Research & Vehicle Technology
"Infotainment Systems Product Development"

Feature – Electro Mechanical Registers

Infotainment Subsystem Part Specific Specification (SPSS)

Version 1.0

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Version Date: September 1, 2021

FORD CONFIDENTIAL

Revision History

Date	Version	Notes	
September 1, 2021	**1.0**	**Initial Release**	

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1 Architectural Design

1.1 Overview

This feature allows the user to control Electro Mechanical air registers position and cycling settings through HMI. This feature shall also provide visual feedback of registers aim directions, air motion and shut off/on.
The requirements on the functionality are described either as use cases or as conventional functional decomposition.

1.2 CLD-REQ-406767/A-EMR Client

EMR (Electro Mechanical Registers) Client will take input for EM register position, air flow from user via HMI and transmit it to EMR (Electro Mechanical Registers) Server for implementation.

1.3 CLD-REQ-406768/A-EMR Server

EMR (Electro Mechanical Registers) Server will take the commands from EMR (Electro Mechanical Registers) Client and make changes to EM register position, airflow as needed and gives feedback of updates made.

1.4 Physical Mapping of Classes

The table below shows how the logical classes that make up the Electro Mechanical Registers feature may be mapped into physical modules. This mapping example is specific to Electro Mechanical Registers architecture and does not necessarily carryover to other carlines or vehicle architectures.

Logical Class	Physical Module (ECU)
EMRClient	APIM PDC
EMRServer	RCCM

1.5 Logical Signal Mapping

The CAN signals mentioned throughout this document shall refer to the CAN signal's logical name. The logical names shall be mapped to their actual CAN signal names. Please use the table below to perform the mapping.

Logical Name	CAN Signal Name
Register_LHOB	RgstrSetObl_D_Rq
Register_LHIB	RgstrSetIbl_D_Rq
Register_RHOB	RgstrSetObr_D_Rq
Register_RHIB	RgstrSetIbr_D_Rq
Register_LHOB_Horizontal	RgstrHzntlObl_An_Rq
Register_LHIB_Horizontal	RgstrHzntlIbl_An_Rq
Register_RHOB_Horizontal	RgstrHzntlObr_An_Rq
Register_RHIB_Horizontal	RgstrHzntlIbr_An_Rq
Register_LHOB_Vertical	RgstrVertObl_An_Rq
Register_LHIB_Vertical	RgstrVertIbl_An_Rq
Register_RHOB_Vertical	RgstrVertObr_An_Rq
Register_RHIB_Vertical	RgstrVertIbr_An_Rq
ActiveButtonsLHS_Rq	ActvButtnLeft_D_Rq
ActiveButtonsRHS_Rq	ActvButtnRight_D_Rq
HMIFeedback_LHOB_Horizontal	RgstrHzntlObl_An_Actl
HMIFeedback_LHIB_Horizontal	RgstrHzntlIbl_An_Actl
HMIFeedback_RHOB_Horizontal	RgstrHzntlObr_An_Actl
HMIFeedback_RHIB_Horizontal	RgstrHzntlIbr_An_Actl

HMIFeedback_LHOB_Vertical	RgstrVertObl_An_Actl
HMIFeedback_LHIB_Vertical	RgstrVertIbl_An_Actl
HMIFeedback_RHOB_Vertical	RgstrVertObr_An_Actl
HMIFeedback_RHIB_Vertical	RgstrVertIbr_An_Actl

Table: Logical name/CAN signal mapping

1.6 IIR-REQ-406771/A-EMR Client _Tx

1.6.1 MD-REQ-420272/A-Register_LHOB

Message Type: Request
This signal shall be sent by the EMRClient as request to the EMRServer to change Aim Command for Lefthand Outboard Register

Name	Literals	Value	Description
Register_LHOB	-	-	Change Air Command for Lefthand Outboard Register
	noChange	0x0	
	manualChange	0x1	
	featureManualChange	0x2	
	featureButtonChange	0x3	
	open	0x4	
	close	0x5	
	Not Used	0x6-0x7	

0x2 & 0x3 encodings are associated with request from another feature to control airflow. Currently there are no features identified which will trigger EMRClient to transmit these values, so the requirements/ use cases are not captured in this SPSS.

1.6.2 MD-REQ-420273/A-Register_LHIB

Message Type: Request
This signal shall be sent by the EMRClient as request to the EMRServer to change Aim Command for Lefthand Inboard Register

Name	Literals	Value	Description
Register_LHIB	-	-	Change Air Command for Lefthand Inboard Register
	noChange	0x0	
	manualChange	0x1	
	featureManualChange	0x2	
	featureButtonChange	0x3	
	open	0x4	
	close	0x5	
	Not Used	0x6-0x7	

0x2 & 0x3 encodings are associated with request from another feature to control airflow. Currently there are no features identified which will trigger EMRClient to transmit these values, so the requirements/ use cases are not captured in this SPSS.

1.6.3 MD-REQ-420274/A-Register_RHOB

Message Type: Request
This signal shall be sent by the EMRClient as request to the EMRServer to change Aim Command for Righthand Outboard Register

Name	Literals	Value	Description
Register_RHOB	-	-	Change Air Command for Righthand Outboard Register
	noChange	0x0	
	manualChange	0x1	
	featureManualChang	0x2	
	featureButtonChange	0x3	
	open	0x4	
	close	0x5	
	Not Used	0x6-0x7	

0x2 & 0x3 encodings are associated with request from another feature to control airflow. Currently there are no features identified which will trigger EMRClient to transmit these values, so the requirements/ use cases are not captured in this SPSS.

1.6.4 MD-REQ-420275/A-Register_RHIB

Message Type: Request
This signal shall be sent by the EMRClient as request to the EMRServer to change Aim Command for Righthand Outboard Register

Name	Literals	Value	Description
Register_RHIB	-	-	Change Air Command for Righthand Outboard Register
	noChange	0x0	
	manualChange	0x1	
	featureManualChange	0x2	
	featureButtonChange	0x3	
	open	0x4	
	close	0x5	
	Not Used	0x6-0x7	

0x2 & 0x3 encodings are associated with request from another feature to control airflow. Currently there are no features identified which will trigger EMRClient to transmit these values, so the requirements/ use cases are not captured in this SPSS.

1.6.5 MD-REQ-420276/A-Register_LHOB_Horizontal

Message Type: Request
This signal shall be sent by the EMRClient as request to the EMRServer to Command Position of Horizontal Vanes for Lefthand Outboard Register

Name	Literals	Value	Description
Register_LHOB_Horizontal	-	0x00 – 0xFF	Command Position of Horizontal Vanes for Lefthand Outboard Register

The actual range of values that EMRClient transmits is 0x00 to 0x5A (0 to 90 degrees) with resolution 1.

1.6.6 MD-REQ-420277/A-Register_LHIB_Horizontal

Message Type: Request
This signal shall be sent by the EMRClient as request to the EMRServer to Command Position of Horizontal Vanes for Lefthand Inboard Register

Name	Literals	Value	Description
Register_LHIB_Horizontal	-	0x00 – 0xFF	Command Position of Horizontal Vanes for Lefthand Inboard Register

The actual range of values that EMRClient transmits is 0x00 to 0x5A (0 to 90 degrees) with resolution 1.

1.6.7 MD-REQ-420278/A-Register_RHOB_Horizontal

Message Type: Request
This signal shall be sent by the EMRClient as request to the EMRServer to Command Position of Horizontal Vanes for Righthand Outboard Register

Name	Literals	Value	Description
Register_RHOB_Horizontal	-	0x00 – 0xFF	Command Position of Horizontal Vanes for Righthand Outboard Register

The actual range of values that EMRClient transmits is 0x00 to 0x5A (0 to 90 degrees) with resolution 1.

1.6.8 MD-REQ-420279/A-Register_RHIB_Horizontal

Message Type: Request
This signal shall be sent by the EMRClient as request to the EMRServer to Command Position of Horizontal Vanes for Righthand Inboard Register

Name	Literals	Value	Description
Register_RHIB_Horizontal	-	0x00 – 0xFF	Command Position of Horizontal Vanes for Righthand Inboard Register

The actual range of values that EMRClient transmits is 0x00 to 0x5A (0 to 90 degrees) with resolution 1.

1.6.9 MD-REQ-420280/A-Register_LHOB_Vertical

Message Type: Request
This signal shall be sent by the EMRClient as request to the EMRServer to Command Position of Vertical Vanes for Lefthand Outboard Register

Name	Literals	Value	Description
Register_LHOB_Vertical	-	0x00 – 0xFF	Command Position of Vertical Vanes for Lefthand Outboard Register

The actual range of values that EMRClient transmits is 0x00 to 0x5D (0 to 93 degrees) with resolution 1.

1.6.10 MD-REQ-420281/A-Register_LHIB_Vertical

Message Type: Request
This signal shall be sent by the EMRClient as request to the EMRServer to Command Position of Vertical Vanes for Lefthand Inboard Register

Name	Literals	Value	Description

Register_LHIB_Vertical	-	0x00 – 0xFF	Command Position of Vertical Vanes for Lefthand Inboard Register

The actual range of values that EMRClient transmits is 0x00 to 0x5D (0 to 93 degrees) with resolution 1.

1.6.11 MD-REQ-420282/A-Register_RHOB_Vertical

Message Type: Request
This signal shall be sent by the EMRClient as request to the EMRServer to Command Position of Vertical Vanes for Righthand Outboard Register

Name	Literals	Value	Description
Register_RHOB_Vertical	-	0x00 – 0xFF	Command Position of Vertical Vanes for Righthand Outboard Register

The actual range of values that EMRClient transmits is 0x00 to 0x5D (0 to 93 degrees) with resolution 1.

1.6.12 MD-REQ-420283/A-Register_RHIB_Vertical

Message Type: Request
This signal shall be sent by the EMRClient as request to the EMRServer to Command Position of Vertical Vanes for Righthand Inboard Register

Name	Literals	Value	Description
Register_RHIB_Vertical	-	0x00 – 0xFF	Command Position of Vertical Vanes for Righthand Inboard Register

The actual range of values that EMRClient transmits is 0x00 to 0x5D (0 to 93 degrees) with resolution 1.

1.6.13 MD-REQ-420284/A-ActiveButtonsLHS_Rq

Message Type: Request
This signal shall be sent by the EMRClient as request to the EMRServer for Subfeature Selection Commands for Left Side Registers

Name	Literals	Value	Description
ActiveButtonsLHS_Rq	-	-	Subfeature Selection Commands for Left Side Registers
	nonePressed	0x0	
	onBodyLHS	0x1	
	offBodyLHS	0x2	
	presetOneLHS	0x3	
	presetTwoLHS	0x4	
	presetOneSaveLHS	0x5	
	presetTwoSaveLHS	0x6	
	cycle_8_LHS	0x7	
	cycle_C_LHS	0x8	
	cycle_O_LHS	0x9	
	cycle_--_LHS	0xA	

	cycle_I_LHS	0xB	
	Not Used	0xC-0xF	

0x3 through 0xB encodings are associated for button presses for presets and predefined air motion patterns which are not applicable to NA APIM so the requirements/use cases are not captured in this SPSS.

