1 Outside Air Temperature Function – CGEA1.3

1.1 Functional Description

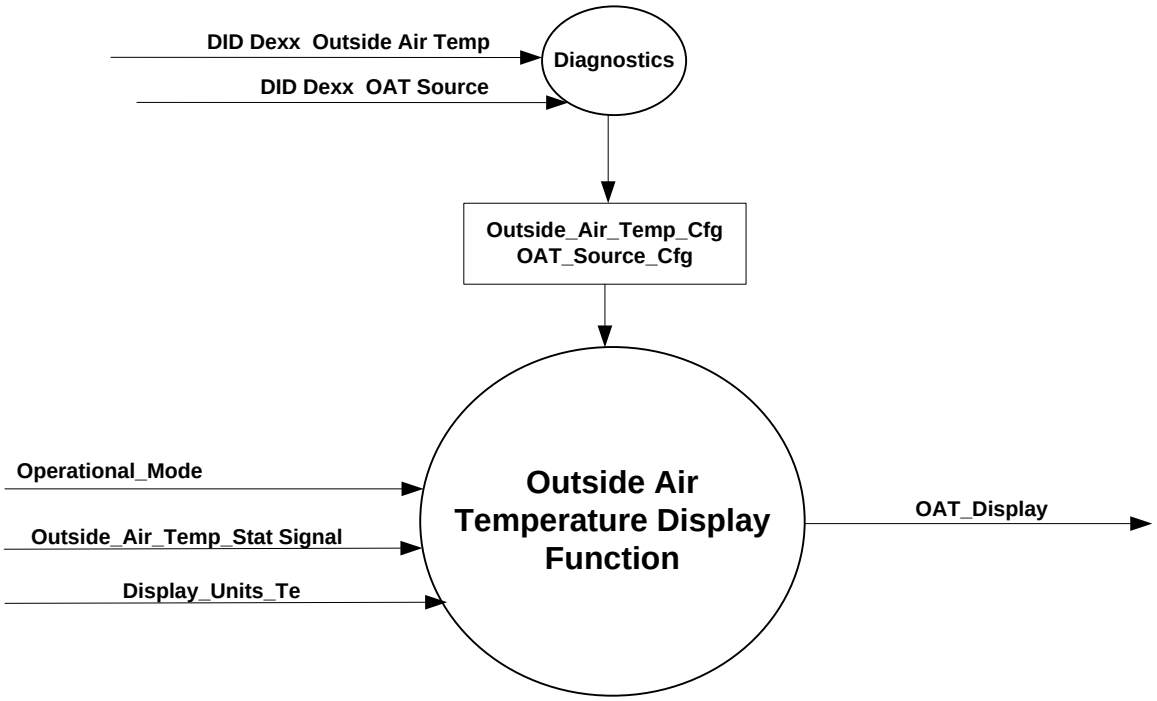
The Outside Air Temperature (OAT) display allows the driver to see the outside air temperature in the HUD.

The OAT correlates the Outside_Air_Temp_Stat signal from the HVAC module and the Operational_Mode to display the temperature to the driver.

1.2 Interfaces

1.2.1 Interface Context Diagram (I/O Block Diagram)

Outside Air Temperature Display Function Context Diagram



1.2.2 Inputs

1.2.2.1 IR-REQ-302275/A-INTERNAL:

- Operational_Mode
- Display_Units_Te

1.2.2.2 MUX messages

1.2.2.2.1 SIG-REQ-302271/A-Outside_Air_Temp_Stat Signal

Signal Name	Size (bits)	Detail	Units	Res.	Offset	State Encoded	Min.	Max.
Outside_Air_Temp_Stat	8		Degrees C	0.5	-40		-40 (0x0)	86.5 (0xFD)
		Unknown				0xFE		
		Invalid				0xFF		

1.2.3 IR-REQ-302283/A-Outputs

- OAT_Display, the OAT value for display.

