Research & Vehicle Technology
"Infotainment Systems Product Development"

Feature – Heat Skin

Infotainment Subsystem Part Specific Specification (SPSS)

Version 1.7
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Revision History

Date	Version	Notes
3/6/2023	V1.0	Initial releasing.
3/13/2023	V1.1	Change chapter2.1/2.4/2.5/3.2/3.3/3.4/3.5
3/21/2023	V1.2	Change chapter3.2/3.4/2.2/2.7/3.4.1.1
4/3/2023	V1.3	Change chapter2.7/3.2/3.4/3.5/3.6
4/12/2023	V1.4	Change chapter1.7.22/3.4.2/2.4
4/13/2023	V1.5	Change chapter2.2/3.4.3
4/18/2023	V1.6	Change chapter2.7/2.8
4/19/2023	V1.7	Change chapter3

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1 Architectural Design

1.1 Overview

Customers expect longer drive range for BEV vehicles, in the winter due to low outside temperature and BEV vehicle won't have engine to provide heat, the driver range will highly reduce by Air Conditioning System making heat. Because of Conduction & Radiation is more preferred in Cold Climate, the customer could get direct heat from new heating surface on the doors / console armrest / seat headrest, which could reduce the Air Conditioning System load and improve the BEV drive range.

The experiment shows that different Surface Has Different Thermal Improvement & Power Demand and Headrest, Console armrest & Door armrest has highest efficiency & feasibility, So Heat Skin Feature is to control heating surface on doors / console armrest / seat headrest / heated seat and heated steering wheel feature to provide the customer better Thermal Comfort and reduce the Air Conditioning System load to approve BEV driver range in the winter.
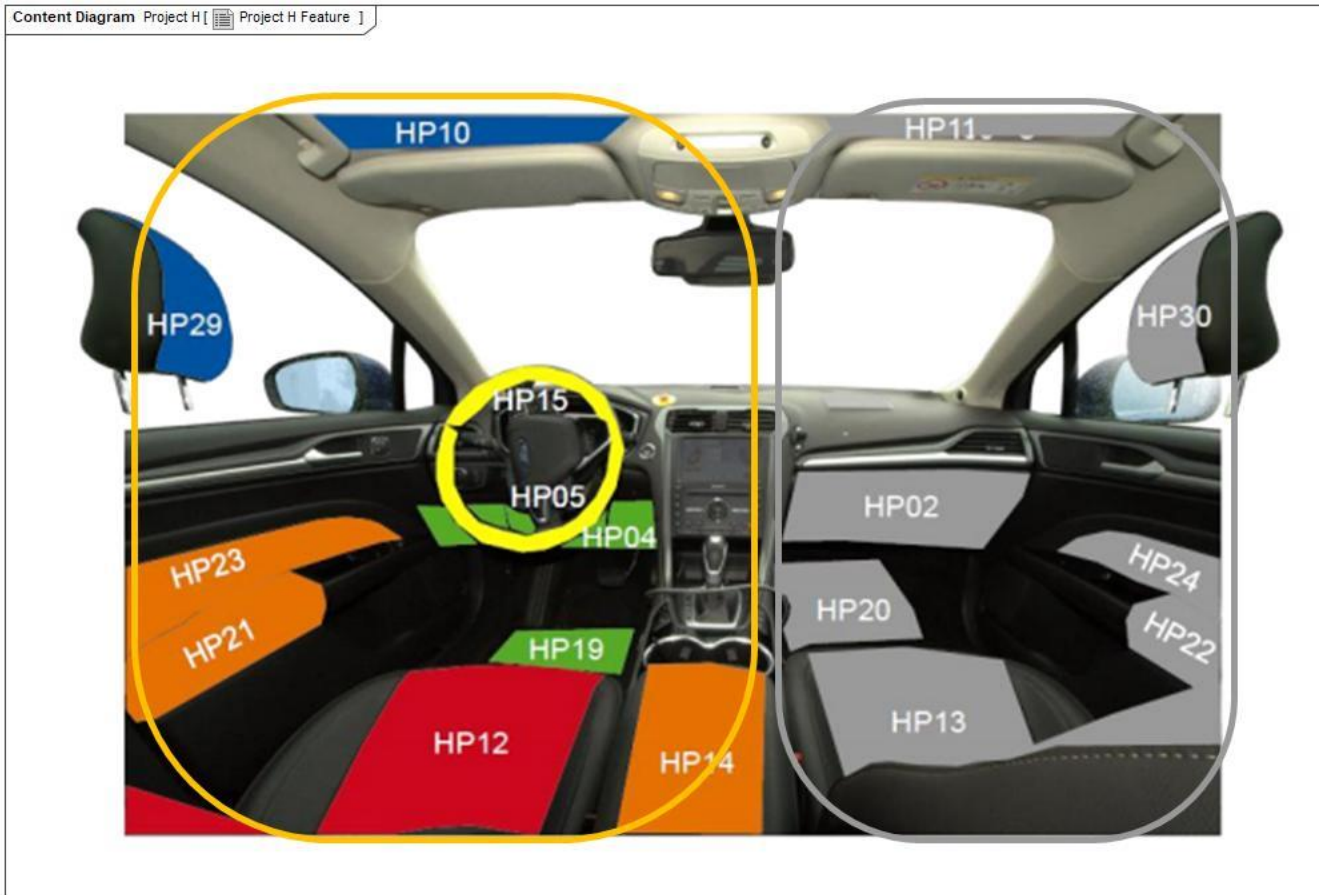
1.2 HS-CLD-REQ-xxxx/A-Heat Skin Client

The Heat Skin Client is responsible to provide the user HMI. User could select heated mode, heated surfaces and heated level via HMI.

1.3 HS-CLD-REQ-xxxx/A-Heat Skin

The Heat Skin Server is responsible for gatewaying CAN / LIN bidirectionally.

1.4 Physical Mapping of Classes

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

Logical Class	Physical Module (ECU)
Heat Skin Client	APIM
Heat Skin Server	Body Heat Surface Controller

1.5 Logical Signal Mapping

Each logical name used in this document is mapped to its corresponding CAN signal or LIN signal. Please refer to the following mapping:

CAN/ LIN signal name	Description	Signal type
DrvDrHeatSfeLevCmd	Heat Skin Driver Door Armrest heat surface level command	LIN
ConArmHeatSfeLevCmd	Heat Skin Console armrest heat surface level command	LIN
DrvHdHeatSfeLevCmd	Heat Skin headrest heat surface level command	LIN
PsngrDrHeatSfeLevCmd	Heat Skin Passenger Side Door Armrest heat surface level command	LIN
PsngrHdHeatSfeLevCmd	Heat Skin Passenger Side headrest heat surface level command	LIN
DrvDrHeatSfeLevSts	Heat Skin Driver heat surface level status	LIN
ConArmHeatSfeLevSts	Heat Skin Console armrest heat surface level status	LIN
DrvHdHeatSfeLevSts	Heat Skin headrest heat surface level status	LIN
ConArmHeatSfeTempSts	Heat Skin Console armrest heat surface temperature feedback status	LIN
DrvDrHeatTempSts	Heat Skin Driver heat surface temperature feedback status	LIN
DrvHdHeatTempSts	Heat Skin headrest heat surface temperature feedback status	LIN
DrvDrHeatSfeFail	Driver Door Heat Surface Heating Feedback Failure	LIN
DrvHdHeatFail	Driver Headrest Surface Heating Feedback Failure	LIN
ConArmHeatSfeFail	Console armrest Surface Heating Feedback Failure	LIN
PsngrDrHeatSfeLevSts	Heat Skin Passenger Door heat surface level status	LIN
PsngrHdHeatSfeLevSts	Heat Skin Passenger Side headrest heat surface level status	LIN
PsngrDrHeatTempSts	Heat Skin Passenger Side Door heat surface temperature feedback status	LIN
PsngrHdHeatTempSts	Heat Skin Passenger Side headrest heat surface temperature feedback status	LIN
PsngrDrHeatSfeFail	Heat Skin Passenger Side Door Door Heat Surface Heating Feedback	LIN
PsngrHdHeatFail	Heat Skin Passenger Side Door Headrest Surface Heating	LIN
Frt_Btn_Status_1st	AC panel button output signal include seat heat and string heat.	CAN
Drv_Set_Temp	Driver side climate temperature setting.	CAN
Psngr_Set_Temp	Passenger side climate temperature setting.	CAN
LHS_Temp_Display_Digit1	主驾驶温度反馈	CAN
LHS_Temp_Display_Digit2	主驾驶温度反馈	CAN
LHS_Temp_Display_Digit3	主驾驶温度反馈	CAN
RHS_Temp_Display_Digit1	副驾驶温度反馈	CAN
RHS_Temp_Display_Digit2	副驾驶温度反馈	CAN
RHS_Temp_Display_Digit3	副驾驶温度反馈	CAN

Outside_Air_Temp_Stat	外温输入	CAN
PsngrFrntDetct_D_Actl	passenger seats detect	CAN
Floor_Btn_Stt	Floor Button Status	CAN
Ignition_Status	Ignition_Status	CAN
Remote_Start_Status	Remote_Start_Status	CAN
ElCmpr_D_Stat	压缩机状态反馈	CAN
ClimtCool_D_Rq	AC request	CAN
LHS_Auto_Seat_Btn_Stt	Driver Seat Auto Button Status	CAN
RHS_Auto_Seat_Btn_Stt	Passenger Seat Auto Button Status	CAN
ElCmpr_N_Actl	AC 转速反馈	CAN
Front_Blower_Indicate	空调风量挡位反馈信号	CAN
Panel_Btn_Stt	Panel Button Status	CAN
Windscreen_Btn_Stt	Windscreen Button Status	CAN
Row2DrvPrsnc_D_Actl	2nd row left seat detect	CAN
Row2MidPrsnc_D_Actl	2nd row mid seat detects	CAN
Row2PsngrPrsnc_D_Actl	2nd row right seat detects	CAN

1.6   HS-IIR-REQ-xxxx/A-Heat Skin Client _Tx

1.6.1   MD-REQ-xxxx/A- DrvDrHeatSfeLevCmd

Message Type: Request

Heat Skin Driver Door Armrest heat surface level command request signal.

Name	Literals	Value	Description
DrvDrHeatSfeLevCmd	-	-	
	off	0x0	
	low	0x1	
	mid	0x2	
	high	0x3	

1.6.2   MD-REQ-xxxx/A-ConArmHeatSfeLevCmd

Message Type: Request
Heat Skin Console armrest heat surface level command request signal.

Name	Literals	Value	Description
ConArmHeatSfeLevCmd	-	-	
	off	0x0	
	low	0x1	
	mid	0x2	
	high	0x3	

1.6.3   MD-REQ-xxxx/A- DrvHdHeatSfeLevCmd

Message Type: Request
Heat Skin head heat surface level command request signal.

Name	Literals	Value	Description
DrvHdHeatSfeLevCmd	-	-	

	off	0x0	
	low	0x1	
	mid	0x2	
	high	0x3	

1.6.4   MDREQ-xxxx/A- PsngrDrHeatSfeLevCmd

Message Type: Request

Heat Skin Passenger side Door heat surface level command request signal

Name	Literals	Value	Description
DrvHdHeatSfeLevCmd	-	-	
	off	0x0	
	low	0x1	
	mid	0x2	
	high	0x3	

1.6.5   MD-REQ-xxxx/A- PsngrHdHeatSfeLevCmd

Message Type: Request
Heat Skin Passenger side head heat surface level command request signal.

Name	Literals	Value	Description
PsngrHdHeatSfeLevCmd	-	-	
	off	0x0	
	low	0x1	
	mid	0x2	
	high	0x3	

1.6.6   MDREQ-xxxx/A- Frt_Btn_Status_1st

Message Type: Request

Steering Wheel and driver side seat heat level request.

Name	Literals	Value	Description
Frt_Btn_Status_1st	-	-	
	0x0~ 0x3A		Refer DBC

1.6.7   MDREQ-xxxx/A- Drv_Set_Temp

Message Type: Request

Driver side climate temperature setting.

Name	Literals	Value	Description
Drv_Set_Temp	-	-	
	0x0~ 0x1F		Refer DBC

1.6.8 MDREQ-xxxx/A- Psngr_Set_Temp

Message Type: Request

Passenger side climate temperature setting.

Name	Literals	Value	Description
Psngr_Set_Temp	-	-	
	0x0~ 0x1F		Refer DBC

1.7 HS-IIR-REQ-xxxx/A-Heat Skin Client _Rx

1.7.1 MD-REQ-xxxx/A-DrvDrHeatSfeLevSts

Message Type: Status

Heat Skin Driver door surface heat level status

Name	Literals	Value	Description
DrvDrHeatSfeLevSts	-	-	
	off	0x0	
	low	0x1	
	mid	0x2	
	high	0x3	

1.7.2 MD-REQ-xxxx/A-PsngrDrHeatSfeLevSts

Message Type: Status

Heat Skin passenger door surface heat level status

Name	Literals	Value	Description
PsngrDrHeatSfeLevSts	-	-	
	off	0x0	
	low	0x1	
	mid	0x2	
	high	0x3	

1.7.3 MD-REQ-xxxx/A-ConArmHeatSfeLevSts

Message Type: Status

Heat Skin Console armrest surface heat level status

Name	Literals	Value	Description
ConArmHeatSfeLevSts	-	-	
	off	0x0	
	low	0x1	
	mid	0x2	
	high	0x3	

1.7.4 MD-REQ-xxxx/A-DrvHdHeatSfeLevSts

Message Type: Status

Heat Skin headrest surface heat level status

Name	Literals	Value	Description
DrvHdHeatSfeLevSts	-	-	
	off	0x0	
	low	0x1	
	mid	0x2	
	high	0x3	

1.7.5   MD-REQ-xxxx/A-PsngrHdHeatSfeLevSts

Message Type: Status

Heat Skin passenger side headrest surface heat level status

Name	Literals	Value	Description
PsngrHdHeatSfeLevSts	-	-	
	off	0x0	
	low	0x1	
	mid	0x2	
	high	0x3	

1.7.6   MD-REQ-xxxx/A-Htd_Strg_Whl_Btn_Stt

Message Type: Status

Heat Skin Steering wheel surface heat level status

Name	Literals	Value	Description
Htd_Strg_Whl_Btn_Stt	-	-	
	Enabled_Inactive	0x0	
	Active	0x1	
	Disabled	0x2	
	Unused	0x3	