1.6.14 MD-REQ-420285/A-ActiveButtonsRHS_Rq

Message Type: Request
This signal shall be sent by the EMRClient as request to the EMRServer for Subfeature Selection Commands for Right Side Registers

Name	Literals	Value	Description
ActiveButtonsRHS_Rq	-	-	Subfeature Selection Commands for Right Side Registers
	nonePressed	0x0	
	onBodyLHS	0x1	
	offBodyLHS	0x2	
	presetOneLHS	0x3	
	presetTwoLHS	0x4	
	presetOneSaveLHS	0x5	
	presetTwoSaveLHS	0x6	
	cycle_8_LHS	0x7	
	cycle_C_LHS	0x8	
	cycle_O_LHS	0x9	
	cycle_--_LHS	0xA	
	cycle_I_LHS	0xB	
	Not Used	0xC-0xF	

0x3 through 0xB encodings are associated for button presses for presets and predefined air motion patterns which are not applicable to NA APIM so the requirements/use cases are not captured in this SPSS.

1.7 IIR-REQ-406769/A-EMR Client _Rx

1.7.1 MD-REQ-420286/A-HMIFeedback_LHOB_Horizontal

Message Type: Status
This signal shall be sent by the EMRServer to the EMRClient for Aim Status of Lefthand Outboard Register Horizontal Vanes

Name	Literals	Value	Description
HMIFeedback_LHOB_Horizontal	-	0x00 – 0xFF	Aim Status of Lefthand Outboard Register Horizontal Vanes

1.7.2 MD-REQ-420287/A-HMIFeedback_LHIB_Horizontal

Message Type: Status
This signal shall be sent by the EMRServer to the EMRClient for Aim Status of Lefthand Inboard Register Horizontal Vanes

Name	Literals	Value	Description
HMIFeedback_LHIB_Horizontal	-	0x00 – 0xFF	Aim Status of Lefthand Inboard Register Horizontal Vanes

1.7.3 MD-REQ-420288/A-HMIFeedback_RHOB_Horizontal

Message Type: Status
This signal shall be sent by the EMRServer to the EMRClient for Aim Status of Righthand Outboard Register Horizontal Vanes

Name	Literals	Value	Description
HMIFeedback_RHOB_Horizontal	-	0x00 – 0xFF	Aim Status of Righthand Outboard Register Horizontal Vanes

1.7.4 MD-REQ-420289/A-HMIFeedback_RHIB_Horizontal

Message Type: Status
This signal shall be sent by the EMRServer to the EMRClient for Aim Status of Lefthand Inboard Register Horizontal Vanes

Name	Literals	Value	Description
HMIFeedback_RHIB_Horizontal	-	0x00 – 0xFF	Aim Status of Righthand Inboard Register Horizontal Vanes

1.7.5 MD-REQ-420290/A-HMIFeedback_LHOB_Vertical

Message Type: Status
This signal shall be sent by the EMRServer to the EMRClient for Aim Status of Lefthand Outboard Register Vertical Vanes

Name	Literals	Value	Description
HMIFeedback_LHOB_Vertical	-	0x00 – 0xFF	Aim Status of Lefthand Outboard Register Vertical Vanes

1.7.6 MD-REQ-420291/A-HMIFeedback_LHIB_Vertical

Message Type: Status
This signal shall be sent by the EMRServer to the EMRClient for Aim Status of Lefthand Inboard Register Vertical Vanes

Name	Literals	Value	Description
HMIFeedback_LHIB_Vertical	-	0x00 – 0xFF	Aim Status of Lefthand Inboard Register Vertical Vanes

1.7.7 MD-REQ-420292/A-HMIFeedback_RHOB_Vertical

Message Type: Status
This signal shall be sent by the EMRServer to the EMRClient for Aim Status of Righthand Outboard Register Vertical Vanes

Name	Literals	Value	Description
HMIFeedback_RHOB_Vertical	-	0x00 – 0xFF	Aim Status of Righthand Outboard Register Vertical Vanes

1.7.8 MD-REQ-420293/A-HMIFeedback_RHIB_Vertical

Message Type: Status
This signal shall be sent by the EMRServer to the EMRClient for Aim Status of Lefthand Inboard Register Vertical Vanes

Name	Literals	Value	Description
HMIFeedback_RHIB_Vertical	-	0x00 – 0xFF	Aim Status of Righthand Inboard Register Vertical Vanes

2 General Requirements

2.1 EMR-REQ-421157/A-Electro Mechanical Registers while Ignition not in Run

When Ignition ≠ Run, HMI display shall disable EM registers display. Airflow lines and grabbers are not visible as well. User cannot make any selection to control registers via touchscreen.

2.2 EMR-REQ-421158/A-Electro Mechanical Registers dependency on Climate System

When the climate system display is turned off, it shall disable airflow lines and grabbers.
When the climate system is in EATC mode, HMI Screen shall show EM register airflow lines and grabbers in "greyed-out" coloring. Grabbers, aiming, presets and dynamic modes will work as normal.
When the climate system is in manual mode, EM registers shall only show as active on HMI if PANEL VENTS is selected by itself or in any combination with the other manual mode buttons (FLOOR VENTS and DEFROSTER VENTS).
When the climate system is in manual mode and the PANEL VENTS are set to off then the display shall not show airflow lines nor grabbers.

2.3 EMR-REQ-421159/A-HMI requirements for Electro Mechanical Registers, Grabbers and Airflow lines

The details of how the grabbers are moved, how the airflow lines move/change direction are covered in HMI specification document (X26k_EM Registers).

2.4 EMR-REQ-435217/A-Coordinate system for each Electro Mechanical Register

EMRClient shall provide a "range of coverage" box around each register on the HMI screen. This box provides the area of coverage for each register relative to the Cockpit as depicted by the Wireframe image. EMRClient shall provide coordinate tracking of the grabbers within these zones in (X,Y) format, where X is the cross car component of the grabber and Y is the up down component of the grabber. The origin (0,0) will be in the lower left corner of the box. The maximum values shall be (93, 90) in the upper right corner of the box. HMI shall return a linearly proportional position of the grabber anywhere within the box that it is positioned. The nominal units of the grabber shall be degrees which coincide with the register vane rotations required to provide air to the relative position as depicted on the Cockpit HMI wireframe image.

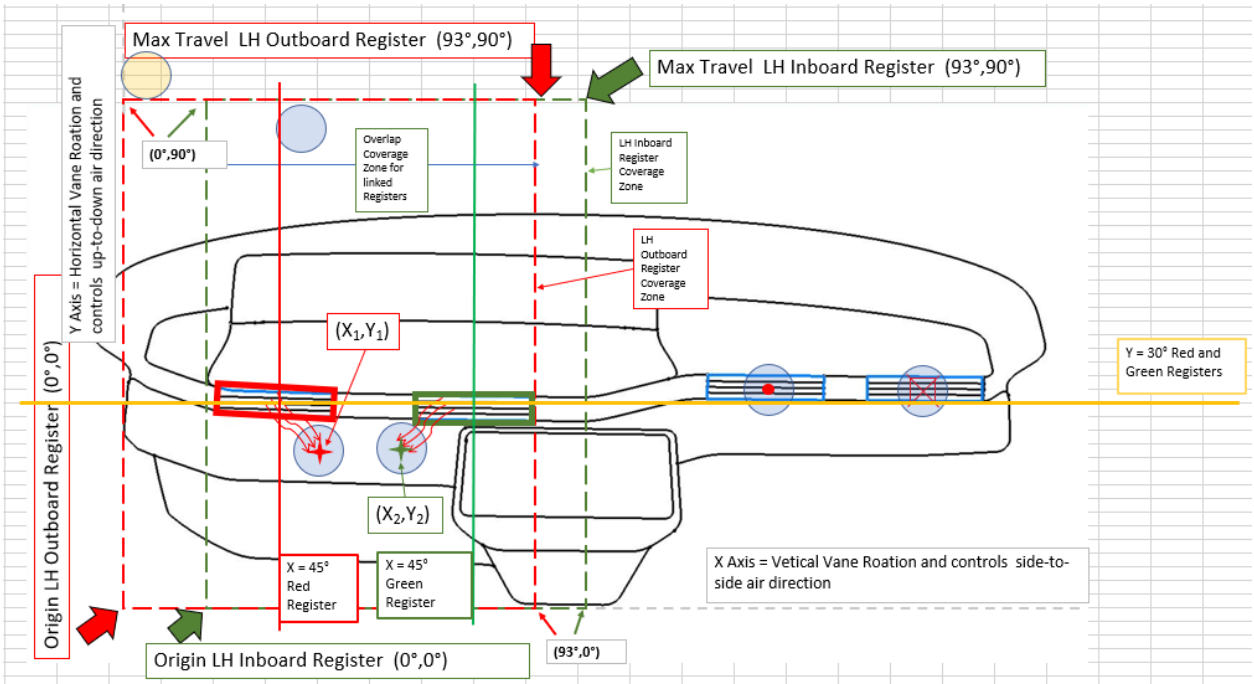


Diagram: Range of coverage of EM Register

2.5 EMR-REQ-438186/A-Memorizing Coordinates

When user touches grabber and starts moving it, EMRClient shall memorize the coordinates for the first position of grabber movement.
If the EM Register is closed, EMRClient shall transmit the memorized position to EMRServer as the last known position before close.

2.6 EMR-REQ-421160/A-Rejuvenate Control of Electro Mechanical Registers

EM register Control will be passed from EMRClient to Rejuvenate Feature when commanded.
There will be 2 sweep patterns available for EM registers while in Rejuvenate mode which are defined and controlled by EMRServer.
If Register HMI is accessed during Rejuvenate feature execution, control shall exit Rejuvenate mode and revert EM Registers to last known position. HMI shall send Manual Change request.

2.7 EMR-REQ-435218/A-Electro Mechanical Registers while vehicle in Driver Focus Mode

When Driver Focus Mode (DFM) initiates, EMRServer shall move the Passenger side EM Registers to CLOSED position.
When DFM is active EMRClient shall show Passenger side EM Registers as inactive (No airflow lines & no grabbers).
Driver side EM Registers function normally while DFM is initiated or active.
If passenger side EM Registers are adjusted or opened, DFM shall be deactivated.
If driver side EM Registers are adjusted or closed, DFM shall not be deactivated.
When DFM is exited by a finger touch to either Passenger side EM Registers or other method, both Passenger Side EM Registers will become active, return to Last Static Position with airflow lines and grabbers aligned. After that, passenger side EM Registers can be adjusted as needed.
When DFM is exited by any other preset button push, EM Registers shall respond as expected for the preset.

2.8 EMR-REQ-421161/A-Response time for Electro Mechanical Register change request

Time for the system to respond (Registers start movement) to button pushed or movement of the grabber shall not be more than 150 milli-seconds. Time for Display to update from Register movement shall not be more than 250 milli-seconds.

3 Functional Definition

3.1 EMR-FUN-REQ-410841/A-Electro Mechanical Register position changed manually

3.1.1 Requirements

3.1.1.1 EMR-REQ-421164/A-Electro Mechanical Register position changed manually

EMRClient shall allow the user to select position of any individual EM register manually by moving its grabber as desired. Airflow lines will follow the grabber as it is moved.

