



# Scaling MBD Collaboration with Raptor: CI/CD Strategies

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Richard D. Walker IV 9-23-2025



**Who Is Harbinger Motors?**

**Familiar Form. Revolutionary Foundation.**

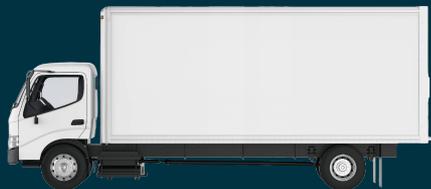


# HARBINGER

Familiar Form. Revolutionary Foundation.



- **Founded in 2021**
- **Headquartered in Southern California**
- **Electric Chassis for Medium Duty**
- **Raptor Vehicle & Body Controllers**



Familiar Form. Revolutionary Foundation.

# What kind of Scaling?

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2 years



+1 years



+1 year

1-3 Developer



4-8 Developer



8+ Developer

Development Only



Roadworthy



Saleable

# How to Handle?

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**Need developer bandwidth in parallel to move fast**

**Blend practices from across sectors & development stages**

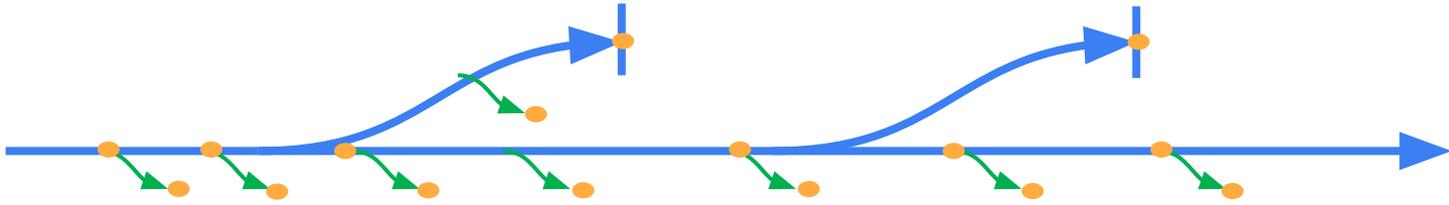
**Visibility across team / leadership**



Alpha

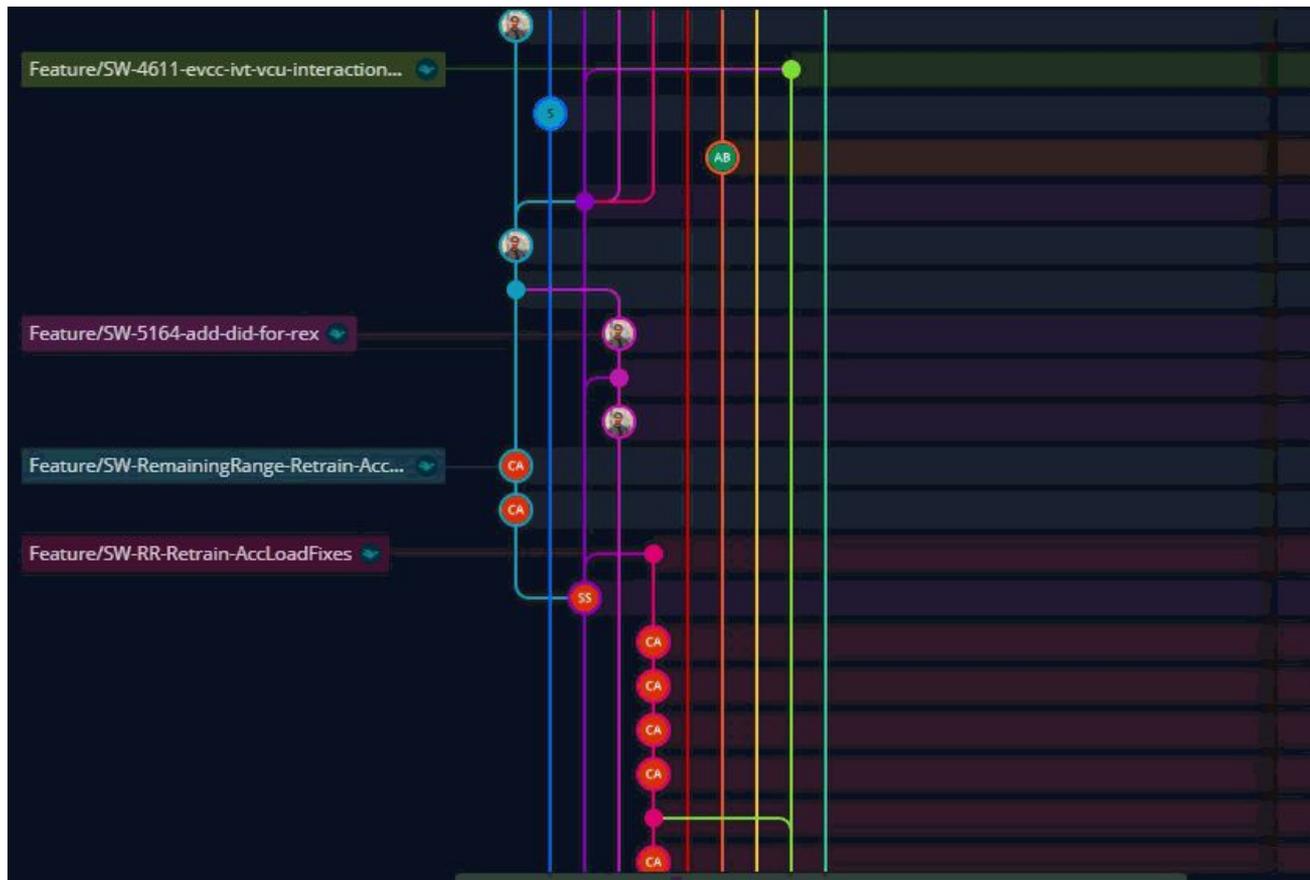
Beta

Pilot



- Single main / master branch
- Tags for Releases / Release Candidates
- Release Branches for hotfixes
- Cherry pick or rebase or merge release branch content into main

# Parallel Development looks like this





1185 Commits

~50 per month

~104 Pull Requests

~1 per week



1744 Commits

~150 per month

~287 Pull Requests

~5.5 per week



3260 Commits

~400 per month

~466 Pull Requests

~9 per week



# Strategies to Handle with CI/CD

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# Merge & Pull Request

## Feature/SW-4568 update to low power available lo

feature/SW-4568-update-to-... → master **MERGED**  
#823 • Created 2025-08-14 • Last updated 2025-08-18

✓ Approve ...

Overview Files changed 10 Commits 10

