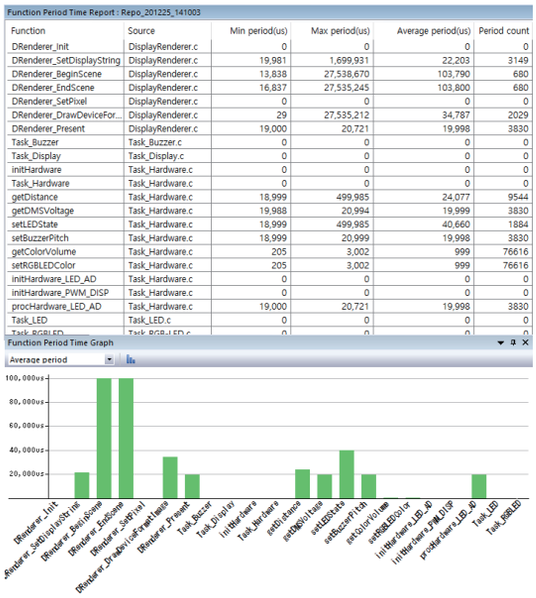
Profiling & Performance(성능측정)

- 시스템의 Core, Process, Thread 동작 흐름을 시각화하여 시스템의 부하요인 파악이 용이합니다.
- OS를 사용하는 경우 CPU 점유율을 실시간으로 분석하고 시각화 할 수 있습니다.

Performance Monitor



Function Period Time Report



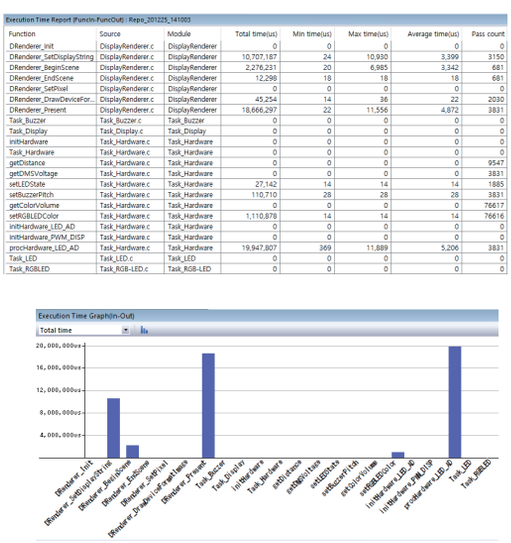
Function Period Time Report : Repo_201225_141003

Function	Source	Min period(us)	Max period(us)	Average period(us)	Period count
DRenderer_Init	DisplayRenderer.c	0	0	0	0
DRenderer_SetDisplayString	DisplayRenderer.c	19,981	1,699,931	22,203	3149
DRenderer_BeginScene	DisplayRenderer.c	13,838	27,538,670	103,790	680
DRenderer_EndScene	DisplayRenderer.c	16,837	27,535,245	103,800	680
DRenderer_SetPixel	DisplayRenderer.c	0	0	0	0
DRenderer_DrawDeviceFor...	DisplayRenderer.c	29	27,535,212	34,787	2029
DRenderer_Present	DisplayRenderer.c	19,000	20,721	19,998	3830
Task_Buzzer	Task_Buzzer.c	0	0	0	0
Task_Display	Task_Display.c	0	0	0	0
initHardware	Task_Hardware.c	0	0	0	0
Task_Hardware	Task_Hardware.c	0	0	0	0
getDistance	Task_Hardware.c	18,999	499,985	24,077	9544
getDMSVoltage	Task_Hardware.c	19,988	20,994	19,999	3830
setLEDState	Task_Hardware.c	18,999	499,985	40,660	1884
setBuzzerPitch	Task_Hardware.c	18,999	20,999	19,998	3830
getColorVolume	Task_Hardware.c	205	3,002	999	76616
setRGBLEDColor	Task_Hardware.c	205	3,002	999	76616
initHardware_LED_AD	Task_Hardware.c	0	0	0	0
initHardware_PWM_DISP	Task_Hardware.c	0	0	0	0
procHardware_LED_AD	Task_Hardware.c	19,000	20,721	19,998	3830
Task_LED	Task_LED.c	0	0	0	0
Task_RGBLED	Task_RGB-LED.c	0	0	0	0

