

# Software Design Description

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## Introduction

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### Purpose and Scope

이 문서는 MoBeE의 SyRS를 기초로 한 소프트웨어에 설계에 관한 내용을 묘사하며,

- 소프트웨어 및 SWC구성
- Interfaces 및 Configuration Parameters정의
- Function Description

의 내용을 포함한다.

### Definitions, Terminology and Abbreviations

Table of abbreviations used in this document

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| Abbreviation | Description                          |
|--------------|--------------------------------------|
| TBD          | To be defined SWC Software Component |

### References

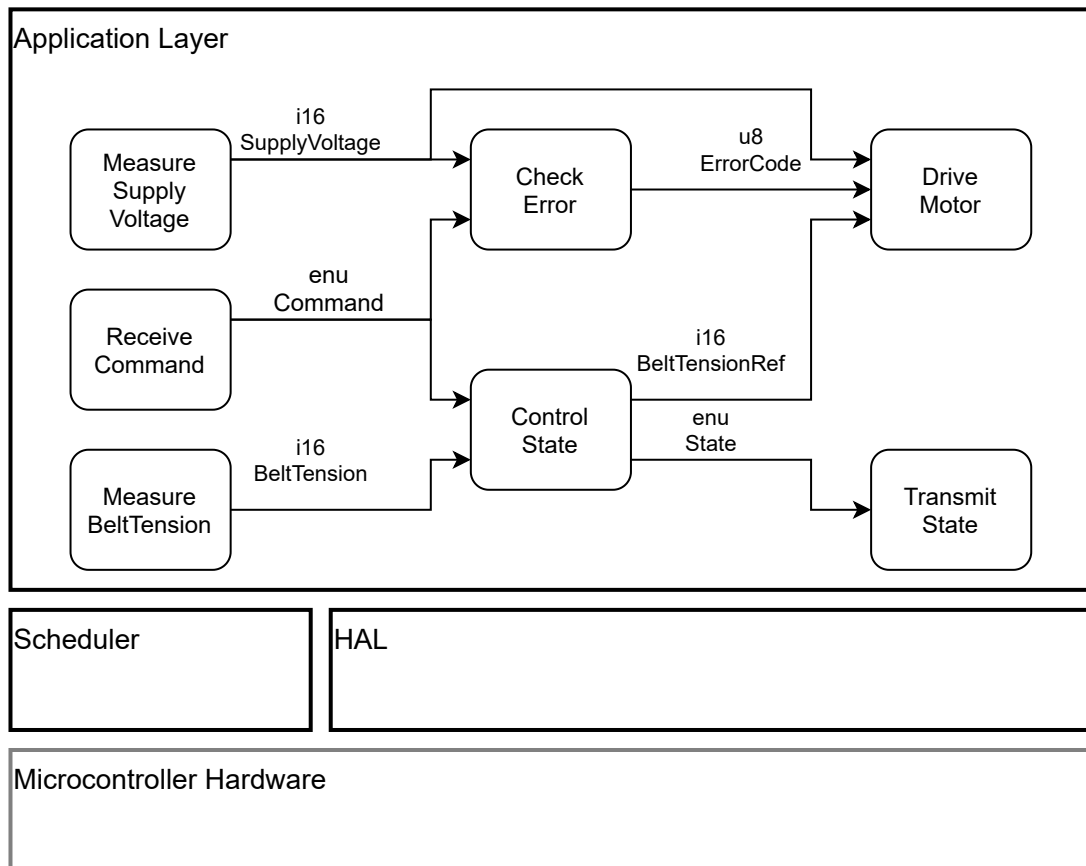
1. ARC Lab Internal Document, ADPro-SE, MoBeE Example, System Requirement Specification
2. ARC Lab Internal Document, ADPro-A, Architecture Guideline
3. ARC Lab Internal Document, ADPro-SE, Coding Guideline