1.7.7   MD-REQ-xxxx/A-LHS_Cond_Seat_Status

Message Type: Status

Heat Skin driver side seat surface heat level status

Name	Literals	Value	Description
DrvHdHeatSfeLevSts	-	-	
	Off	0x0	
	Level_1_Cooling	0x1	
	Level_2_Cooling	0x2	
	Level_3_Cooling	0x3	
	Level_1_Heating	0x4	
	Level_2_Heating	0x5	
	Level_3_Heating	0x6	
	Unused	0x7	

1.7.8   MD-REQ-xxxx/A-DrvDrHeatSfeFail

Message Type: Status

Heat Skin driver side door heat surface failure status

Name	Literals	Value	Description
DrvDrHeatSfeFail	-	-	
	Normal	0x0	
	Failure: NTC Resistance drift	0x1	
	Failure: NTC Open Circuit or Short to Battery	0x2	
	Failure: NTC Short Circuit to Ground	0x3	
	Failure: NTC Temperature Abnormal	0x4	
	Failure: Overheat	0x5	
	Failure: Heating Wire Open circuit or short to Battery	0x6	
	Failure: Heating Wire Short to Ground	0x7	

1.7.9   MD-REQ-xxxx/A-PsngrDrHeatSfeFail

Message Type: Status

Heat Skin Psngr side door heat surface failure status

Name	Literals	Value	Description
PsngrDrHeatSfeFail	-	-	
	Normal	0x0	
	Failure: NTC Resistance drift	0x1	
	Failure: NTC Open Circuit or Short to Battery	0x2	
	Failure: NTC Short Circuit to Ground	0x3	
	Failure: NTC Temperature Abnormal	0x4	
	Failure: Overheat	0x5	
	Failure: Heating Wire Open circuit or short to Battery	0x6	
	Failure: Heating Wire Short to Ground	0x7	

1.7.10   MD-REQ-xxxx/A-DrvHdHeatFail

Message Type: Status

Driver Headrest Surface Heating Feedback Failure status

Name	Literals	Value	Description
DrvHdHeatFail	-	-	
	Normal	0x0	
	Failure: NTC Resistance drift	0x1	

		Failure: NTC Open Circuit or Short to Battery	0x2	
		Failure: NTC Short Circuit to Ground	0x3	
		Failure: NTC Temperature Abnormal	0x4	
		Failure: Overheat	0x5	
		Failure: Heating Wire Open circuit or short to Battery	0x6	
		Failure: Heating Wire Short to Ground	0x7	

1.7.11 MD-REQ-xxxx/A-PsngrHdHeatFail

Message Type: Status

Driver Headrest Surface Heating Feedback Failure status

Name	Literals	Value	Description
PsngrHdHeatFail	-	-	
	Normal	0x0	
	Failure: NTC Resistance drift	0x1	
	Failure: NTC Open Circuit or Short to Battery	0x2	
	Failure: NTC Short Circuit to Ground	0x3	
	Failure: NTC Temperature Abnormal	0x4	
	Failure: Overheat	0x5	
	Failure: Heating Wire Open circuit or short to Battery	0x6	
	Failure: Heating Wire Short to Ground	0x7	

1.7.12 MD-REQ-xxxx/A-ConArmHeatSfeFail

Message Type: Status

Console armrest Surface Heating Feedback Failure status

Name	Literals	Value	Description
ConArmHeatSfeFail	-	-	
	Normal	0x0	
	Failure: NTC Resistance drift	0x1	
	Failure: NTC Open Circuit or Short to Battery	0x2	

	Failure: NTC Short Circuit to Ground	0x3	
	Failure: NTC Temperature Abnormal	0x4	
	Failure: Overheat	0x5	
	Failure: Heating Wire Open circuit or short to Battery	0x6	
	Failure: Heating Wire Short to Ground	0x7	

1.7.13 MDREQ-xxxx/A- Ignition_Status

Message Type: Status

Vehicle Ignition_Status.

Name	Literals	Value	Description
Ignition_Status	-	-	
	Unknown	0x0	
	Off	0x1	
	Accessory	0x2	
	Run	0x3	
	Start	0x4	
	Invalid	0x5	

1.7.14 MD-REQ-xxxx/A- ElPw_D_Stat

Message Type: Status

Vehicle ElPw_D_Stat.

Name	Literals	Value	Description
ElPw_D_Stat	-	-	
	Not_Supported	0x0	
	Supported	0x1	
	Not_Supported_Imminent	0x2	
	LV_Event_In_Progress	0x3	
	Fault_Limited	0x4	
	NotUsed_1	0x5	
	NotUsed_2	0x6	
	NotUsed_3	0x7	

1.7.15 MD-REQ-xxxx/A- LHS_Temp_Display_Digit1/2

Message Type: Status

LHS_Temp_Display_Digit1/2

Name	Literals	Value	Description
LHS_Temp_Display_Digit1/2	-	-	ASCII

1.7.16 MD-REQ-xxxx/A- RHS_Temp_Display_Digit1/2

Message Type: Status

RHS_Temp_Display_Digit1/2

Name	Literals	Value	Description
RHS_Temp_Display_Digit1/2	-	-	ASCII

1.7.17 MD-REQ-xxxx/A- R/LHS_Temp_Display_Digit3

Message Type: Status

R/LHS_Temp_Display_Digit3

Name	Literals	Value	Description
R/LHS_Temp_Display_Digit3	-	-	
	OFF	0x0	
	_0	0x1	
	_5	0x2	

1.7.18 MD-REQ-xxxx/A- Outside_Air_Temp_Stat

Message Type: Status

Outside_Air_Temp_Stat

Name	Literals	Value	Description
Outside_Air_Temp_Stat	-	-	
	Unknown	0xFE	
	Invalid	0xFF	

1.7.19 MD-REQ-xxxx/A- PsngrFrntDetct_D_Actl

Message Type: Status

PsngrFrntDetct_D_Actl

Name	Literals	Value	Description
PsngrFrntDetct_D_Actl	-	-	
	Faulty	0x0	
	Occupied	0x1	
	Empty	0x2	
	Unknown	0x3	

1.7.20 MD-REQ-xxxx/A- Rr_Floor_Btn_Stt

Message Type: Status

Rr_Floor_Btn_Stt

Name	Literals	Value	Description
Rr_Floor_Btn_Stt	-	-	
	Enabled_Inactive	0x0	
	Active	0x1	

| | Disabled | 0x2 | |
| | Unused | 0x3 | |

1.7.21 MD-REQ-xxxx/A- Remote_Start_Status

Message Type: Status

Remote_Start_Status

Name	Literals	Value	Description
Remote_Start_Status	-	-	
	Null	0x0	
	Remote	0x1	
	Unknown	0x2	
	Invalid	0x3	

1.7.22 MD-REQ-xxxx/A- CabnAmb_Te_Actl

Message Type: Status

Cabin Temperature

Name	Literals	Value	Description
CabnAmb_Te_Actl	-	-	
	degC	-57 (0x0)~ 70 (0xFE)	

2 General Requirements

2.1 HS-GR-REQ-xxxx/A-Heat Skin Client Power Mode

Heat Skin setting menu shall be available on the HMI only when EIPw_D_Stat='Supported' and Ignition_Status='Run or Start'.

2.2 HS-GR-REQ-xxxx/A-Heat Skin Client Configuration

Heat Skin is a configurable function on infotainment system as below, if it is configurated to disable, all the HMI interface and functions will be not visible and available for the user.