When user moves grabber on the HMI, EMRClient shall send following request to EMRServer:
Register_LHOB = 0x1 (manualChange),
Register_LHOB_Horizontal = 0x00 – 0x5A (0 to 90 degrees),
Register_LHOB_Vertical = 0x00 – 0x5D (0 to 93 degrees) if user moves Lefthand Outboard Register
Or
Register_LHIB = 0x1 (manualChange),
Register_LHIB_Horizontal = 0x00 – 0x5A (0 to 90 degrees),
Register_LHIB_Vertical = 0x00 – 0x5D (0 to 93 degrees) if user moves Lefthand Inboard Register
Or
Register_RHOB = 0x1 (manualChange),
Register_RHOB_Horizontal = 0x00 – 0x5A (0 to 90 degrees),
Register_RHOB_Vertical = 0x00 – 0x5D (0 to 93 degrees) if user moves Righthand Outboard Register
Or
Register_RHIB = 0x1 (manualChange),
Register_RHIB_Horizontal = 0x00 – 0x5A (0 to 90 degrees),
Register_RHIB_Vertical = 0x00 – 0x5D (0 to 93 degrees) if user moves Righthand Outboard Register

When EMRServer gets the manual move register request it shall process the request and send actual position of EM register to the EMRClient in real time as follows:
HMIFeedback_LHOB_Horizontal = 0x00 – 0xFF,
HMIFeedback_LHOB_Vertical = 0x00 - 0xFE if user moves Lefthand Outboard Register
Or
HMIFeedback_LHIB_Horizontal = 0x00 – 0xFF,
HMIFeedback_LHIB_Vertical = 0x00 - 0xFE if user moves Lefthand Inboard Register
Or
HMIFeedback_RHOB_Horizontal = 0x00 – 0xFF,
HMIFeedback_RHOB_Vertical = 0x00 - 0xFE if user moves Righthand Outboard Register
Or
HMIFeedback_RHIB_Horizontal = 0x00 – 0xFF,
HMIFeedback_RHIB_Vertical = 0x00 - 0xFE if user moves Righthand Inboard Register

EMRClient shall send out horizonal and vertical position signals as frequently as possible.
Manual change shall not be sent for longer than 60 seconds.
The EM register will function for this position until request is made to change it.

3.1.2 Use Cases

3.1.2.1 EMR-UC-REQ-421178/A-User adjusts EM register to desired position manually

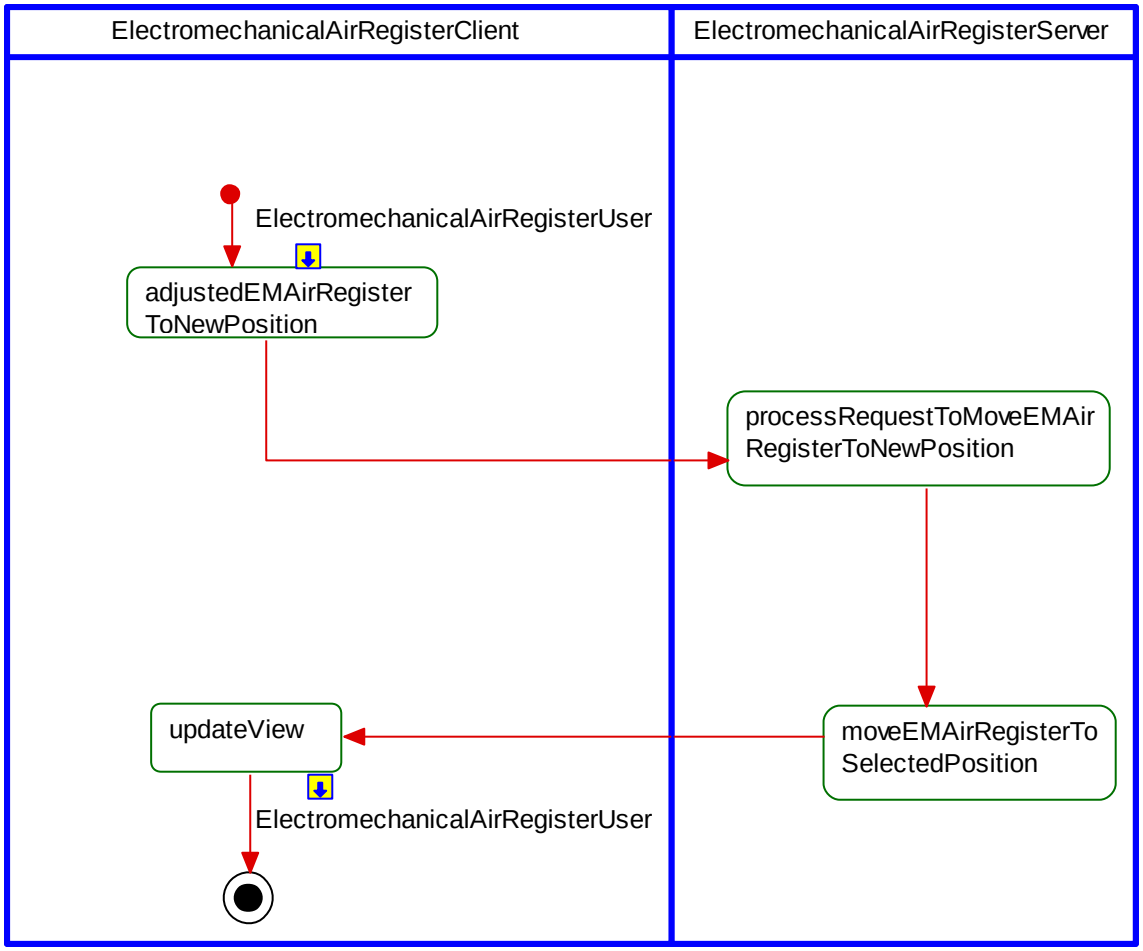
Actors	EMRClient, User
Pre-conditions	Power mode is ON. EMRClient is active. EMRClient screen is ON.
Scenario Description	User touch grabber adjacent to EM register and drag it to any location within a periphery to aim.

Post-conditions	Airflow lines follows grabber as Louvers move. EM register move to new position as requested by user through HMI resulting in the airflow change within cabin. HMI displays the new EM register position.
List of Exception Use Cases	
Interfaces	HMI, CAN

3.1.3 White Box Views

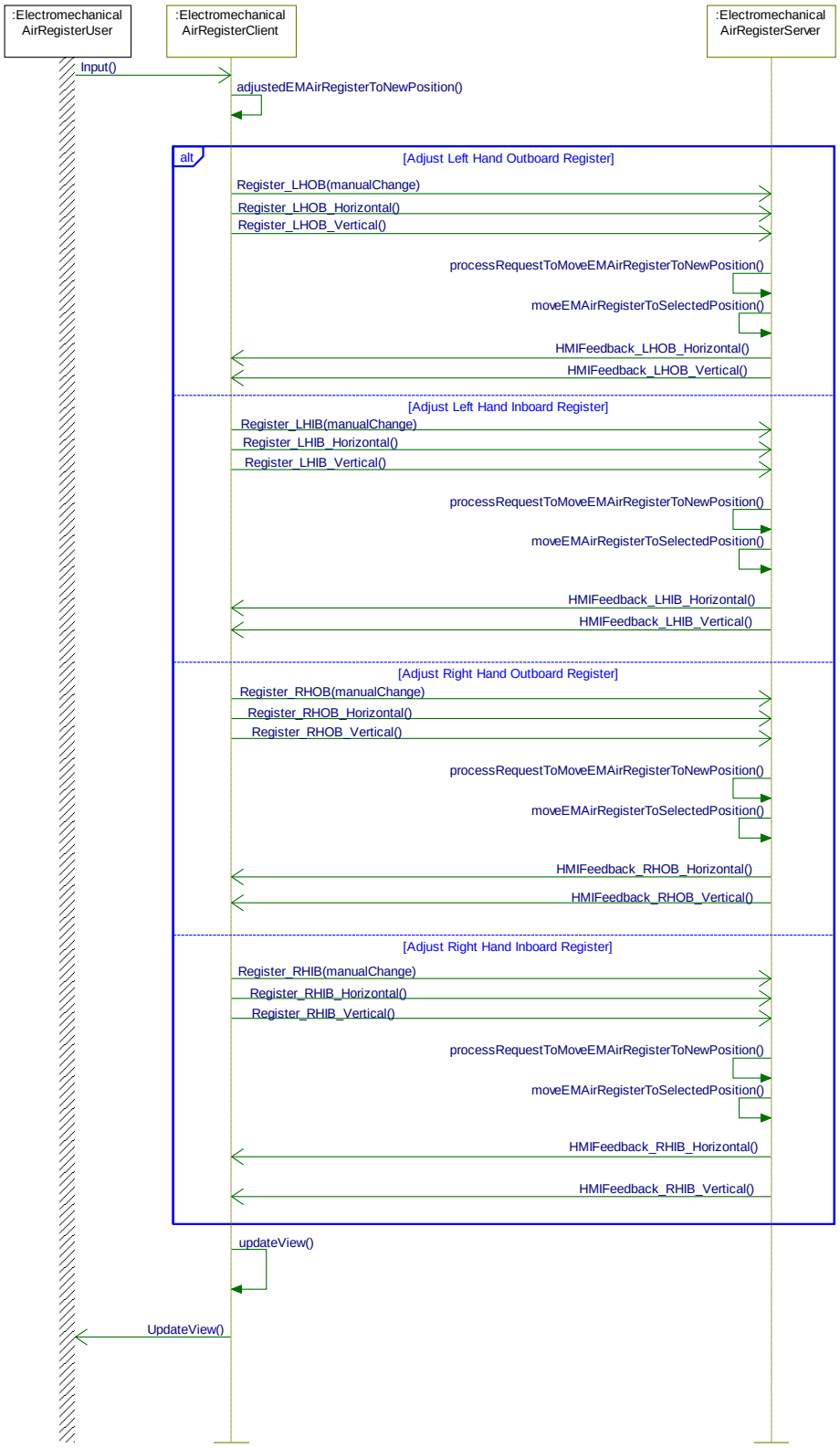
3.1.3.1 Activity Diagrams

3.1.3.1.1 EMR-ACT-REQ-421222/A-User Adjusts Register



3.1.3.2 Sequence Diagrams

3.1.3.2.1 EMR-SD-REQ-421223/A-User Adjusts Register



3.2 EMR-FUN-REQ-421204/A-On Body/Off Body selection

3.2.1 Requirements

3.2.1.1 EMR-REQ-421170/A-On Body option selection

EMRClient shall allow the user to aim airflow from Left side or Right side EM registers pointing towards occupant on that side of vehicle.
When user touches On Body button on the HMI, EMRClient shall send following request to EMRServer:
ActiveButtonsLHS_Rq = 0x1 (onBodyLHS) if user selects Left side On Body
Or
ActiveButtonsRHS_Rq = 0x1 (onBodyRHS) if user selects Right side On Body

EMRServer upon receiving request from EMRClient shall position the Left side or Right side EM registers to the pre-defined fixed values and update EMRClient as follows:
HMIFeedback_LHOB_Horizontal = 0x00 – 0xFF,
HMIFeedback_LHOB_Vertical = 0x00 - 0xFE,
HMIFeedback_LHIB_Horizontal = 0x00 – 0xFF,
HMIFeedback_LHIB_Vertical = 0x00 - 0xFE if user selects Left side On Body
Or
HMIFeedback_RHOB_Horizontal = 0x00 – 0xFF,
HMIFeedback_RHOB_Vertical = 0x00 - 0xFE,
HMIFeedback_RHIB_Horizontal = 0x00 – 0xFF,
HMIFeedback_RHIB_Vertical = 0x00 - 0xFE if user selects Right side On Body

EMRClient upon receiving the status from EMRServer shall move both the EM registers on that side for the fixed preset.