### ✓ Merged pull request

Merged in feature/SW-4568-update-to-low-power-available-lo (pull request #823)  
cf2a5fe · 3 builds · Author: Daidipya Nikam · Closed by: Daidipya Nikam · 2025-08-18

#### > Description

#### > 0 attachments

#### Activity

All activity ▾



What do you want to say?

Monday, August 18, 2025



Daidipya Nikam **MERGED** the pull request 2025-08-18



Emilie Caussat **APPROVED** the pull request 2025-08-18



Daidipya Nikam **UPDATED** the pull request with 3 commits: ed740e0, 1781e8d, 9e8c01d 2025-08-18

Thursday, August 14, 2025



Daidipya Nikam **OPENED** the pull request 2025-08-14

#### 3 of 3 builds passed

- ✓ ci/circleci: build  
Your tests passed on CircleCI! · 2025-08-18
- ✓ ci/circleci: swc-stats  
Your tests passed on CircleCI! · 2025-08-18
- ✓ ci/circleci: swc-unit-tests  
Your tests passed on CircleCI! · 2025-08-18

#### 5 of 5 checks passed

- ✓ No failed builds
- ✓ No in progress builds
- ✓ 1+ approval
- ✓ 3+ builds passed
- ✓ No changes requested

#### > 3 reviewers

#### 0 tasks

#### > 0 Jira work items

#### 1 report

- ✓ Harbinger Motors CI Report for feature/S...

Pull Requests are like mini design reviews

MBD needs some help making this an effective collaborative tool



# Merge & Pull Request

Overview [Files changed](#) 10 [Commits](#) 10

All changes ▾

Comments (0 unresolved) ▾

Sort by File tree ▾

0 of 10 files viewed ⚙

Lines updated

+3 -3

Components

DerateManager

DerateManager\_harnessInfo.xml +3 -3

DerateManager.slx

unitTests

DerateManager\_Harness.slx

PropulsionPowerLimiting

PropulsionPowerLimiting\_dd.sldd

PropulsionPowerLimiting.slx

ctrlsTasks

PropulsionCtrlsTask\_Pilot.slx

domains

PropulsionSystemStateControl.slx

TorquePathAndStateEstimation.slx

global

buses.sldd

utilities

hbg\_utilities.slx

> Components / DerateManager / DerateManager\_harnessInfo.xml   Viewed  ...