Config Block	Byte	Start Bit	Length	Definition	Default	Operation
DE04	3	1	2	Heat Skin	0x2	0x0: Disable 0x1: Enable_exclude auto mode 0x2: Enable_include auto mode 0X3: Reserve
0XFE94			50bit/7Byte	HS_Auto Algorithm Table1_ Armrest & Door Panel	Refer Chapter 3.4.2	Refer Chapter 3.4.2
0XFE95			50bit/7Byte	HS_Auto Algorithm Table1_ Headrest	Refer Chapter 3.4.2	Refer Chapter 3.4.2
0XFE96			50bit/7Byte	HS_Auto Algorithm Table1_ Seat	Refer Chapter 3.4.2	Refer Chapter 3.4.2
0XFE97			50bit/7Byte	HS_Auto Algorithm Table2_ Armrest & Door Panel	Refer Chapter 3.4.2	Refer Chapter 3.4.2
0XFE98			50bit/7Byte	HS_Auto Algorithm Table2_ Headrest	Refer Chapter 3.4.2	Refer Chapter 3.4.2
0XFE99			50bit/7Byte	HS_Auto Algorithm Table2_ Seat	Refer Chapter 3.4.2	Refer Chapter 3.4.2
0XFEA0			100bit/13Byte	HS_Auto Algorithm Table3_Eco	Refer Chapter 3.4.2	Refer Chapter 3.4.2
0XFEA1			100bit/13Byte	HS_Auto Algorithm Table3_Cozy	Refer Chapter 3.4.2	Refer Chapter 3.4.2

Note.
If user configurate DE04 to 0x1, just enable customized mode and only customized interface will be shown without any icon of eco/cozy/customized.
All internal configurations will be not available after PP and it will be stored on SOC inside.

2.3 HS-GR-REQ-xxxx/A-Heat Skin Setting Menu Storage

IVI will memorize all heat shin setting after Ignition reset and will be switch default value after battery reset.
IVI will not memorize customed setting on auto mode. It will be switch to default value after Ignition reset.

Default mode is Eco.
Default heated level is OFF on customize mode.

2.4 HS-GR-REQ-xxxx/A-Heat Skin Remote Start

MCU should wake up and send last heated level signals as below to BHM only when receiving Remote_Start_Status= Remote&&(ClimtCool_D_Rq≠OpportunisticCoolingReq or ElCmpr_D_Stat≠Comp_On)

DrvDrHeatSfeLevCmd
ConArmHeatSfeLevCmd
DrvHdHeatSfeLevCmd
PsngrDrHeatSfeLevCmd
PsngrHdHeatSfeLevCmd

IVI should exit remote start HS status if Remote_Start_Status is missing.

2.5 HS-GR-REQ-xxxx/A-Heat Skin error handling

IVI will keep last status when heated level status signal is missing (it will be regard as missing when lost communication for 5 cycles).
Heat skin setting menu will be not available when missing ElPw_D_Stat or Ignition_Status signal.

2.6 HS-GR-REQ-xxxx/A-Heat Skin DTC Recording

IVI will record DTC if lose communication with BHM as below:
DTC 0x0x91D101/B11D1-01 - LIN Bus "C" General Electrical Failure

DTC Number	0x91D101/B11D1-01
Root Description	LIN Bus "C"
Failure Type Byte Description	General Electrical Failure
ECU Connector Pin	
Continuous Monitoring Supported	yes
Monitoring Cycle	Ignition in RUN
Test Run Criteria	1. Key in Run. 2. Voltage is between 10 and 16 volts. 3. DE04-byte3-bit5-4=1（Project H enable） Test is run if 1, 2, and 3 are true.
Test Period	Once every 100ms
Fault Detection Counter Increment Value	127
Fault Detection Counter Decrement Value	255
Pass / Fail Criteria	set when missing LIN signals for greater than five (5) seconds.
Action Taken by ECU in Response To Fault	Report the fault.
Fault Symptom Recognized by Vehicle Occupants	Heated Surfaces will not work
Extended Data Record used for Aging Counter	0x02
Counter Value when Aged	80
Special Considerations	DE04-byte3-bit5-4=1（Project H enable）
Extended Data Records Supported	0x02,0x10
Reported via Control Routines	

2.7 HS-GR-REQ-xxxx/A-Heat Skin Engineering Mode

Below internal parameters should be printed on engineering mode, and it should be updated per second

Armrest & Door Panel_X1/X2/X
Headrest_X1/X2/X
Seat_ X1/X2/X
Climate_L_temp_decline_ Y1
Climate_R_temp_decline_ Y1
Display failure mode if any surface is failed.
For example:
If DrvDrHeatSfeFail $\neq$ 0, display "DrvDrHeatSfeFail=X" on engineering mode.

2.8 HS-GR-REQ-xxxx/A-Heat Skin Android Log Requirement

Below failure signal value should be print in android Log and should be updated per second.
DrvDrHeatSfeFail
PsngrDrHeatSfeFail
DrvHdHeatFail
PsngrHdHeatFail
ConArmHeatSfeFail

2.9 HS-SR-REQ-XXXX/A-Heat Skin Setting change

Heat Skin Client will just send 3 frames Heated level Cmd_LIN signals to Heat Skin Server when user select heated level, Heat Skin Server should continuously send Heated level Sts_LIN signals to Heat Skin Client.

The Heat Skin Server shall respond within T_Heatskin_Rsp.

2.10 HS-SR-REQ-XXXX/A- T_Heatskin_Rsp

Name	Description	Units	Range	Resolution	Default
T_Heatskin_Rsp	Maximum time the Heat Skin Setting Server shall take to respond to the Heat Skin Setting Client. Maximum time defined as the default value	msec	0-1000	10	200

3 Functional Definition

3.1 HS-FUN-REQ-XXXX/A-Enter/Exit the Heat Skin setting interface

3.1.1 Use Cases

3.1.1.1 Users click on the icon to enter the heat skin setting interface

Actors	User
Pre-conditions	ElPw_D_Stat=='Supported' and Ignition_Status=='Run' Infotainment System is On Heat Skin Server is not on Failure mode
Scenario Description	Users enter heat skin function setting interface via click on or left slide the icon in setting menu HMI.
Post-conditions	heat skin setting interface will be open display based on the status of every heat surface
List of Exception Use Cases	
Interfaces	CAN, HMI, LIN

3.1.1.2 Users click on the icon to exit the heat skin setting interface

Actors	User
Pre-conditions	ElPw_D_Stat=='Supported' and Ignition_Status=='Run' Infotainment System is On Heat Skin Server is not on Failure mode
Scenario Description	Users exit heat skin function setting interface via click on or right slide the icon in setting menu HMI.
Post-conditions	heat skin setting interface will be exit icon status display based on the status of heat skin function enable/disable
List of Exception Use Cases	
Interfaces	CAN, HMI, LIN

3.2 HS-FUN-REQ-XXXX/A-Heat Skin function Turn On/Off

3.2.1 Use Cases

3.2.1.1 HS-UC-REQ-376836/A-Users click on the icon to turn on the Heat Skin

Actors	User
Pre-conditions	ElPw_D_Stat=='Supported' and Ignition_Status=='Run' Infotainment System is On Heat Skin Server is not on Failure mode
Scenario Description	Users turn on heat skin function via below ways: 1. click ON/OFF icon. 2. click Eco/Cozy/Customize icon. 3. touch any surface to adjust heated level (include auto and vent).
Post-conditions	heat skin function will be turned on to below corresponding scenarios