3.2.1.2 EMR-REQ-421171/A-Off Body option selection

EMRClient shall allow the user to aim airflow from Left side or Right side EM registers pointing away from occupant on that side of vehicle.
When user touches Off Body button on the HMI, EMRClient shall send following request to EMRServer:
ActiveButtonsLHS_Rq = 0x2 (offBodyLHS) if user selects Left side Off Body
Or
ActiveButtonsRHS_Rq = 0x2 (offBodyRHS) if user selects Right side Off Body

EMRServer upon receiving request from EMRClient shall position the Left side or Right side registers to the pre-defined fixed values and send status to the EMRClient as follows:
HMIFeedback_LHOB_Horizontal = 0x00 – 0xFF,
HMIFeedback_LHOB_Vertical = 0x00 - 0xFE,
HMIFeedback_LHIB_Horizontal = 0x00 – 0xFF,
HMIFeedback_LHIB_Vertical = 0x00 - 0xFE if user selects Left side Off Body
Or
HMIFeedback_RHOB_Horizontal = 0x00 – 0xFF,
HMIFeedback_RHOB_Vertical = 0x00 - 0xFE,
HMIFeedback_RHIB_Horizontal = 0x00 – 0xFF,
HMIFeedback_RHIB_Vertical = 0x00 - 0xFE if user selects Right side Off Body

EMRClient upon receiving the status from EMRServer shall move both the EM registers on that side for the fixed preset.

3.2.2 Use Cases

3.2.2.1 EMR-UC-REQ-421186/A-User selects Left side On Body option

Actors	EMRClient, User
Pre-conditions	Power mode is ON. EMRClient is active. EMRClient screen is ON.

Scenario Description	User selects Left side On Body option.
Post-conditions	Left side EM registers move to aim airflow directly onto Left side. HMI displays the Left side EM registers airflow lines pointing towards the occupant.
List of Exception Use Cases	
Interfaces	HMI, CAN

3.2.2.2 EMR-UC-REQ-421187/A-User selects Right side On Body option

Actors	EMRClient, User
Pre-conditions	Power mode is ON. EMRClient is active. EMRClient screen is ON.
Scenario Description	User selects Right side On Body option.
Post-conditions	Right side EM registers move to aim airflow directly onto Right side. HMI displays the Right side EM registers airflow lines pointing towards the occupant.
List of Exception Use Cases	
Interfaces	HMI, CAN

3.2.2.3 EMR-UC-REQ-421188/A-User selects Left side Off Body option

Actors	EMRClient, User
Pre-conditions	Power mode is ON. EMRClient is active. EMRClient screen is ON.
Scenario Description	User selects Left side Off Body option.
Post-conditions	Left side EM registers move to aim airflow away from Left side. HMI displays the Left side EM registers airflow lines pointing away from the occupant.
List of Exception Use Cases	
Interfaces	HMI, CAN

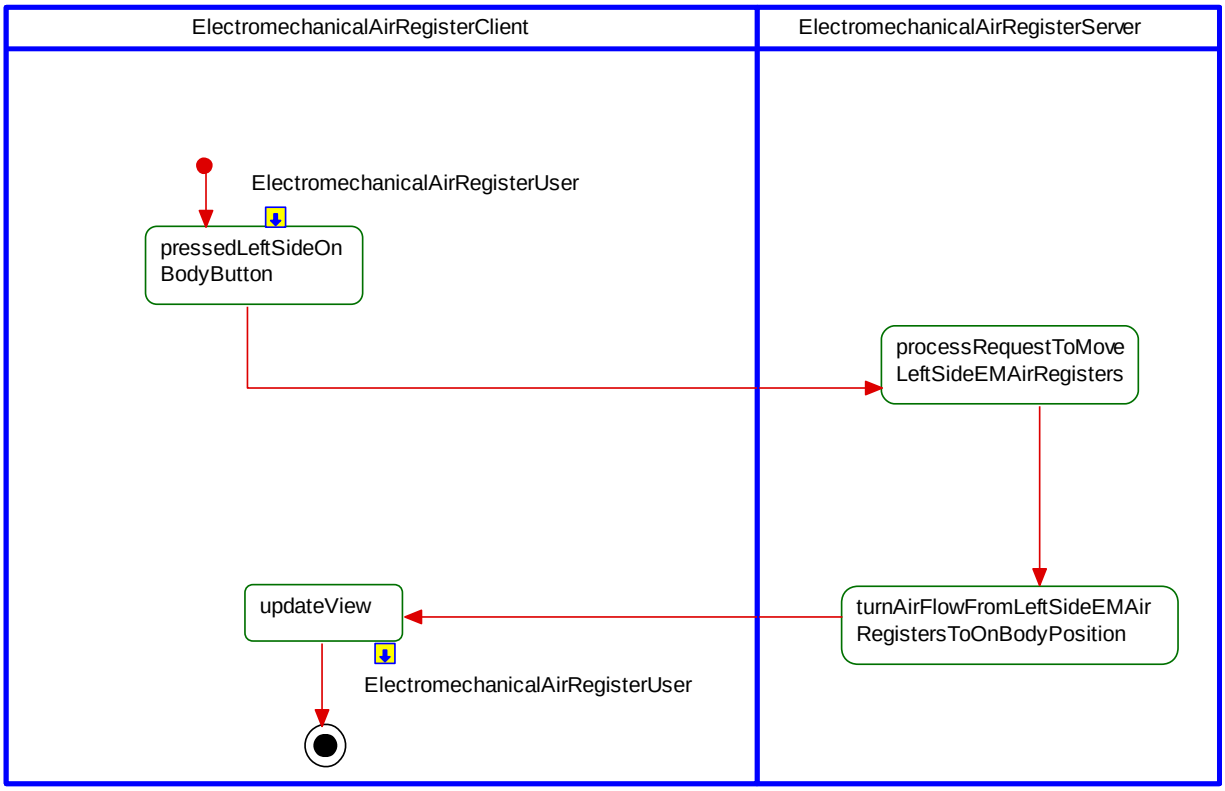
3.2.2.4 EMR-UC-REQ-421189/A-User selects Right side Off Body option

Actors	EMRClient, User
Pre-conditions	Power mode is ON. EMRClient is active. EMRClient screen is ON.
Scenario Description	User selects Right side Off Body option.
Post-conditions	Right side EM registers move to aim airflow away from Right side. HMI displays the Right side EM registers airflow lines pointing away from the occupant.
List of Exception Use Cases	
Interfaces	HMI, CAN