## Software Description

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### Architecture

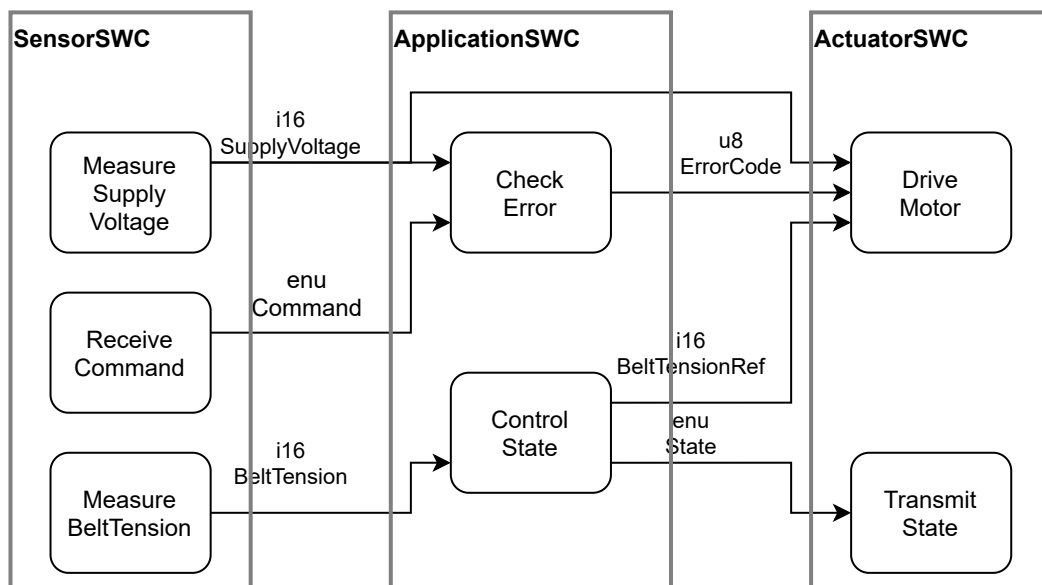
ADPro-A의 Architecture를 따른다.



## Interfaces and Parameters

- .InterfacesParameter.xlsx 파일 참고

## Software Component Description



## Sensor SWC

### InitSensorSWC

Sensor SWC에 사용되는 Data 및 상태를 초기화 한다.

- `i16SupplyVoltage = 0`  
`enumCommandInfo = UNDEFINED_CMD`  
`i16BeltTension = 0`

## MeasureSupplyVoltage

$$i16SupplyVoltage[0.01V] = \left( \frac{1}{VolSenseGain} \right) \left( \frac{500[0.01V]}{1024} \right) \times AdcRawData$$

$$= \frac{1 \times 500}{VolSenseGain \times 1024} \times AdcRawData$$

- `VolSenseGain`
  - 1/6 : Voltage Divider

## MeasureBeltTension

$$i16BeltTension[0.01N] = 0 \text{ (if } i16MotorCurrent \leq FrictionCurrent)$$

$$= MotorCurrent2BeltTention \times (i16MotorCurrent[0.01A] - FrictionCurrent[0.01A])$$

$$i16MotorCurrent[0.01A] = 100 \times \left( \frac{1}{CurSenseGain[V/A]} \right) \left( \frac{5[V]}{1024} \right) \times AdcRawData \text{ (else)}$$

$$= \left( \frac{100 \times 5}{CurSenseGain \times 1024} \right) \times AdcRawData$$

- `BeltTension`을 직접적으로 측정할 수 없으므로 모터의 전류를 측정하여 간접적으로 추정한다.
- `CurSenseGain`
  - 12/100
- 1차 LPF를 사용하여 노이즈를 제거한다
  - Corner Frequency = 20Hz

## ReceiveCommand

- [TBD]