	1. Switch to Eco (if it is first time for user to turn on this function), otherwise switch to memorized last status. 2. Switch to Eco/Cozy/Customize mode (default level is OFF on Customize mode). 3. Switch to Customize mode (touched surface could switch to corresponding heated level (include auto and vent). Others will switch to default level)
List of Exception Use Cases	
Interfaces	CAN, HMI, LIN

3.2.1.2   HS-UC-REQ-376836/A-Users click on the icon to turn off the Heat Skin

Actors	User
Pre-conditions	ElPw_D_Stat=='Supported' and Ignition_Status=='Run' Infotainment System is On Heat Skin Server is not on Failure mode
Scenario Description	Users turn off heat skin function via click on the icon in setting menu HMI.
Post-conditions	Heat skin function will be turned off, meanwhile IVI will memorize all setting status. (Seat Auto and vent mode also could be turned off.)
List of Exception Use Cases	
Interfaces	CAN, HMI, LIN

3.2.2   Sequence Diagrams

3.2.2.1   HS-SD-REQ-XXXX/A- Heat Skin Turn On

sd [Interaction] 3-Technology Level[3-Technology Level]

User   **Heat Skin Client**   **Heat Skin Server**

1: Pre_Condition:
DrvDrHeatSfeFail/DrvHdHeatFail/
ConArmHeatSfeFail=Normal

2: User Input

3: Heat Skin Turn On

4: DrvDrHeatSfeLevCmd=low/mid/high
ConArmHeatSfeLevCmd=low/mid/high
DrvHdHeatSfeLevCmd=low/mid/high
(IVI just send 3 frame heated level Cmd_LIN
signals then back to no_request)
Frt_Btn_Status_1st=Htg_Strg_Whl_Pressed
Frt_Btn_Status_1st=LHS_Htd_SeatX_Pressed

5: Receiving Signals:
DrvDrHeatSfeLevSts=low/mid/high
ConArmHeatSfeLevSts=low/mid/high
DrvHdHeatSfeLevSts=low/mid/high
(BHM should continuously send
heated level Sts_LIN Signals to IVI).
Htd_Strg_Whl_Btn_Stt=Active
DrvHdHeatSfeLevSts=Level_X_Heating

6: Feedback to User

3.2.2.2 HS-SD-REQ-XXXX/A- Heat Skin Turn Off
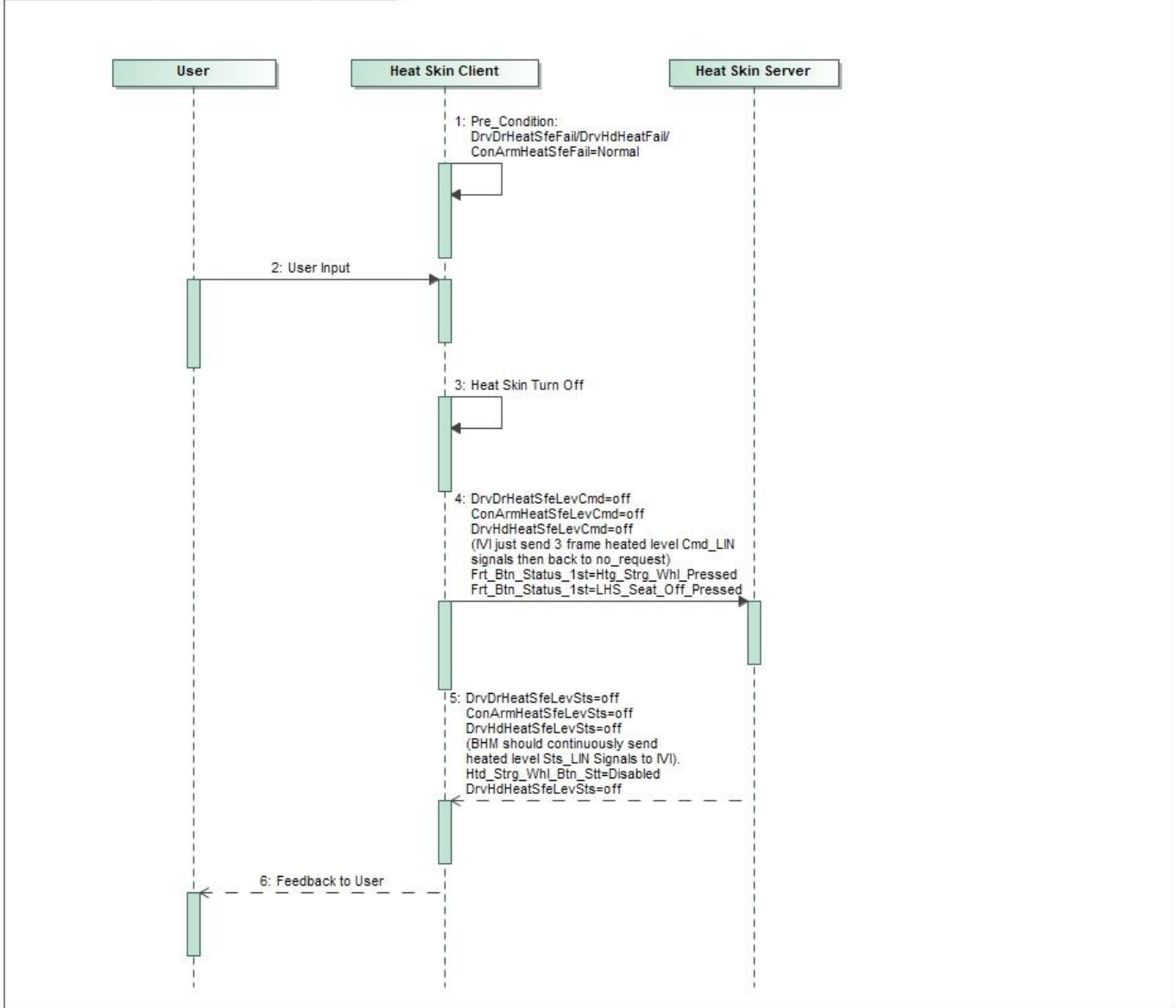
3.3   HS-FUN-REQ-XXXX/A-Heat Skin Customized Mode

3.3.1   Use Cases

3.3.1.1   *HS-UC-REQ-XXXX/A- Select Customize Heat level*

Actors	User
Pre-conditions	Infotainment System is On. ElPw_D_Stat=='Supported' and Ignition_Status=='Run'. Heat Skin Server is not on Failure mode. Heat Skin has been Turn ON. Heat Skin is on auto mode.
Scenario Description	User touch customized mode icon. User touch any surfaces.
Post-conditions	1. Switch to customized mode based on last memorized settings.

	2. Touched surface could switch to corresponding heated level. Others will switch to default level.
List of Exception Use Cases	
Interfaces	CAN, HMI, LIN

3.3.1.2 HS-UC-REQ-XXXX/A-Exit Customized Mode

Actors	User
Pre-conditions	Infotainment System is On. ElPw_D_Stat=='Supported' and Ignition_Status=='Run'. Heat Skin Server is not on Failure mode. Heat Skin has been Turn ON. Heat Skin is customized mode.
Scenario Description	Users selected auto mode (Eco/Cozy).
Post-conditions	IVI will memorize customized setting status and switch to auto mode.
List of Exception Use Cases	
Interfaces	CAN, HMI, LIN

3.3.2 Requirements

3.3.2.1 HS-SR-REQ-XXXX/A-Heat Skin Setting storage

Heated Skin setting will be memorized in customized mode when User switch to auto mode or turn off.