1.3 Function/Performance

1.3.1 F-REQ-302280/A-Operational Modes

Mode	Differentiating Vehicle Conditions
Sleep Mode	OAT OFF
Limited Mode	OAT OFF
Normal Mode	OAT ON/OFF
Crank Mode	OAT ON/OFF

1.3.2 Voltage Levels

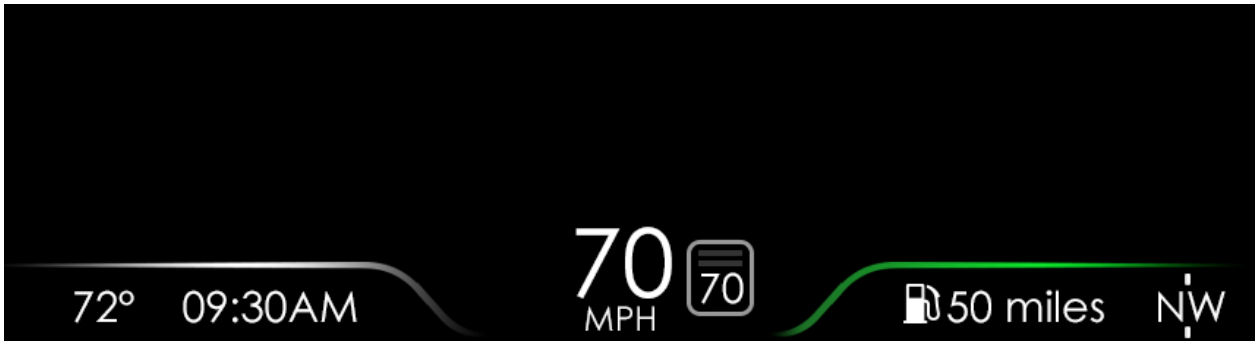
Refer to the HUD Features table located in the Operational Modes and Voltage Range Strategy Section in this SPSS.

1.3.3 Human-Machine Interface

1.3.3.1 Visual

1.3.3.1.1 HMI-REQ-302272/A-Indicator Graphics / Display Format

Refer to Graphics Section in the Master Document Section in this SPSS. Example shown below.



1.3.3.1.2 Indicator Color Coordinates

None

1.3.3.1.3 Indicator Characteristics

None

1.3.3.2 Audio

None.

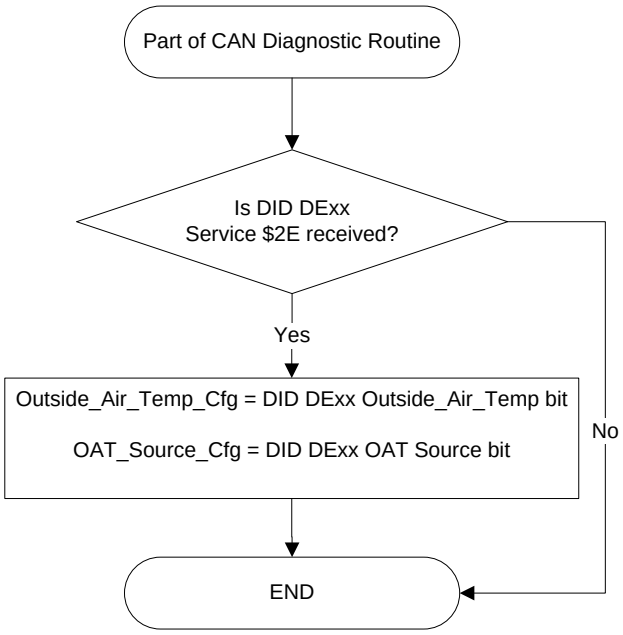
1.3.4 PFM-REQ-302284/A-System Accuracy

The OAT_Display shall change within 100msec of a change as indicated in the state matrix reference 1.3.5.1 Subsystem Algorithm Flowchart/ State Diagram.