## ControlSWC

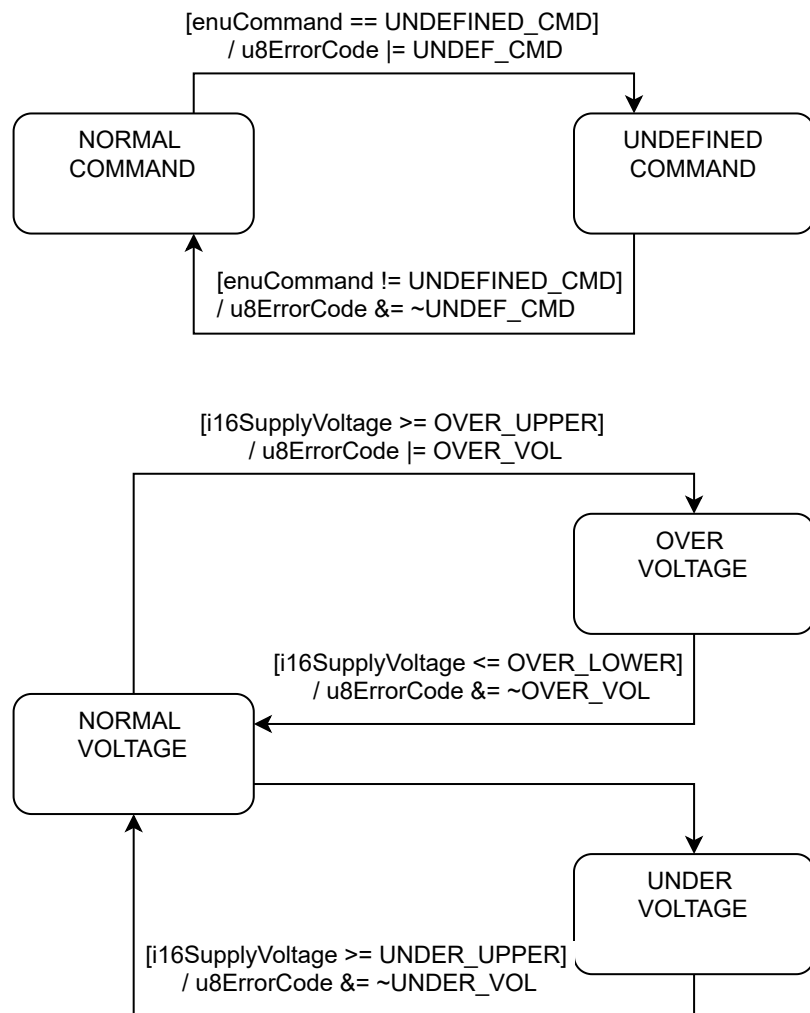
### InitControlSWC

- Control SWC에 사용되는 Data 및 상태를 초기화 한다.

```
1 | u8ErrorCode = 0
2 | i16BeltTensionRef = 0;
3 | enumMsbStateInfo = READY_STATE
```

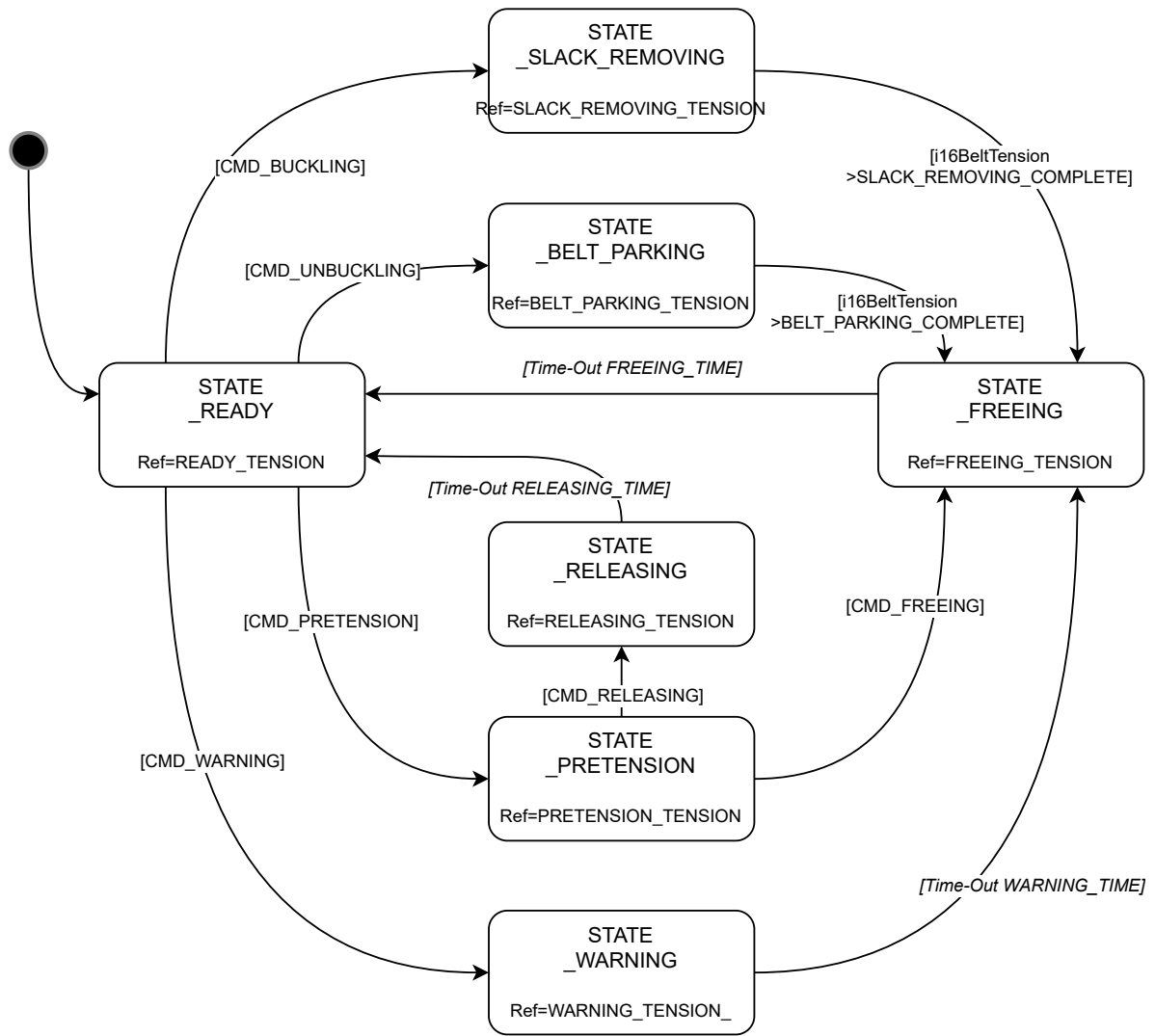
### CheckError

- 사전에 정의 되지 않은 동작명령, 혹은 MSB 동작 전압 이외의 전원이 입력될 경우, `u8ErrorCode`에 오류를 반영한다.