3.3.3 Sequence Diagrams

3.3.3.1.1 HS-SD-REQ-XXXX/A- Select Customize Heated Level

sd [Interaction] 3-Technology Level [3-Technology Level]

```
User            Heat Skin Client            Heat Skin Server

                1: Pre_Condition:
                DrvDrHeatSfeFail/DrvHdHeatFail/
                ConArmHeatSfeFail=Normal

      2: User Input

                3: Customized Heat Level

                4: DrvDrHeatSfeLevCmd=off/low/mid/high OR
                ConArmHeatSfeLevCmd=off/ow/mid/high OR
                DrvHdHeatSfeLevCmd=Off/low/mid/high OR
                (IVI just send 3 frame heated level Cmd_LIN
                signals then back to no_request)
                Frt_Btn_Status_1st=Htg_Strg_Whl_Pressed OR
                Frt_Btn_Status_1st=LHS_Htd_SeatX_Pressed

                5: DrvDrHeatSfeLevSts=off/low/mid/high OR
                ConArmHeatSfeLevSts=off/low/mid/high OR
                DrvHdHeatSfeLevSts=off/low/mid/high OR
                (BHM should continuously send
                heated level Sts_LIN Signals to IVI).
                Htd_Strg_Whl_Btn_Stt=disable OR
                DrvHdHeatSfeLevSts=Level_X_Heating/off

      6: Feedback to User
```

3.4 HS-FUN-REQ-XXXX/A-Heat Skin Auto Mode

3.4.1 Use Cases

3.4.1.1 HS-UC-REQ-XXXX/A-Entry Auto Mode

Actors	User
Pre-conditions	Infotainment System is On EIPw_D_Stat=='Supported' and Ignition_Status=='Run' Heat Skin Server is not on Failure mode Heat Skin is in Manual Mode or Custom Mode
Scenario Description	Users click auto icon switch to auto mode.
Post-conditions	Switch auto mode (Eco/Cozy) It will Toast to Infor driver when outside temperature is too high to enable heat surface function
List of Exception Use Cases	
Interfaces	CAN, HMI, LIN

3.4.1.2 HS-UC-REQ-XXXX/A- Exit Auto Mode

Actors	User
Pre-conditions	Infotainment System is On EIPw_D_Stat=='Supported' and Ignition_Status=='Run' Heat Skin Server is not on Failure mode Heat Skin is in Auto mode
Scenario Description	Users click icon switch to customized mode or turn off
Post-conditions	Switch to customize mode or turn off.
List of Exception Use Cases	
Interfaces	CAN, HMI, LIN

3.4.1.3 HS-UC-REQ-XXXX/A- User Set Heated Level on Auto Mode

Actors	User
Pre-conditions	Infotainment System is On EIPw_D_Stat=='Supported' and Ignition_Status=='Run' Heat Skin Server is not on Failure mode Heat Skin is in Auto mode
Scenario Description	User could set any skins heated level on auto mode.
Post-conditions	Selected surface will temporary keep current heated level (it will be overwritten if use switch to another mode or turn off or ignition reset), others will be still on auto mode.
List of Exception Use Cases	

Interfaces	CAN, HMI, LIN

3.4.2   Requirements

3.4.2.1   HS-SR-REQ-XXXX/A-Heat Skin Signals missing handling

If any below signal is missing, auto algorithm will utilize last value to calculate continuously.
LHS_Temp_Display_Digit1/2
RHS_Temp_Display_Digit1/2
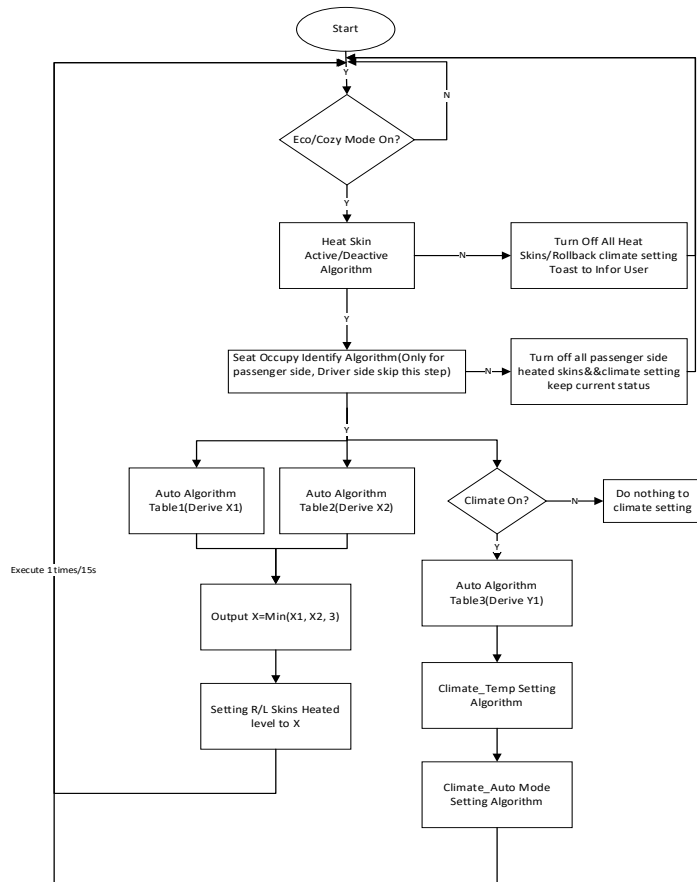R/LHS_Temp_Display_Digit3
Outside_Air_Temp_Stat
CabnAmb_Te_Actl

If it has already missed before battery reset or ignition reset, all surfaces will be turned off if it is on auto mode.
It will be recovered immediately when all missing signals are received.

3.4.3   Auto Mode Algorithm Flow Chart

Heat Skin Auto Mode Algorithm For Both Driver And Passenger(R/L)

Heat Skin Auto Mode Algorithm flowchart:
Start → Eco/Cozy Mode On? → (N) loops back; (Y) → Heat Skin Active/Deactive Algorithm → (N) Turn Off All Heat Skins/Rollback climate setting Toast to Infor User; (Y) → Seat Occupy Identify Algorithm(Only for passenger side, Driver side skip this step) → (N) Turn off all passenger side heated skins&&climate setting keep current status; (Y) → Auto Algorithm Table1(Derive X1), Auto Algorithm Table2(Derive X2) → Output X=Min(X1, X2, 3) → Setting R/L Skins Heated level to X

Climate On? → (N) Do nothing to climate setting; (Y) → Auto Algorithm Table3(Derive Y1) → Climate_Temp Setting Algorithm → Climate_Auto Mode Setting Algorithm

Execute 1 times/15s

Climate_Temp Setting Algorithm

Derive Y1 → Drv/Psngr_Set_Temp=Drv_Set_Temp-Y1 → Drv/Psngr_Set_Temp → RCCM
Drv/Psngr_Set_Temp

LHS_Temp_Display_Digit1/2/3=LHS_Temp_Display_Digit1/2/3+Y1
L/RHS_Temp_Display_Digit1/2/3 ← ← L/RHS_Temp_Display_Digit1/2/3