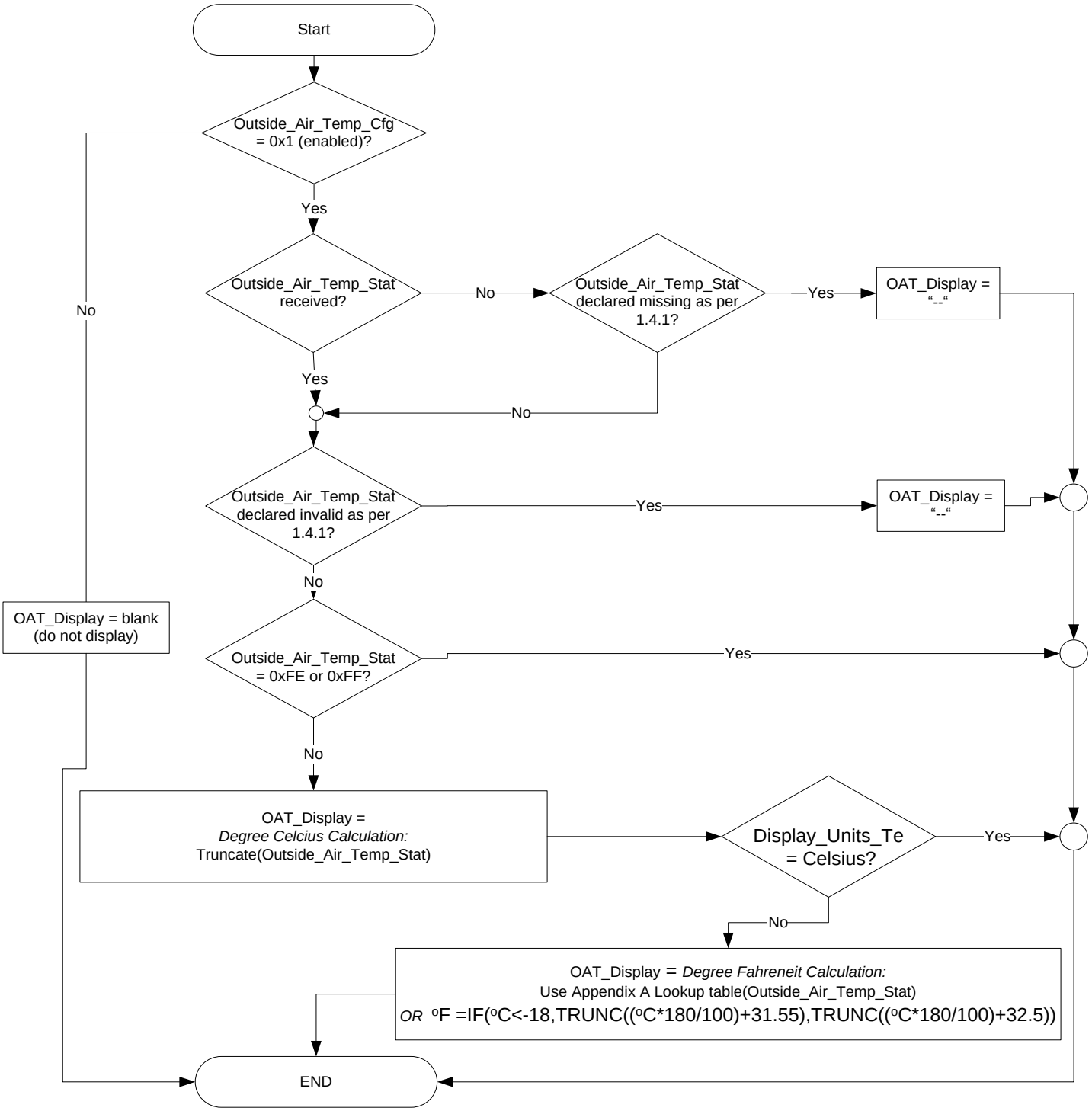
1.3.5 Operation: Performance and Functional