▾ Components / DerateManager / DerateManager.slx   Viewed  ...

 Binary file

We can't show you the diff for this binary file here, but you can open the diff in a new tab instead.

[Open file's diff](#)

> Components / DerateManager / unitTests / DerateManager\_Harness.slx   Viewed  ...

> Components / PropulsionPowerLimiting / PropulsionPowerLimiting\_dd.sldd   Viewed  ...

> Components / PropulsionPowerLimiting / PropulsionPowerLimiting.slx   Viewed  ...

> ctrlsTasks / PropulsionCtrlsTask\_Pilot.slx   Viewed  ...

> domains / PropulsionSystemStateControl.slx   Viewed  ...

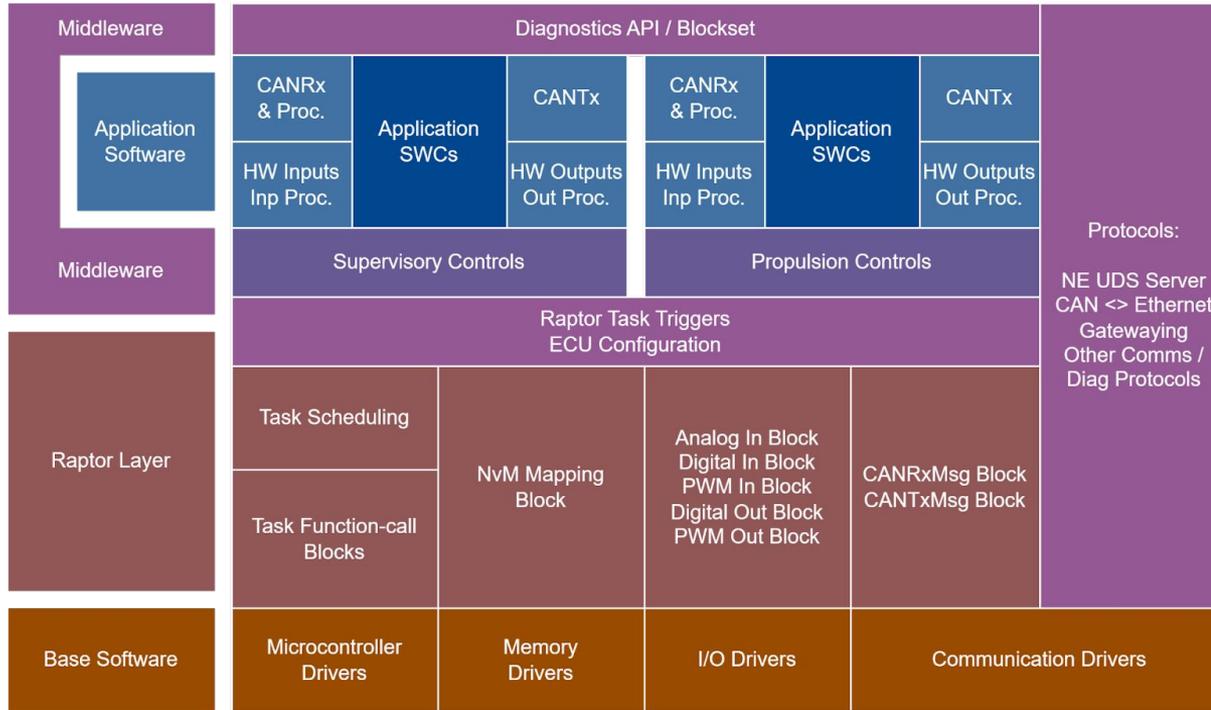
> domains / TorquePathAndStateEstimation.slx   Viewed  ...

> global / buses.sldd   Viewed  ...

> utilities / hbg\_utilities.slx   Viewed  ...