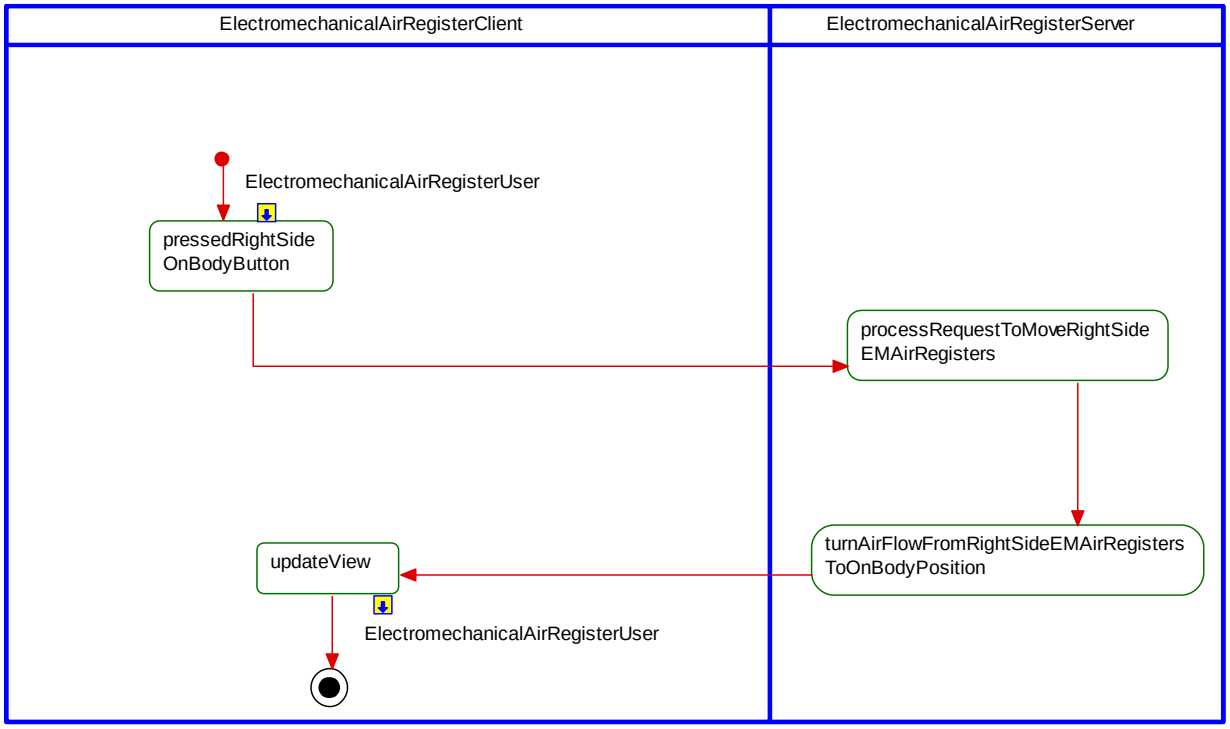
3.2.3 White Box Views

3.2.3.1 Activity Diagrams

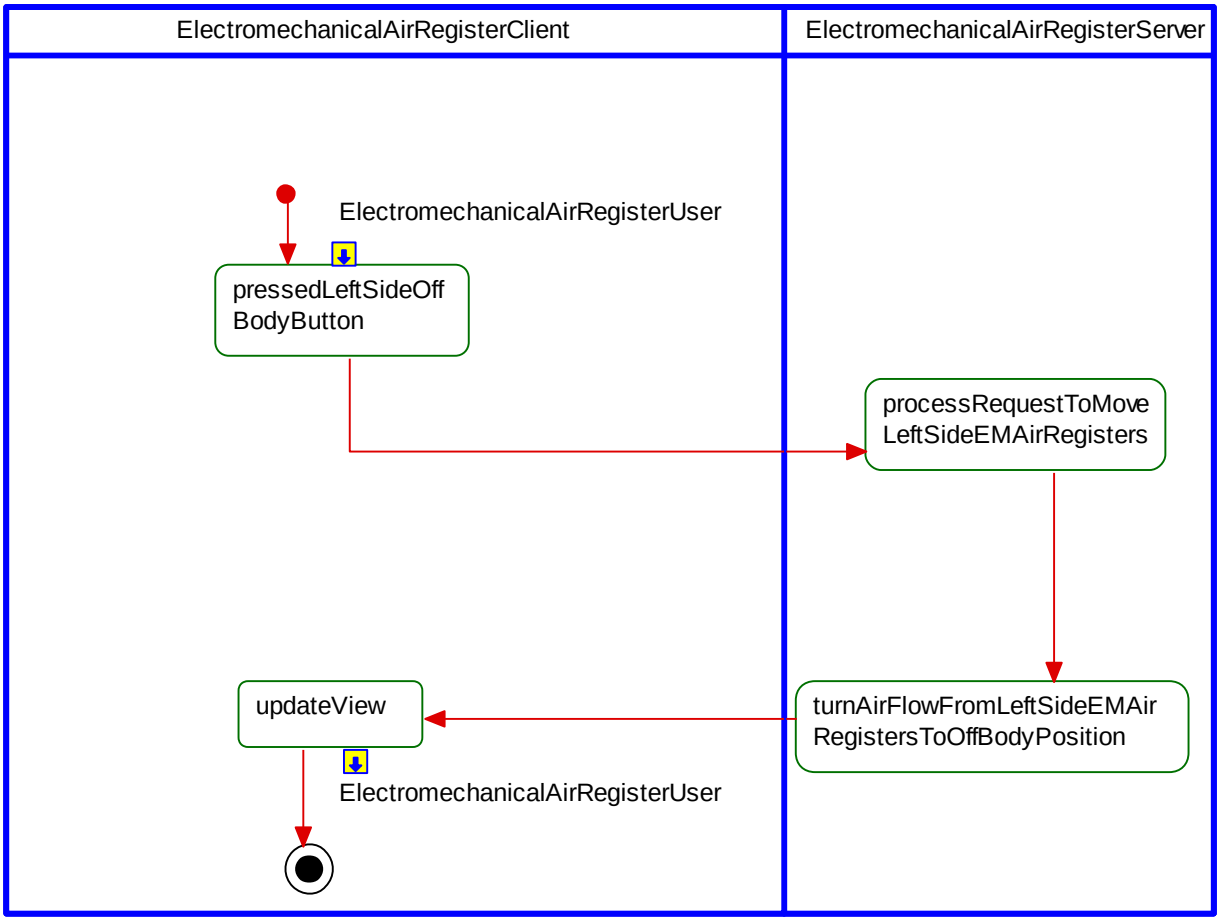
3.2.3.1.1 EMR-ACT-REQ-421232/A-Left Side On Body Selection



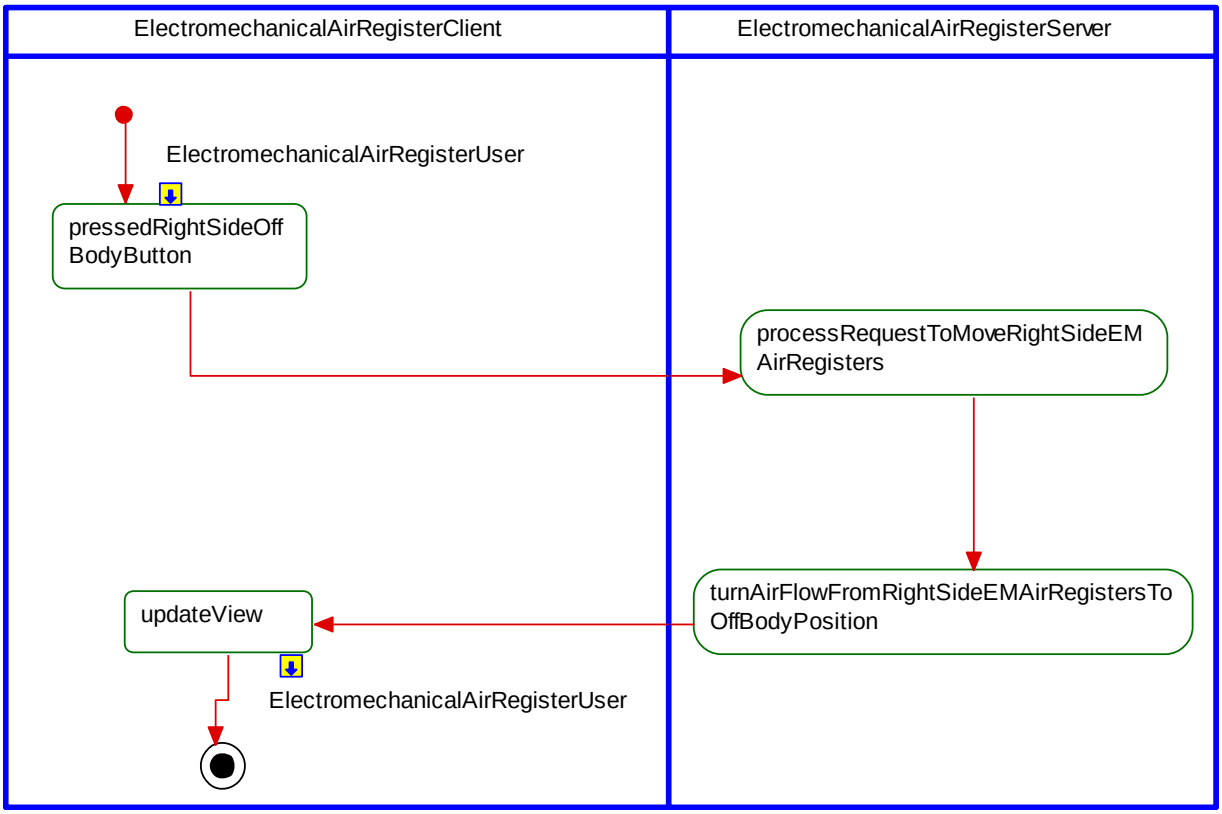
3.2.3.1.2 EMR-ACT-REQ-421233/A-Right Side On Body Selection