Seat Occupy Identify Algorithm(Only for passenger side, Driver side skip this step)

Start → Seat has been Occupied → PsngrFrntDetct_D_Actl is equal to Empty OR missing for 30s → Seat is vacant → End
PsngrFrntDetct_D_Actl is equal to Occupied for 2s

Heat Skin Active/Deactive Algorithm

Start → Active Heat Skin Function → if Outside_Air_Temp_stat More than 10°C → Deactive Heat Skin Function → End
if Outside_Air_Temp_stat Less than 9°C

Climate_Auto Mode Setting Algorithm

Start → Keep on ECO or Cozy Mode? → (N) Set Climate_Auto Mode Setting flag==0; (Y) → Climate_Auto Mode Setting flag==1? → (Y) End; (N) → Step1:Set to AUTO(Level 2), Step2:Set Vent to Floor, Step3:Set Climate_Auto Mode Setting flag=1 → End

Auto Algorithm Table1(Derive X1)

Group 1 — Armrest & Door Panel

Set temp(Climate) / Outside_Air_Temp_Stat	ST < 18	20 > ST > 18	22 > ST > 20	24 > ST > 22	ST > 24
OAT< - 18	1	2	2	3	3
- 10>OAT> - 18	1	1	2	2	3
- 1>OAT> - 10	1	1	1	2	2
5>OAT>-1	1	1	1	1	2
10>OAT>5	1	1	1	1	1

Group 2 — Headrest

Set temp(Climate) / Outside_Air_Temp_Stat	ST < 18	20 > ST > 18	22 > ST > 20	24 > ST > 22	ST > 24
OAT< - 18	1	1	2	2	2
- 10>OAT> - 18	1	1	1	2	2
- 1>OAT> - 10	1	1	1	1	2
5>OAT>-1	1	1	1	1	1
10>OAT>5	1	1	1	1	1

Group 3 — Seat

Set temp(Climate) / Outside_Air_Temp_Stat	ST < 18	20 > ST > 18	22 > ST > 20	24 > ST > 22	ST > 24
OAT< - 18	1	1	1	1	2
- 10>OAT> - 18	1	1	1	1	2
- 1>OAT> - 10	0	1	1	1	1
5>OAT>-1	0	0	1	1	1
10>OAT>5	0	0	0	1	1

Note.
Tolerance for X axis is 1;
Tolerance for Y axis is 1;
For example:
Current OAT is -9, it will jump into another level until OAT decreases to -11 or increases to 0.

Auto Algorithm Table1(Derive X2)

Group 1 — Armrest & Door Panel

Delta(LHS/RHS_Temp_Display_Digit1/2/3-CabnAmb_Te_Actl) / Outside_Air_Temp_Stat	Delta < 0	2 > Delta > 0	5 > Delta > 2	10 > Delta > 5	15 > Delta > 10	Delta > 15
OAT< - 18	0	1	1	1	2	2
- 10>OAT> - 18	0	0	1	1	1	2
- 1>OAT> - 10	0	0	0	1	1	2
5>OAT>-1	0	0	0	0	1	1
10>OAT>5	0	0	0	0	1	1

Group 2 — Headrest

Delta(LHS/RHS_Temp_Display_Digit1/2/3-CabnAmb_Te_Actl) / Outside_Air_Temp_Stat	Delta < 0	2 > Delta > 0	5 > Delta > 2	10 > Delta > 5	15 > Delta > 10	Delta > 15
OAT< - 18	0	1	1	2	2	2
- 10>OAT> - 18	0	0	1	1	2	2
- 1>OAT> - 10	0	0	0	1	2	2
5>OAT>-1	0	0	0	1	1	2
10>OAT>5	0	0	0	0	1	1

Group 3 — Seat

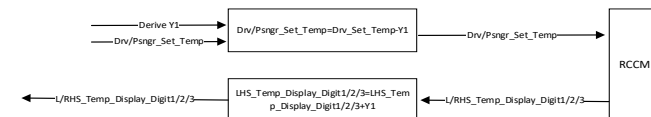| Delta(LHS/RHS_Temp_Display_Digit1/2/3-CabnAmb_Te_Actl) / Outside_Air_Temp_Stat	Delta < 0	2 > Delta > 0	5 > Delta > 2	10 > Delta > 5	15 > Delta > 10	Delta > 15
OAT< - 18	0	1	1	2	2	2
- 10>OAT> - 18	0	0	1	1	2	2
- 1>OAT> - 10	0	0	0	1	2	2
5>OAT>-1	0	0	0	0	1	1
10>OAT>5	0	0	0	0	1	1

Note.
Tolerance for X axis is 1;
Tolerance for Y axis is 1;
For example:
Current OAT is -9, it will jump into another level until OAT decreases to -11 or increases to 0.
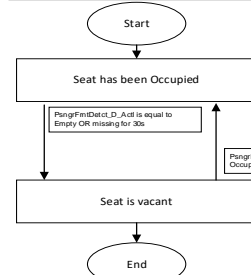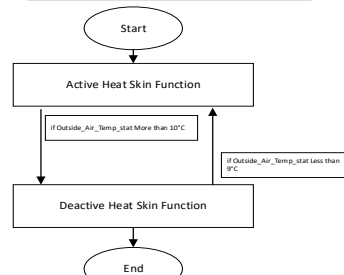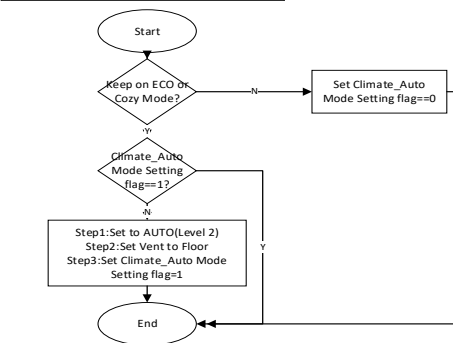
Auto Algorithm Table3(Derive Y1)

Eco

Set temp(Climate) / Outside_Air_Temp_Stat	ST < 18	20 > ST > 18	22 > ST > 20	24 > ST > 22	ST > 24
OAT< - 18	2.5	4	5	5	5
- 10>OAT> - 18	2.5	4	4	5	5
- 1>OAT> - 10	2.5	4	4	4	5
5>OAT>-1	2.5	4	4	4	4
10>OAT>5	2.5	4	4	4	4

Cozy

Set temp(Climate) / Outside_Air_Temp_Stat	ST < 18	20 > ST > 18	22 > ST > 20	24 > ST > 22	ST > 24
OAT< - 18	2.5	3	4	4	4
- 10>OAT> - 18	2.5	3	4	4	4
- 1>OAT> - 10	2.5	3	3	4	4
5>OAT>-1	2	3	3	3	4
10>OAT>5	2	3	3	3	3

Note.
Tolerance for X axis is 1;
Tolerance for Y axis is 1;
For example:
Current OAT is -9, it will jump into another level until OAT decreases to -11 or increases to 0.

Note:
1. if climate is not activated, using 22°c as default value to calculate on Auto Algorithm Table1(Derive X1) and Auto Algorithm Table1(Derive X2).
2. climate temperature setting display value will not be changed by auto mode, it will only change on background.
3. above table should be configurable for calibration.
4. auto mode algorithm will be applicable for all heated surface including steering wheel.
5. if Outside_Air_Temp_stat less than 9°C, there will be a toast only when user stay on or enter to heat skin interface, toast will just one time in a ignition cycle.