# Merge – Model Hierarchy



**Model Reference Blocks used at multiple levels:**

- Task
- Control Domain
- SWCs

**Goal is to partition work across separate files, reduce merge conflicts**

**Protected Models are used to share obfuscated models with 3<sup>rd</sup> parties**

# Merge & Pull Request

Harbinger Motors CI Report for feature/SW-4568-update-to-low-power-available-lo (commit 9e8c01d)

## Report Metadata

Repo: [vcu-simulink](#)

Branch: [feature/SW-4568-update-to-low-power-available-lo](#)

Pull request: [823](#)

Commit: [9e8c01d](#)

## Report Links

[hbg\\_utilities\\_ancestor\\_hbg\\_utilities.html](#)

[buses\\_ancestor.sldd.html](#)

[TorquePathAndStateEstimation\\_ancestor\\_TorquePathAndStateEstimation.html](#)

[PropulsionSystemStateControl\\_ancestor\\_PropulsionSystemStateControl.html](#)

[PropulsionCtrlsTask\\_Pilot\\_ancestor\\_PropulsionCtrlsTask\\_Pilot.html](#)

[PropulsionPowerLimiting\\_dd\\_ancestor.sldd.html](#)

[PropulsionPowerLimiting\\_ancestor\\_PropulsionPowerLimiting.html](#)

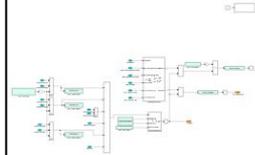
[DerateManager\\_Harness\\_ancestor\\_DerateManager\\_Harness.html](#)

[DerateManager\\_ancestor\\_DerateManager.html](#)

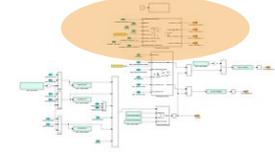
## Comparison Results

### Simulink

PropulsionPowerLimiting\_ancestor



PropulsionPowerLimiting



#### LowPower\_FaultTriggers

Name : LowPower\_FaultTriggers  
InterfaceData :  
ReportName :

#### BMS\_DischargePowerAvailable

InterfaceData :  
Name : BMS\_DischargePowerAvailable

#### BMS\_RegenPowerAvailable

Port : 2  
InterfaceData :  
Name : BMS\_RegenPowerAvailable

#### DataRead\_HVATtempts

Port : 22  
InterfaceData :  
Name : DataRead\_HVATtempts

#### DataRead\_OdoValue\_lowPowerTrig

Port : 23  
InterfaceData :  
Name : DataRead\_OdoValue\_lowPowerTrig



# Merge & Pull Request

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Check Status of pipeline jobs & automation

Enforce gates on automated and manual checks



# Pipeline Overview

vcu-simulink 5653 ✓ Success swc-tests feature/SW-4568-update-to-low-power-available-lo 9e8c01d move data red and write blocks on top level  Push 21d ago 57m 40s    

Jobs

- ✓ swc-unit-tests 7972 21m 57s
- ✓ swc-stats 7971 9m 34s
- ✓ build 7973 33m 42s

MiL Unit Tests

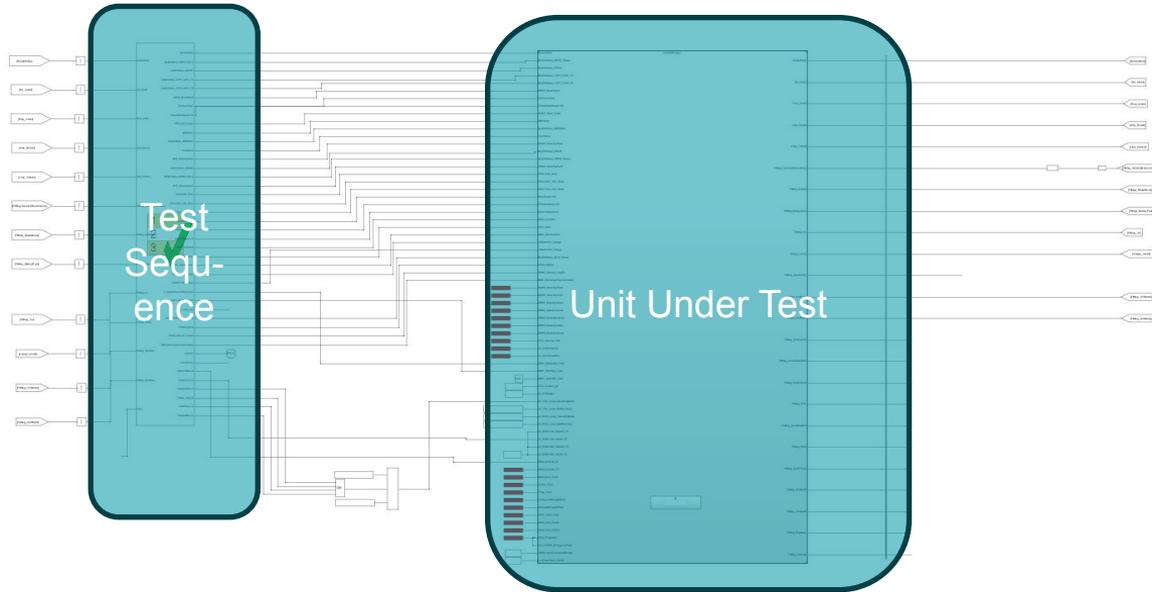
- Diff reporting
- Static Analysis
- Model Metrics