3.2.3.1.3 EMR-ACT-REQ-421236/A-Left Side Off Body Selection

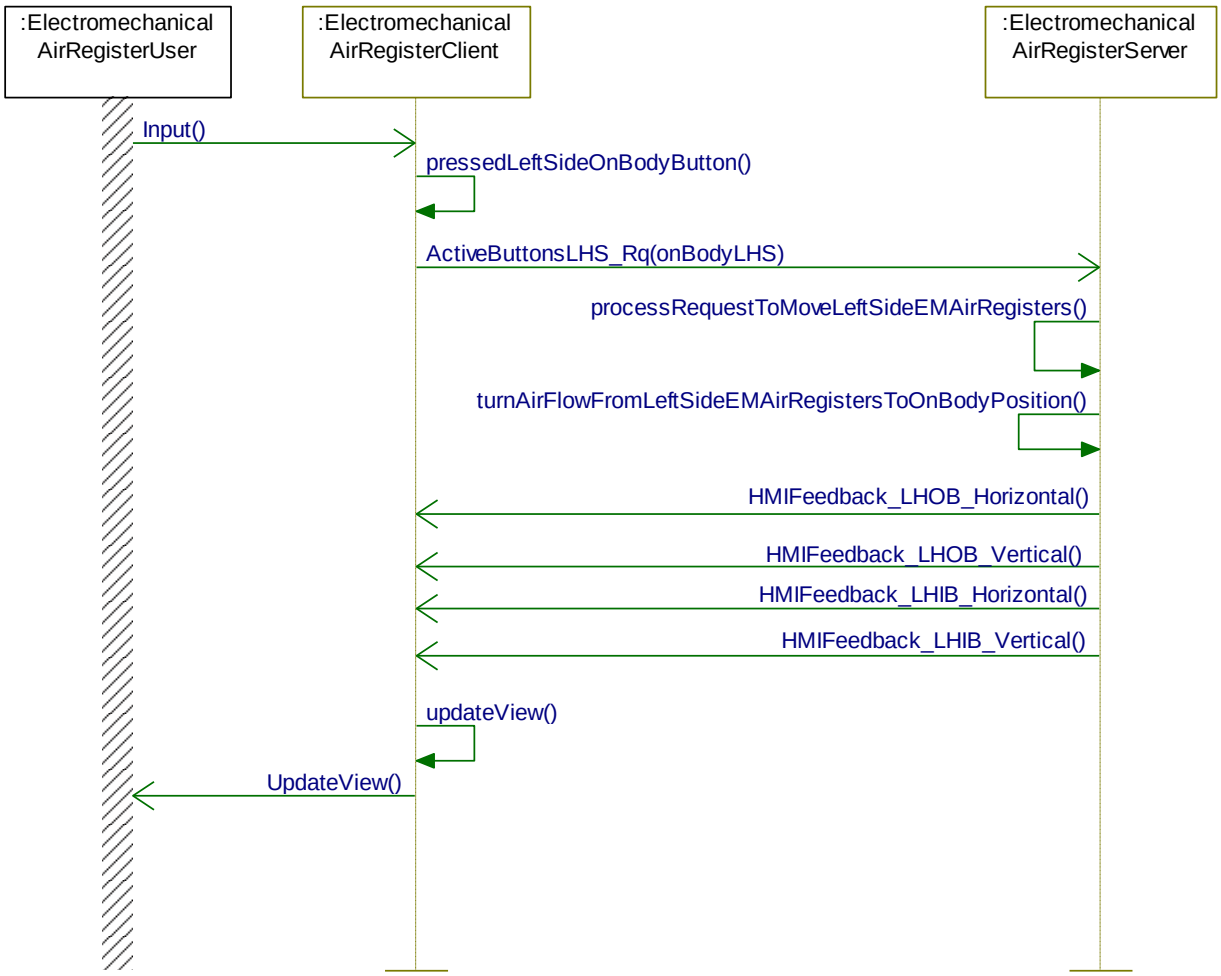


3.2.3.1.4 EMR-ACT-REQ-421237/A-Right Side Off Body Selection

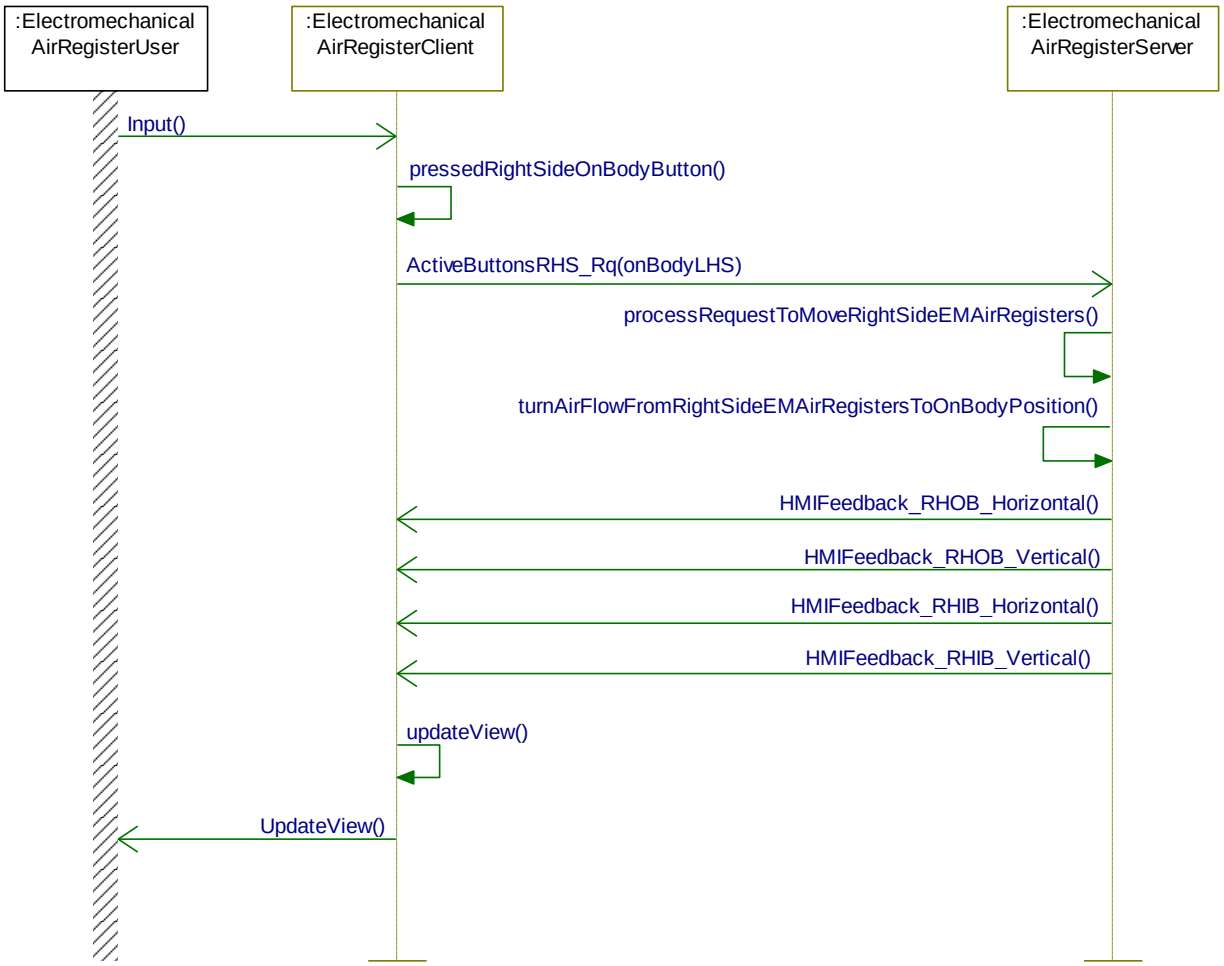


3.2.3.2 Sequence Diagrams

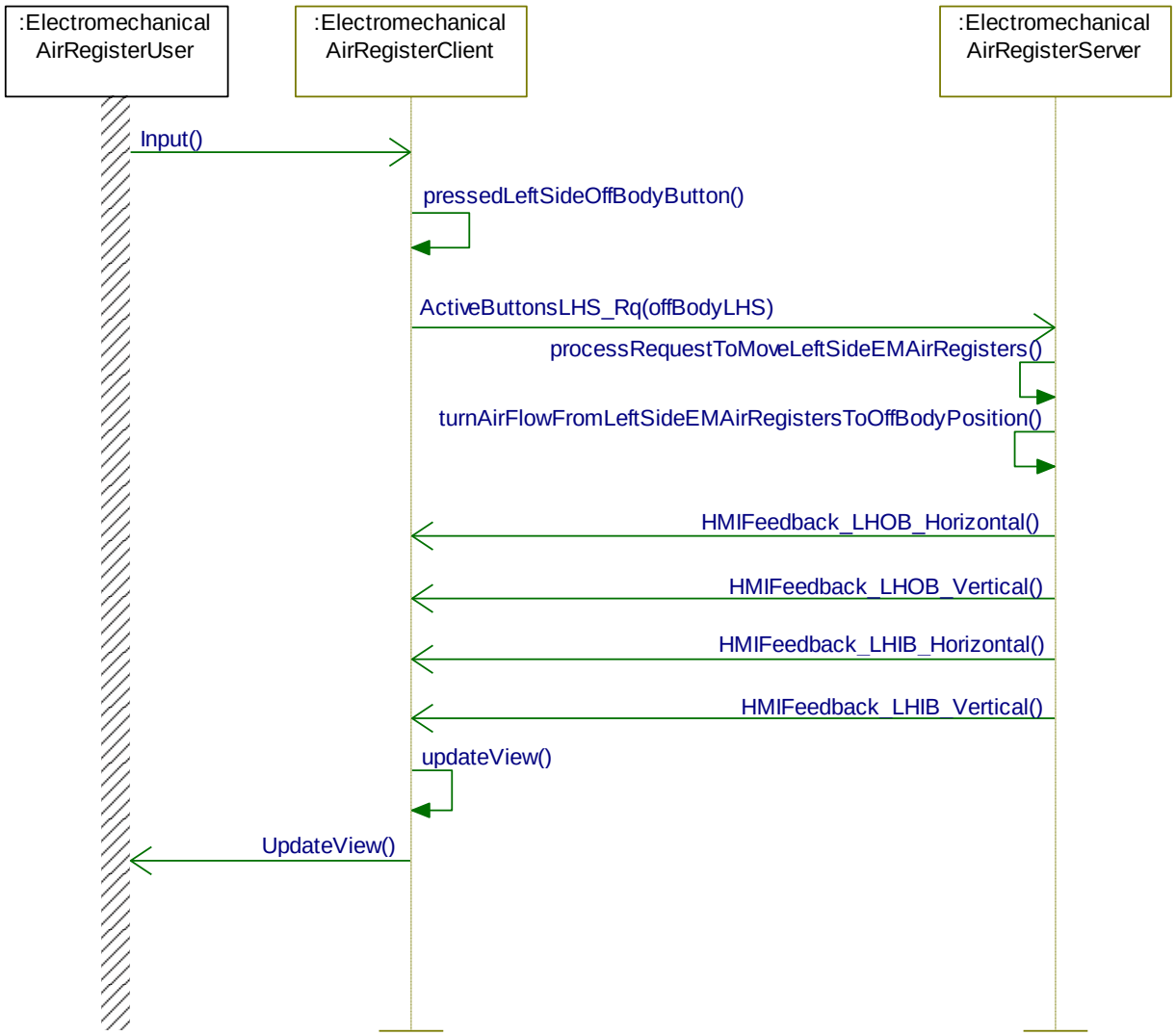
3.2.3.2.1 EMR-SD-REQ-421234/A-Left Side On Body Selection



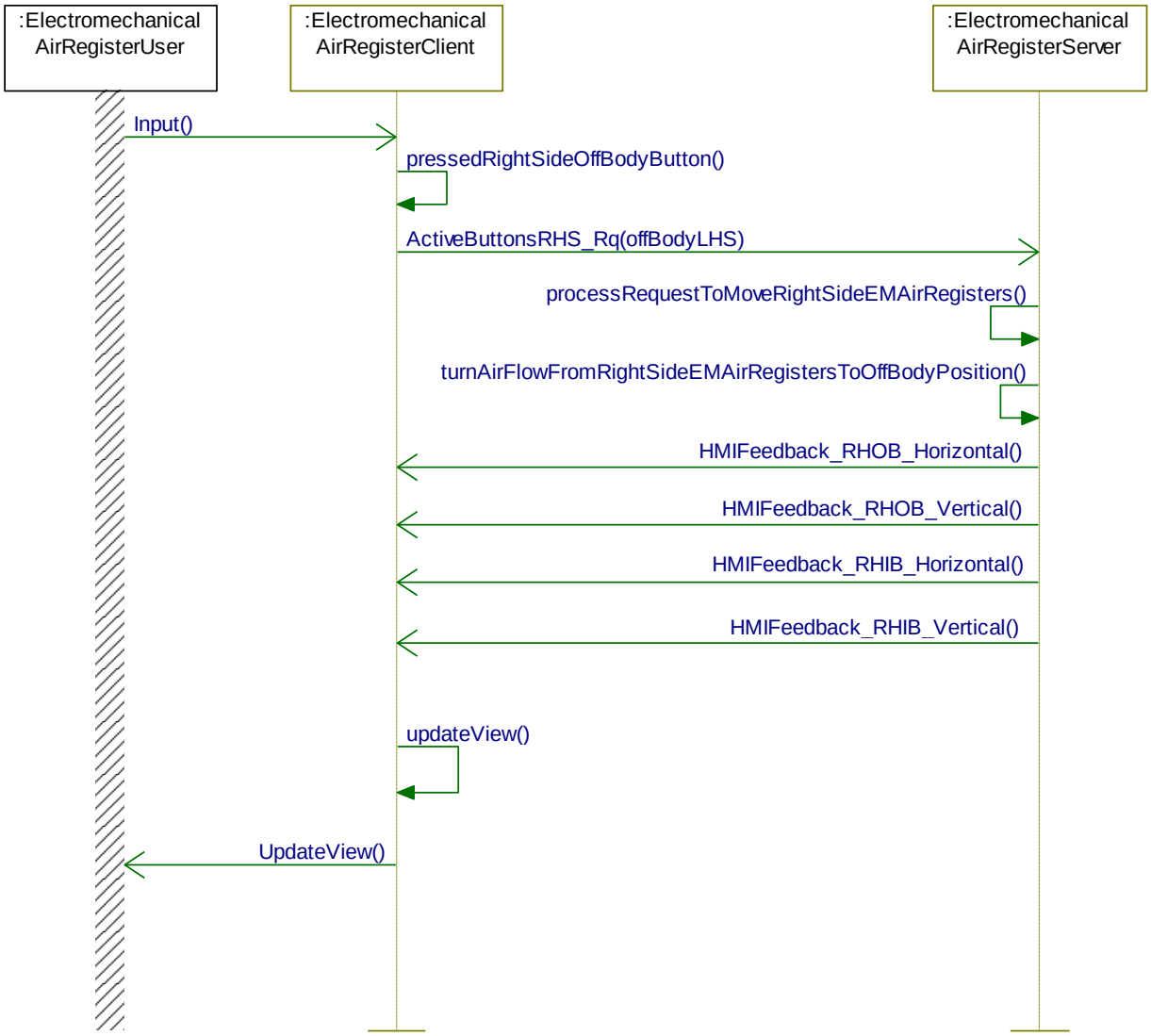
3.2.3.2.2 EMR-SD-REQ-421235/A-Right Side On Body Selection



3.2.3.2.3 EMR-SD-REQ-421238/A-Left Side Off Body Selection



3.2.3.2.4 EMR-SD-REQ-421239/A-Right Side Off Body Selection



3.3 EMR-FUN-REQ-421209/A-Electro Mechanical Register Close/Open

3.3.1 Requirements

3.3.1.1 EMR-REQ-421172/A-Closing Electro Mechanical Register

EMRClient shall allow the user to turn off airflow from any individual EM register.

When user selects to close any individual EM register by moving the grabber over the close vent icon EMRClient shall send following request to EMRServer:

Register_LHOB = 0x1 (manualChange),
Register_LHOB_Horizontal = 0x00 – 0x5A (0 to 90 degrees),
Register_LHOB_Vertical = 0x00 – 0x5D (0 to 93 degrees) if user closing Lefthand Outboard Register
Or
Register_LHIB = 0x1 (manualChange),
Register_LHIB_Horizontal = 0x00 – 0x5A (0 to 90 degrees),
Register_LHIB_Vertical = 0x00 – 0x5D (0 to 93 degrees) if user closing Lefthand Inboard Register
Or

Register_RHOB = 0x1 (manualChange),
Register_RHOB_Horizontal = 0x00 – 0x5A (0 to 90 degrees),
Register_RHOB_Vertical = 0x00 – 0x5D (0 to 93 degrees) if user closing Righthand Outboard Register
Or
Register_RHIB = 0x1 (manualChange),
Register_RHIB_Horizontal = 0x00 – 0x5A (0 to 90 degrees),
Register_RHIB_Vertical = 0x00 – 0x5D (0 to 93 degrees) if user closing Righthand Inboard Register

When grabber reaches the close region, EMRClient identifies that register shall be closed.