## ControlState

MSB의 동작상태를 결정한다.



## ActuatorSWC

### DriveMotor

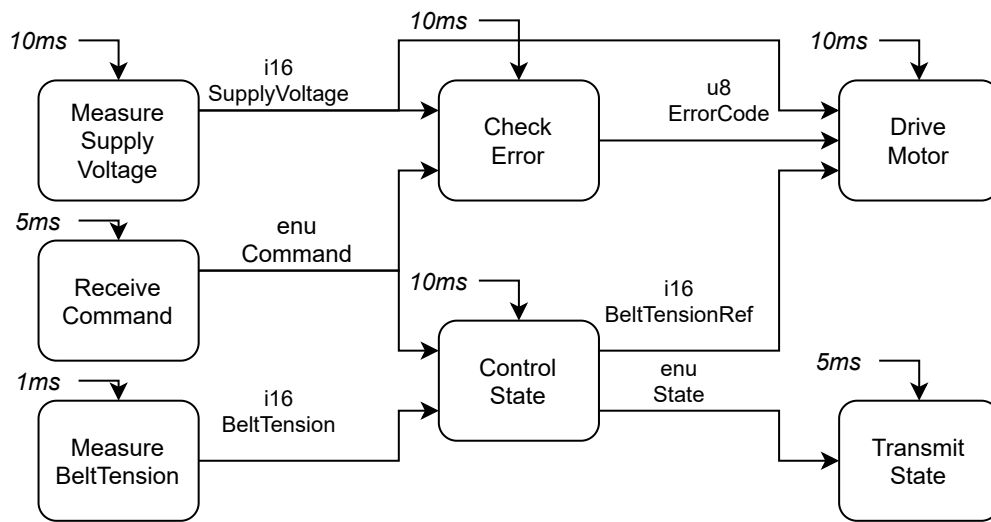
$$\begin{aligned}
 u16MotorVoltage[0.01V] &= \frac{MotorCurrent[A]}{Voltage2Current[A/V]} \\
 &= \frac{1}{Voltage2Current[A/V]} \times \left[ \frac{abs(i16BeltTensionRef[0.01N])}{Current2BeltTension[N/A]} + FrictionCurrent[0.01A] \right] \\
 &= \frac{1}{Voltage2Current \times Current2BeltTension} \times [abs(i16BeltTensionRef) + Current2BeltTension \times FrictionCurrent]
 \end{aligned}$$

$$u16MotorDuty[0.01\%] = 10000 \times \left( \frac{1}{i16SupplyVoltage[0.01V]} \right) \times u16MotorVoltage[0.01V]$$

### TransmitState

- [TBD]

## Real-Time Description

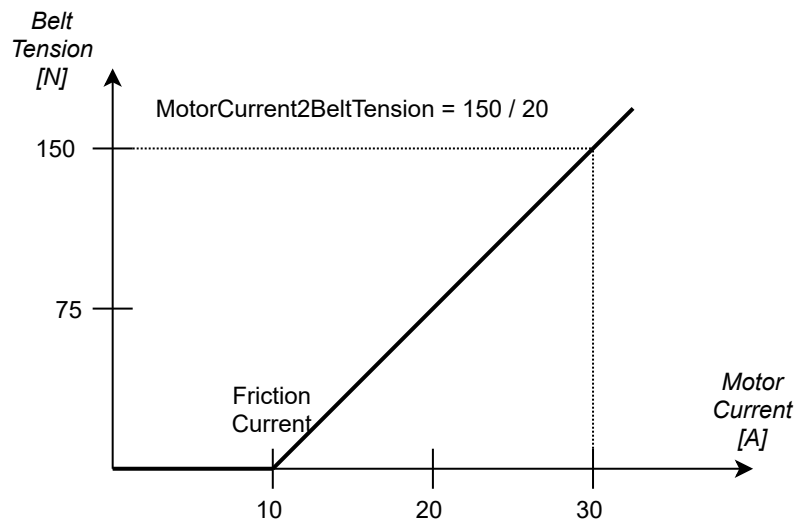


- Schedule Table

| Task    | SensorSWC            | ApplicationSWC             | ActuatorSWC   |
|---------|----------------------|----------------------------|---------------|
| Task1m  | MeasureBeltTension   |                            |               |
| Task5m  | ReceiveCommand       |                            | TransmitState |
| Task10m | MeasureSupplyVoltage | CheckError<br>ControlState | DriveMotor    |

## Appendix

- BeltTension vs. MotorCurrent



- MotorCurrent vs. MotorVoltage