- Build in consistent environment
- Build variants



# Pipeline – Unit Tests

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We use Simulink Test, other tools work just as well.

Software Components that are tested are application functions

Simulink Coverage can measure test coverage & generate report

Software Component is Simulink native blocks + Raptor custom storage classes

# Pipeline – Unit Tests Docker Image

```
# To specify which MATLAB release to install in the container, edit the value of the MATLAB_RELEASE argument.
# Use lower case to specify the release, for example: ARG MATLAB_RELEASE=r2020a
ARG MATLAB_RELEASE=r2025a

# When you start the build stage, this Dockerfile by default uses the Ubuntu-based matlab-deps image.
# To check the available matlab-deps images, see: https://hub.docker.com/r/mathworks/matlab-deps
FROM mathworks/matlab-deps:${MATLAB_RELEASE}

#SHELL ["/bin/bash", "-o", "pipefail", "-c"]

# Declare the global argument to use at the current build stage
ARG MATLAB_RELEASE
ARG MATLAB_PRODUCT_LIST
ARG MATLAB_INSTALL_LOCATION

# switch to root (normally matlab)
USER root

# Install mpm dependencies
RUN export DEBIAN_FRONTEND=noninteractive && apt-get update && \
  apt-get install --no-install-recommends --yes \
  | gettext \
  | wget \
  | unzip \
  | xvfb \
  | gcc \
  | g++ \
  | x11-apps \
  | ca-certificates && \
  apt-get clean && apt-get autoremove \
  && rm -rf /var/lib/apt/lists/*

RUN mkdir /opt/mpm && wget -O /opt/mpm/mpm https://www.mathworks.com/mpm/glnxa64/mpm && chmod +x /opt/mpm/mpm && ln

# Run mpm to install MATLAB in the target location and delete the mpm installation afterwards
RUN wget -q https://www.mathworks.com/mpm/glnxa64/mpm && \
  chmod +x mpm && \
  ./mpm install \
  --release=${MATLAB_RELEASE} \
  --destination=/opt/matlab \
  --products MATLAB Parallel_Computing_Toolbox Simulink Stateflow Simulink_Check Simulink_Test Simulink_Coverage
rm -f mpm /tmp/mathworks_root.log && \
ln -s /opt/matlab/bin/matlab /usr/local/bin/matlab
```

Start with Mathworks dependencies Docker Image

Install Dependencies for virtual display (to generate diff)