At this point EMRClient shall send coordinates for first position of this movement of grabber along with Manual Change signal so that EMRServer shall store it as last know value before receiving Close request.

If user closes Lefthand Outboard Register:
Register_LHOB = 0x1 (manualChange),
Register_LHOB_Horizontal = 0x00 – 0x5A (0 to 90 degrees),
Register_LHOB_Vertical = 0x00 – 0x5D (0 to 93 degrees) coordinates for first position of grabber movement before closing Lefthand Outboard Register
Followed by
Register_LHOB = 0x5 (close)

If user closes Lefthand Inboard Register:
Register_LHIB = 0x1 (manualChange),
Register_LHIB_Horizontal = 0x00 – 0x5A (0 to 90 degrees),
Register_LHIB_Vertical = 0x00 – 0x5D (0 to 93 degrees) coordinates for first position of grabber movement before closing Lefthand Inboard Register
Followed by
Register_LHIB = 0x5 (close)

If user closes Righthand Outboard Register:
Register_RHOB = 0x1 (manualChange),
Register_RHOB_Horizontal = 0x00 – 0x5A (0 to 90 degrees),
Register_RHOB_Vertical = 0x00 – 0x5D (0 to 93 degrees) coordinates for first position of grabber movement before closing Righthand Outboard Register
Followed by
Register_RHOB = 0x5 (close)

If user closes Righthand Inboard Register
Register_RHIB = 0x1 (manualChange),
Register_RHIB_Horizontal = 0x00 – 0x5A (0 to 90 degrees),
Register_RHIB_Vertical = 0x00 – 0x5D (0 to 93 degrees) coordinates for first position of grabber movement before closing Righthand Inboard Register
Followed by
Register_RHIB = 0x5 (close)

EMRServer upon receiving request from EMRClient shall process it and send response as follows:

HMIFeedback_LHOB_Vertical = 0xFF for Lefthand Outboard Register
Or
HMIFeedback_LHIB_Vertical = 0xFF for Lefthand Inboard Register
Or
HMIFeedback_RHOB_Vertical = 0xFF for Righthand Outboard Register
Or
HMIFeedback_RHIB_Vertical = 0xFF for Righthand Inboard Register

EMRClient shall change vent icon to close vent, remove airflow lines and moves the grabber to first position of this grabber movement.

3.3.1.2 EMR-REQ-421173/A-Opening a closed Electro Mechanical Register

EMRClient shall allow the user to turn on airflow from any closed EM register.

When user single-taps grabber or moves the grabber of closed EM register, EMRClient shall send following request to EMRServer:

If user opens closed Lefthand Outboard Register:
Register_LHOB = 0x4 (open) if user single-tap closed Lefthand Outboard Register
Or
Register_LHOB = 0x1 (manualChange),
Register_LHOB_Horizontal = 0x00 – 0x5A (0 to 90 degrees),
Register_LHOB_Vertical = 0x00 – 0x5D (0 to 93 degrees) if user moves grabber of closed Lefthand Outboard Register

If user opens closed Lefthand Inboard Register
Register_LHIB = 0x4 (open) if user single-tap closed LefthandInboard Register
Or
Register_LHIB = 0x1 (manualChange),
Register_LHIB_Horizontal = 0x00 – 0x5A (0 to 90 degrees),
Register_LHIB_Vertical = 0x00 – 0x5D (0 to 93 degrees) if user moves grabber of closed Lefthand Inboard Register

If user opens closed Righthand Outboard Register
Register_RHOB = 0x4 (open) if user single-tap closed Righthand Outboard Register
Or
Register_RHOB = 0x1 (manualChange),
Register_RHOB_Horizontal = 0x00 – 0x5A (0 to 90 degrees),
Register_RHOB_Vertical = 0x00 – 0x5D (0 to 93 degrees) if user moves grabber of closed Righthand Outboard Register

If user opens closed Righthand Inboard Register
Register_RHIB = 0x4 (open) if user single-tap closed Righthand Outboard Register
Or
Register_RHIB = 0x1 (manualChange),
Register_RHIB_Horizontal = 0x00 – 0x5A (0 to 90 degrees),
Register_RHIB_Vertical = 0x00 – 0x5D (0 to 93 degrees) if user moves grabber of closed Righthand Inboard Register

A single tap is when user presses and releases the grabber upon which the EMRClient would send the request to the EMRServer.

When EMRServer gets open register request it shall provide last known position of EM register to the EMRClient as follows:
HMIFeedback_LHOB_Horizontal = 0x00 – 0xFF,
HMIFeedback_LHOB_Vertical = 0x00 - 0xFE for Lefthand Outboard Register
Or
HMIFeedback_LHIB_Horizontal = 0x00 – 0xFF,
HMIFeedback_LHIB_Vertical = 0x00 - 0xFE for closed Lefthand Inboard Register
Or
HMIFeedback_RHOB_Horizontal = 0x00 – 0xFF,
HMIFeedback_RHOB_Vertical = 0x00 - 0xFE for closed Righthand Outboard Register
Or
HMIFeedback_RHIB_Horizontal = 0x00 – 0xFF,
HMIFeedback_RHIB_Vertical = 0x00 - 0xFE for closed Righthand Inboard Register

When EMRServer provides confirmation that the closed EM register is opened EMRClient shall change icon to open vent and display airflow lines.

3.3.2 Use Cases

3.3.2.1 EMR-UC-REQ-421190/A-User shuts off air flow from EM register

Actors	EMRClient, User
Pre-conditions	Power mode is ON. EMRClient is active. EMRClient screen is ON.
Scenario Description	User moves grabber of EM register over the close vent icon to close the EM register.
Post-conditions	EM register is closed and airflow shuts off from that EM register. Grabber moves to the first position of this grabber movement.
List of Exception Use Cases	
Interfaces	HMI, CAN

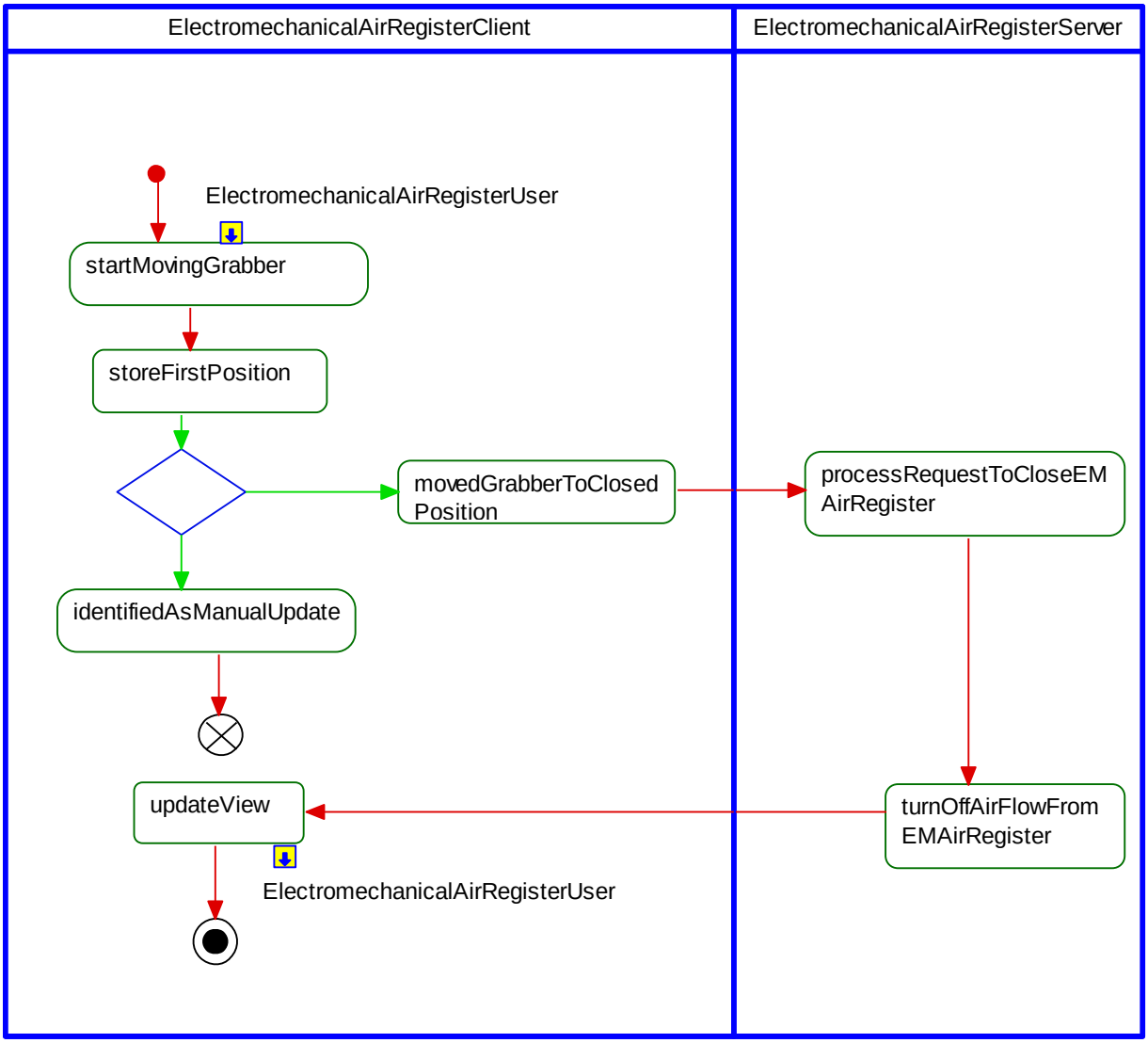
3.3.2.2 EMR-UC-REQ-421191/A-User turns on the closed EM register

Actors	EMRClient, User
Pre-conditions	Power mode is ON. EMRClient is active. EMRClient screen is ON. Air EM register is closed.
Scenario Description	User taps one time on the grabber or moves the grabber of the closed EM register.
Post-conditions	EM register is open for airflow. Note: See “Electro Mechanical Register position changed manually” section if user moved the grabber.
List of Exception Use Cases	
Interfaces	HMI, CAN