Function Period Time Graph

Average period

Execution Time Report



Execution Time Report (Funcin-FuncOut) : Repo_201225_141003

Function	Source	Module	Total time(us)	Min time(us)	Max time(us)	Average time(us)	Pass count
DRenderer_Init	DisplayRenderer.c	DisplayRenderer	0	0	0	0	0
DRenderer_SetDisplayString	DisplayRenderer.c	DisplayRenderer	10,707,187	24	10,930	3,399	3150
DRenderer_BeginScene	DisplayRenderer.c	DisplayRenderer	2,276,231	20	6,985	3,342	681
DRenderer_EndScene	DisplayRenderer.c	DisplayRenderer	12,298	18	18	18	681
DRenderer_SetPixel	DisplayRenderer.c	DisplayRenderer	0	0	0	0	0
DRenderer_DrawDeviceFor...	DisplayRenderer.c	DisplayRenderer	45,254	14	36	22	2030
DRenderer_Present	DisplayRenderer.c	DisplayRenderer	18,666,297	22	11,556	4,872	3831
Task_Buzzer	Task_Buzzer.c	Task_Buzzer	0	0	0	0	0
Task_Display	Task_Display.c	Task_Display	0	0	0	0	0
initHardware	Task_Hardware.c	Task_Hardware	0	0	0	0	0
Task_Hardware	Task_Hardware.c	Task_Hardware	0	0	0	0	0
getDistance	Task_Hardware.c	Task_Hardware	0	0	0	0	9547
getDMSVoltage	Task_Hardware.c	Task_Hardware	0	0	0	0	3831
setLEDState	Task_Hardware.c	Task_Hardware	27,142	14	14	14	1885
setBuzzerPitch	Task_Hardware.c	Task_Hardware	110,710	28	28	28	3831
getColorVolume	Task_Hardware.c	Task_Hardware	0	0	0	0	76617
setRGBLEDColor	Task_Hardware.c	Task_Hardware	1,110,878	14	14	14	76616
initHardware_LED_AD	Task_Hardware.c	Task_Hardware	0	0	0	0	0
initHardware_PWM_DISP	Task_Hardware.c	Task_Hardware	0	0	0	0	0
procHardware_LED_AD	Task_Hardware.c	Task_Hardware	19,947,807	369	11,889	5,206	3831
Task_LED	Task_LED.c	Task_LED	0	0	0	0	0
Task_RGBLED	Task_RGB-LED.c	Task_RGB-LED	0	0	0	0	0

Execution Time Graph(In-Out)

Total time

Process Occupational Ratio Scope

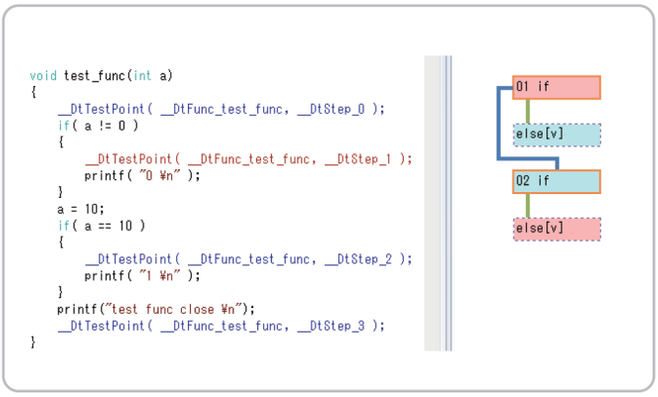
ID	Name	Current-Ratio(%)	Total-Ratio(%)
0		30.85	19.18
1		0.53	0.43
2		0.60	0.60
3		20.88	20.83
4		4.49	1.24
5		42.64	57.71

DT+ Trace

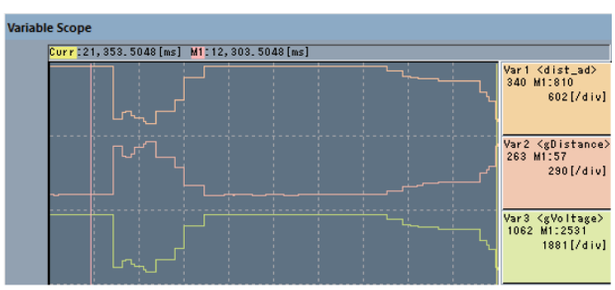
Debugging(코드 디버깅)

- 코드 흐름, 변수 값, 함수 호출 관계 등을 분석할 수 있는 기능을 제공합니다.
- 각 CPU, Task, Function 단위로 필터링하여 코드 흐름을 파악할 수 있습니다.