Install relevant Mathworks Products



# Pipeline – Unit Tests Docker Image

```
RUN wget -q --retry-connrefused https://ssd.mathworks.com/supportfiles/ci/matlab-batch/v1/glnxa64/matlab-batch \
  && mv matlab-batch /usr/local/bin \
  && chmod a+x /usr/local/bin/matlab-batch

COPY isInstalled.p /opt/matlab/toolbox/simulink/simulink/modeladvisor/private

#WORKDIR /tmp/cicd
# Get the mpkginstall file
#RUN wget -q0- --retry-connrefused https://uk.mathworks.com/matlabcentral/mlc-downloads/downloads/d01b1b65-73bb-44d7
# Original lines follow
#COPY cicd-offline-install.tar.gz /tmp/cicd
#RUN tar -xzf cicd-offline-install.tar.gz && \
#   export DISPLAY=:Xvfb -displayfd 1 & && \
#   /opt/matlab/bin/glnxa64/SupportSoftwareInstaller -downloadfolder . -inputFile ssi_input.txt

# Add "matlab" user and grant sudo permission.
RUN adduser --shell /bin/bash --disabled-password --gecos "" matlab && \
  echo "matlab ALL=(ALL) NOPASSWD: ALL" > /etc/sudoers.d/matlab && \
  chmod 0440 /etc/sudoers.d/matlab

# Add git
RUN apt-get update && \
  apt-get upgrade -y && \
  apt-get install -y git

# Add Raptor files
COPY Raptor /opt/Raptor

COPY pathdef.chunk /home/matlab/pathdef.chunk
RUN head -15 /opt/matlab/toolbox/local/pathdef.m > /opt/matlab/toolbox/local/pathdef_temp.m && \
  cat /home/matlab/pathdef.chunk >> /opt/matlab/toolbox/local/pathdef_temp.m && \
  tail +16 /opt/matlab/toolbox/local/pathdef.m >> /opt/matlab/toolbox/local/pathdef_temp.m && \
  cp -f /opt/matlab/toolbox/local/pathdef_temp.m /opt/matlab/toolbox/local/pathdef.m && \
  rm /opt/matlab/toolbox/local/pathdef_temp.m && \
  rm /home/matlab/pathdef.chunk

# Add write permissions for matlab/proj folder
RUN mkdir /home/matlab/proj
RUN chmod 777 /home/matlab
```

Install Matlab-Batch

Add Raptor files

Modify pathdef.m to include Raptor files



# Pipeline – Build

---

CI Agent

Compiler

Raptor

Mathworks / Batch License

Amazon Machine Image

Consistent Build Environment

Generate package documentation artifacts automatically

Connect to software distribution

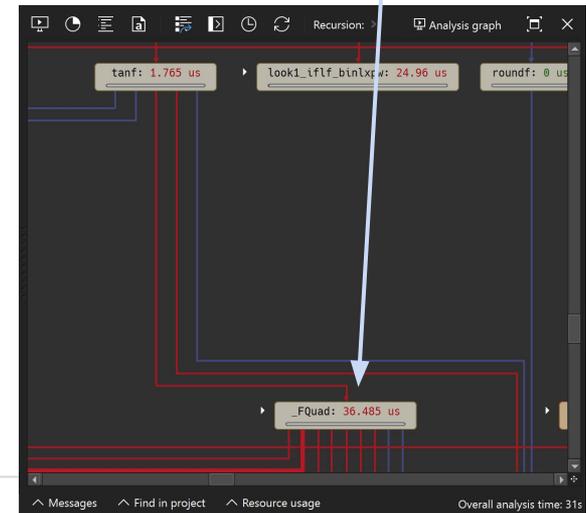


# Raptor Safe

#	Type	ID	Result	Expected Result	Analysis Duration
1	✓	time_check_Os_Entry_task_asw0_1ms	2004 cycles = 10.02 us	0 .. 1 ms	50s
2	!	time_check_Os_Entry_task_asw0_fgnd	859070668 cycles = 4.296 s	0 .. 10 ms	45s
3	✓	time_check_Os_Entry_task_asw0_20ms	717205 cycles = 3.567 ms	0 .. 20 ms	42s
4	✓	time_check_Os_Entry_task_asw0_50ms	1925 cycles = 9.625 us	0 .. 50 ms	57s
5	⚠	time_check_Os_Entry_task_asw0_100ms	2511950 cycles = 12.56 ms	0 .. 100 ms	31s
6	✓	time_check_Os_Entry_task_asw0_250ms	1925 cycles = 9.625 us	0 .. 250 ms	1min 14s
7	✓	time_check_Os_Entry_task_asw0_500ms	1903 cycles = 9.515 us	0 .. 500 ms	1min 28s
8	✓	time_check_Os_Entry_task_asw0_1000ms	108571 cycles = 542.855 us	0 .. 1000 ms	1min 28s
9	✓	time_check_Os_Entry_task_asw1_1ms	1903 cycles = 9.515 us	0 .. 1 ms	1min 33s
10	✓	time_check_Os_Entry_task_asw1_10ms	1925 cycles = 9.625 us	0 .. 10 ms	1min 20s
11	!	time_check_Os_Entry_task_asw1_100ms	unbounded or infeasible	0 .. 100 ms	3min 17s
12	✓	time_check_INIT_CORE_IOP	103170039 cycles = 515.851..		39s
13	!	time_check_INIT_CORE_0	unbounded or infeasible		59s
14	✓	time_check_INIT_CORE_1	1968194652 cycles = 9.841 ..		1min 51s
15	✓	time_check_IDLE_CORE_IOP	8546508 cycles = 42.733 ms		1min 28s
16	!	time_check_IDLE_CORE_0	unbounded or infeasible		2min 29s
17	!	time_check_IDLE_CORE_1	unbounded or infeasible		10min 0s
18	✓	time_check_Timer_FGNDx2_dURWb	61749 cycles = 308.745 us	0 .. 10 ms	2min 10s
19	✓	time_check_Timer_BGND_hvGmw	9130 cycles = 45.65 us	0 .. 100.0 ms	1min 52s
20	!	time_check_Timer_SEC_unt5u	error	0 .. 1000.0 ms	3s
21	✓	time_check_Timer_FGND_CQy4O		0 .. 100.0 ms	
22	✓	time_check_Timer_Task_Core1_100ms_rQiqO		0 .. 100.0 ms	
23	✓	time_check_Timed_Trigger_XCP		0 .. 10 ms	
24	✓	time_check_Timer_FGNDx2_8cMB8		0 .. 10.0 ms	