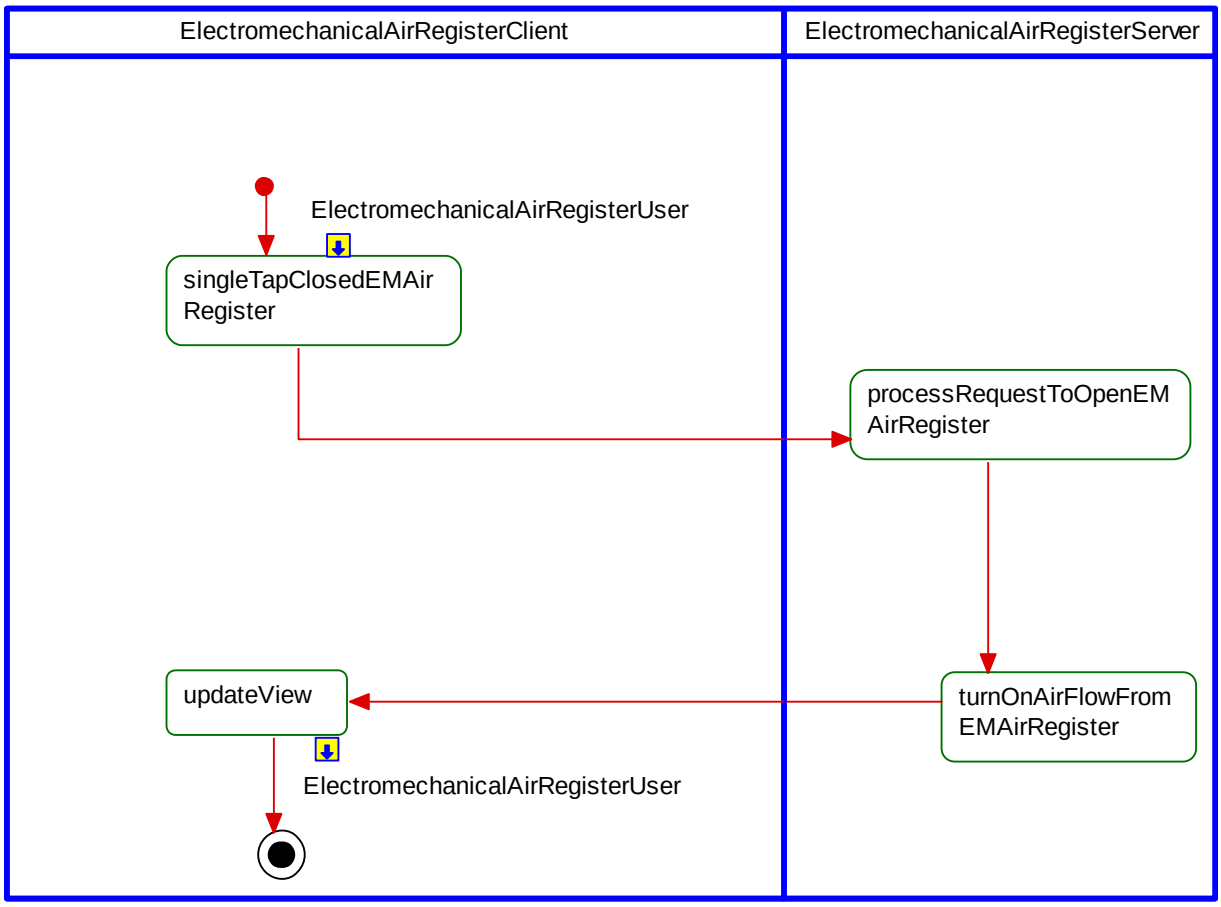
3.3.3 White Box Views

3.3.3.1 Activity Diagrams

3.3.3.1.1 EMR-ACT-REQ-421240/A-User Shuts Off Register

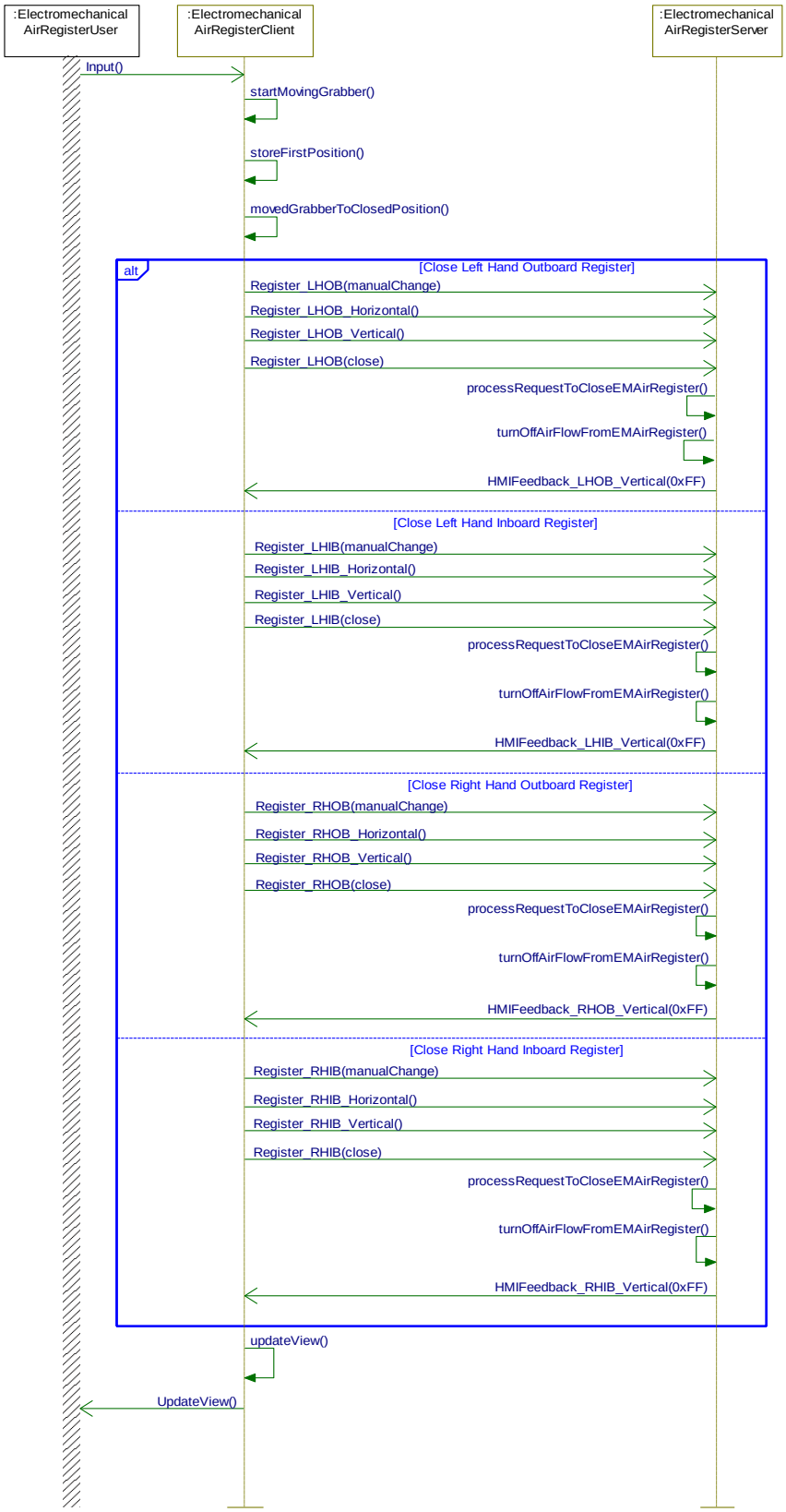


3.3.3.1.2 EMR-ACT-REQ-421241/A-User Turns On Closed Register by Single-Tap Action

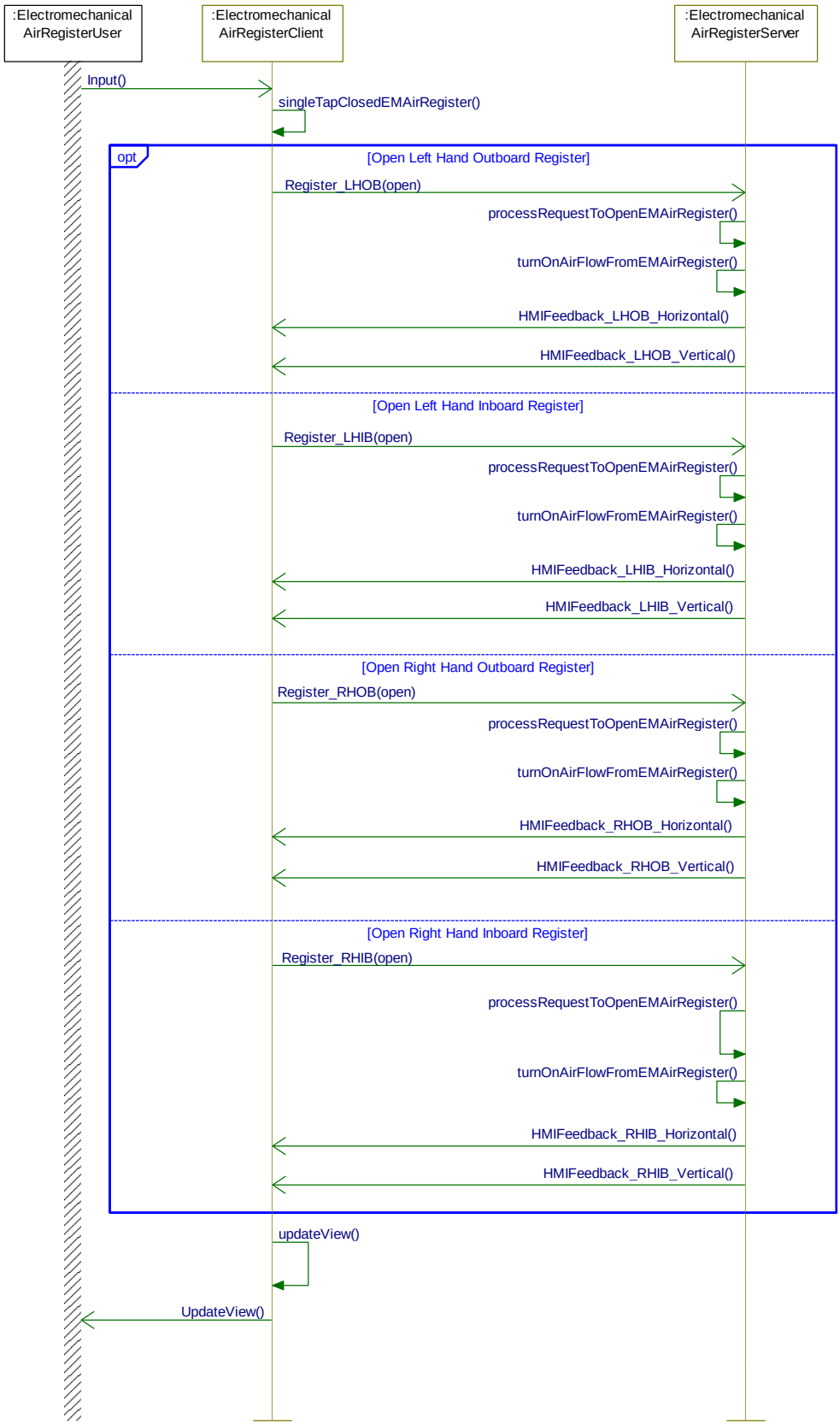


3.3.3.2 Sequence Diagrams

3.3.3.2.1 EMR-SD-REQ-421242/A-User Shuts Off Register



3.3.3.2.2 EMR-SD-REQ-421243/A-User Turns On Closed Register by Single-Tap Action



4 Appendix: Reference Documents

Reference #	Document Title
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