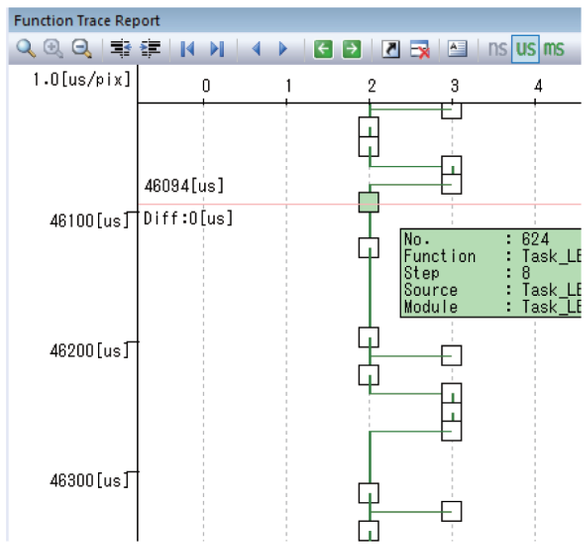
코드 구조 트리 분석



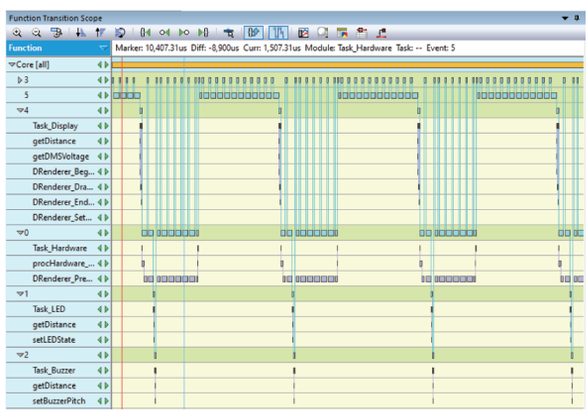
변수 값 모니터링



Function Trace Report



Function Transition Scope



DT+ FS

CERTIFICATE
No. Z10 096390 0005 Rev. 00

Holder of Certificate: Heartland.Data Inc.
361 Fukui-cho, Ashikaga-shi,
Tochigi
326-0338 JAPAN

Certification Mark:

Product: Software Tool for Safety Related Development

Model(s): DT+FS

Parameters: The software tool is fit for purpose for developing safety related software according to ISO 26262 (up to ASIL D) and IEC 61508 (up to SIL 3).
The report referenced below and the user documentation in the currently valid revision are mandatory part of this certificate.

Tested according to: ISO 26262-8:2018
IEC 61508-3:2010

The product was tested on a voluntary basis and complies with the essential requirements. The certification mark shown above can be affixed on the product. It is not permitted to alter the certification mark in any way. In addition the certification holder must not transfer the certificate to third parties. This certificate is valid until the listed date, unless it is cancelled earlier. All applicable requirements of the testing and certification regulations of TÜV SÜD Group have to be complied. For details see: www.tuvsud.com/ps-cert

Test report no.: HT96571C

Valid until: 2026-04-12

Date, 2021-04-14

(Jiayi Dong)

Page 1 of 1
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ZERTIFIKAT ◆ CERTIFICATE ◆ 認證證書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

신뢰성이 보장된 솔루션

DT+Trace의 상위 버전 DT+FS는
기능 안전 도구로 인증 받았습니다.
<ISO 26262>
<IEC 61508>

DT+ Technical Support & Training Course

제품 사용 시 기술 지원이 필요한 경우,
방문/원격/메일/전화를 통해 적극 지원해 드립니다.

DT+Trace
커버리지 교육

- DT+ 소개
- 커버리지 분석
- 커버리지 레포트 생성
- 오버헤드를 최소화한 원비트트레이스

Make Different & Smart

MDSTECH

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