Overall analysis time: 31s

Routine	Calls	Self [cycles]	Self [ms]
Timed_Trigger_OBDFaultManag...	118	31571	0.158
VCU04_v_0_0_SMO2_E2ERx_Plauss...	1	29453	0.148
VCU04_v_0_0_Inputs	1	24875	0.125
Crc8.L1	122	24033	0.121
PRND_Processing	1	19006	0.096
VCU04_v_0_0_PropulsionCtrlsTask	1	17859	0.090
VCU04_v_0_0_E2E_Checker.L1	60	13350	0.067
timeProfile.L1	60	12960	0.065
VCU04_v_0_0_E2E_Checker	12	10104	0.051
VEDRTriggers	1	10013	0.051
Crc_CalculateCRC16.L1	25	9791	0.049
PropulsionSystemStateControl	1	8958	0.045
Os_SuspendOSInterrupts	4	8566	0.043
timeProfile.L2	60	8517	0.043
_FXp_mulh	10	7140	0.036
timeProfile.L3	60	7131	0.036
VCU04_v_0_0_E2E_checker.L2	25	6875	0.035
Os_ResumeOSInterrupts	4	5884	0.030
_FQuad.L1	4	5522	0.028
timeProfile	3	4671	0.023
pre_start_CAN_1154_0006	1	4701	0.024
VCU04_v_0_0_E2E_checker	5	4462	0.023



# Artifactory

---

[%%BaseURL%%]/#/packages/vcu/versions/4.21.1

Package vcu 4.21.1

Changelog

- [/browse/SW-4781 VCU CAN transmission rate does not match DBC](#)
- [/browse/SW-4468 VCU inverter fault during active discharge when L2 overrides to enabled](#)
- [/browse/SW-4921 VCU OTA State Enters LV\\_Only when TCU State is Inactive](#)
- [/browse/SW-5306 Range Estimation Modification: Temp based acc load adjustment](#)

Compressed Size 74.2 MB

Release Date 2025-09-06

[View Files →](#) [View Webview 📄](#) [Download ⬇️](#)



# Artifactory - Webview

VCU04\_v\_0\_0 View All

VCU04\_v\_0\_0

VCU04\_v\_0\_0

Property Inspector

Parameter Attributes

ModelVersion	16.38
LastModifiedDate	Thu Sep 04 12:01:06 2025
LibraryLinkDisplay	user
ModelBrowserVisibility	off
Dirty	off
Description	

At a glance check of logic for given tagged package version



# Conclusion

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# How to Handle?

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## **Need developer bandwidth in parallel to move fast**

Create processes and automation that enabled collaboration and parallelization of development

## **Blend practices from across sectors & development stages**

Pair speed of Model Based Development, with CI/CD software development work-flows originally common in domains with predominantly textual code-bases

## **Visibility across team / leadership**

Store documentation of tagged package versions, creating traceability with ticketing and requirements



Thank You

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