3.5 HS-FUN-REQ-XXXX/A-Heat Skin Failure Mode

3.5.1 Use Cases

3.5.1.1 HS-UC-REQ-xxxx/A- Trigger Failure Mode

Actors	User
Pre-conditions	Infotainment System is On ElPw_D_Stat=='Supported' and Ignition_Status=='Run' Heat Skin in auto mode or customized mode
Scenario Description	Heat Skin Server feedback failure mode via LIN
Post-conditions	1. If user stay on heat skin interface. Just use icon to show failed surface and there will be a toast to notify driver if user click failed icon. 2. If user does not stay on heat skin interface. There will a Pop-up to notify user
List of Exception Use Cases	
Interfaces	CAN, HMI, LIN

3.5.1.2 HS-UC-REQ-xxxx/A- Recover from Failure Mode

Actors	User
Pre-conditions	Infotainment System is On ElPw_D_Stat=='Supported' and Ignition_Status=='Run' All Failure status signal recover from failure mode.
Scenario Description	Heat Skin Server recover from failure mode.
Post-conditions	Pop-up and failure icon will disappear. Failed surfaces will recover.
List of Exception Use Cases	
Interfaces	CAN, HMI, LIN

3.5.2 Requirements

It will be regard as failure mode until IVI receive Failure mode signal for 5 cycles, IVI will recover immediately once receiving normal signal or missing.
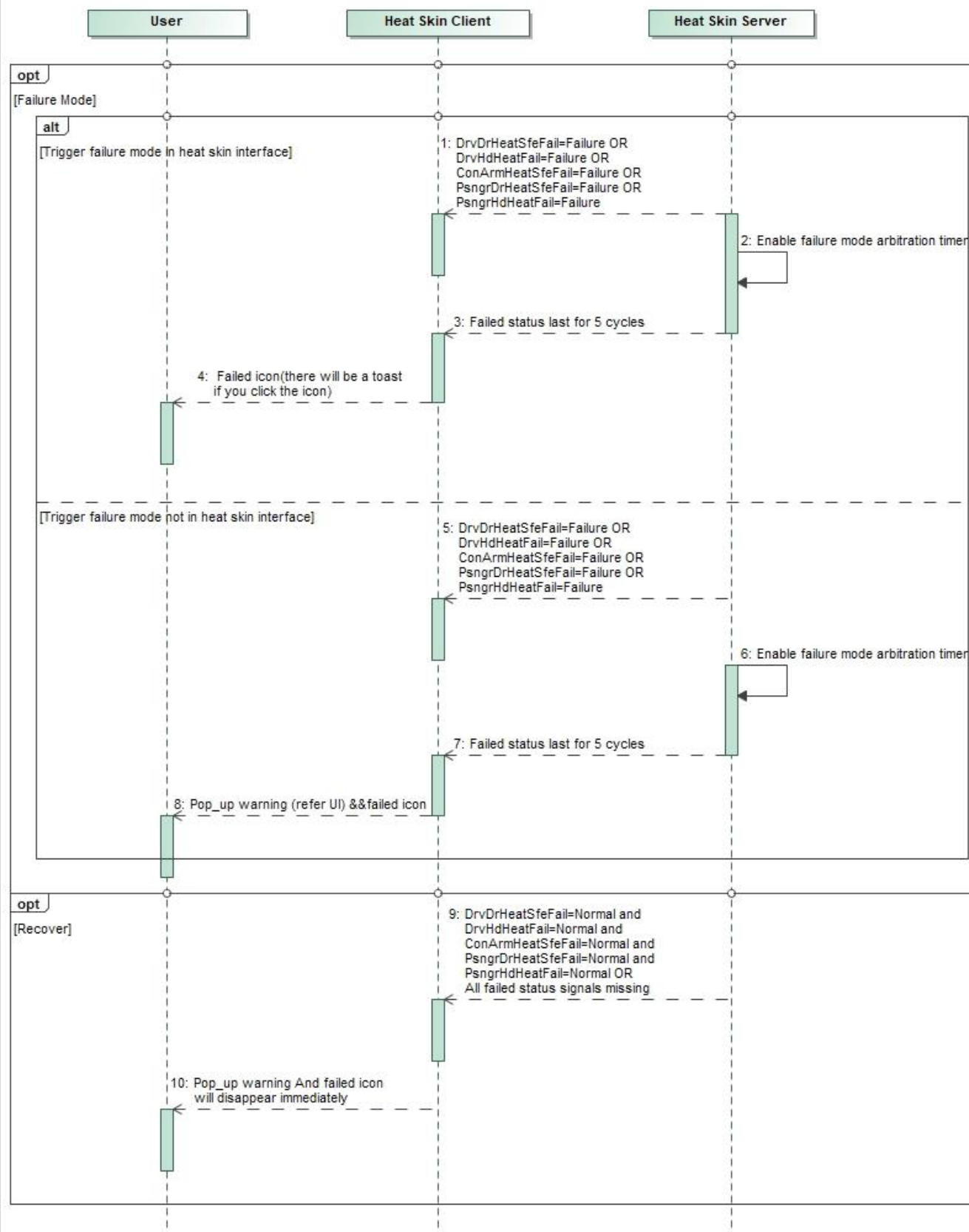
Pop-up will should be only one time on single ignition cycle.

Failure mode LIN signals need to continuously feedback to IVI.

3.5.2.1 Sequence Diagrams

sd [Interaction] 3-Technology Level [3-Technology Level]

```
                User            Heat Skin Client          Heat Skin Server

opt
[Failure Mode]

  alt
  [Trigger failure mode in heat skin interface]
                                   1: DrvDrHeatSfeFail=Failure OR
                                      DrvHdHeatFail=Failure OR
                                      ConArmHeatSfeFail=Failure OR
                                      PsngrDrHeatSfeFail=Failure OR
                                      PsngrHdHeatFail=Failure
                                                                2: Enable failure mode arbitration timer

                                   3: Failed status last for 5 cycles

                      4:  Failed icon(there will be a toast
                          if you click the icon)


  [Trigger failure mode not in heat skin interface]
                                   5: DrvDrHeatSfeFail=Failure OR
                                      DrvHdHeatFail=Failure OR
                                      ConArmHeatSfeFail=Failure OR
                                      PsngrDrHeatSfeFail=Failure OR
                                      PsngrHdHeatFail=Failure

                                                                6: Enable failure mode arbitration timer

                                   7: Failed status last for 5 cycles

                      8: Pop_up warning (refer UI) &&failed icon


opt
[Recover]
                                   9: DrvDrHeatSfeFail=Normal and
                                      DrvHdHeatFail=Normal and
                                      ConArmHeatSfeFail=Normal and
                                      PsngrDrHeatSfeFail=Normal and
                                      PsngrHdHeatFail=Normal OR
                                      All failed status signals missing

                      10: Pop_up warning And failed icon
                          will disappear immediately
```

3.6 HS-FUN-REQ-XXXX/A-Heat Skin Voice Command

3.6.1 Requirements

IVI should not send heated level command to BHM if current surface is on failure mode.
Heat Skin could support voice command, pls refer VR spec for details.

4 Appendix: Reference Documents

Reference #	Document Title
1	Heat Skin Auto Mode Algorithm v1.0
2	UE_Project H_v1.7.1_20230324/UI_Project H_v1.5.2_20230324
3	
4	
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