1.3.5.1 Subsystem Algorithm Flowchart / State Diagram

1.3.5.1.1 F-REQ-302273/A-CAN routine



1.3.5.1.2 F-REQ-302274/A-OAT_Display routine


Start
Outside_Air_Temp_Cfg = 0x1 (enabled)?
No
Yes
Outside_Air_Temp_Stat received?
No
Outside_Air_Temp_Stat declared missing as per 1.4.1?
Yes
OAT_Display = "--"
Yes
No
Outside_Air_Temp_Stat declared invalid as per 1.4.1?
Yes
OAT_Display = "--"
No
OAT_Display = blank (do not display)
Outside_Air_Temp_Stat = 0xFE or 0xFF?
Yes
No
OAT_Display = Degree Celcius Calculation: Truncate(Outside_Air_Temp_Stat)
Display_Units_Te = Celsius?
Yes
No
OAT_Display = Degree Fahreneit Calculation:
Use Appendix A Lookup table(Outside_Air_Temp_Stat)
OR °F =IF(°C<-18,TRUNC((°C*180/100)+31.55),TRUNC((°C*180/100)+32.5))
END

1.3.5.2 Operation Description (supports algorithm flowchart /state diagram)

1.3.5.2.1 F-REQ-302423/A-OAT Display

- The OAT display value shall always be displayed in whole degrees only. When data is received via the CAN signal in 0.5°C increments and the value is to be displayed in °C units, the 0.5° portion shall be ignored/dropped.

1.3.5.2.2 F-REQ-302426/A-Temperature Unit

- If the temperature unit is set to Fahrenheit, the OAT_MC value shall be displayed by converting the CAN signal to °F per Appendix A or from the following equation, where °C has not yet been truncated:

°F =IF(°C<-18,TRUNC((°C*180/100)+31.55),TRUNC((°C*180/100)+32.5

1.3.5.2.3 F-REQ-302427/A-OAT Display

- The value for OAT_Display will follow the Outside_Air_Temp_Stat. When the value is 0xFE (unknown) or 0xFF (invalid) for greater than 5s, the display will show "- - - " (Dashes).

1.3.5.3 FS-REQ-302430/A;1-Function Safety Classification (EMC)

Class B

1.3.5.4 NVM-REQ-302277/A-Memory Storage

Parameter Name	Description	Value at Battery Connect	Value at Module Wake-up
OAT_Display	Used to control the state of the Outside Temperature Display. Can be numbers from -40 to 86, "--", or blank (no display)	Blank	Blank
Outside_Air_Temp_Stat signal	CAN signal sent from the BCM	Unknown (0xFE)	Unknown (0xFE)
Outside_Air_Temp_Cfg	Indicator of feature presence controlled via CAN at EOL at VO plant.	Use Stored Value	Use Stored Value
Operational_Mode	4 state indicator for HUD operational mode	Limited	Limited, Normal or Crank

1.3.5.5 Prove Out

No

1.3.5.6 Reconfigurable Telltale

No

1.3.5.7 Message Center Msg

None

1.4 Error Handling

1.4.1 SR-REQ-302281/A-Missing Message Strategy

The signals will be declared missing as per the Diagnostics section of this SPSS.

DTCs states and history will be determined as per the Diagnostics section of this SPSS.

If Outside_Air_Temp_Cfg = Disabled, the HUD shall never log a missing message DTC due to this feature.

1.4.2 SR-REQ-302282/A-Invalid Message Strategy

The signal will be declared invalid as per the Diagnostics section of this SPSS.

DTCs states and history will be determined as per the Diagnostics section of this SPSS.

If Outside_Air_Temp_Cfg = Disabled, the HUD shall never log a missing message DTC due to this feature.

1.5 Diagnostics

1.5.1 Self Test

None

1.5.2 Engineering Test Mode

Reference section “Dealer / Engineering Test Mode (ETM)”.

1.5.3 Part II Performance

1.5.3.1 Supported Diagnostic Trouble Codes (DTCs)

1.5.3.1.1 DTC-REQ-302431/A-DCT C14000

DTC	Description
C14000	Lost communication with BCM

1.5.3.1.2 DTC-REQ-302432/A-DTCs C42482, C42481, 42400

If vehicle equipped with stand alone HVAC thus OAT_Source_Cfg = 0 (HVAC):

DTC	Description
C42482*	Invalid Data Received from HVAC Control Module – Alive / Sequence Counter Incorrect / Not Updated
C42481	Invalid Data Received from HVAC Control Module – Invalid Serial Data Received

C42400	Invalid Data Received from HVAC Control Module

*C42482 applies only when the missed signal has an associated _UB signal. Currently, CGEA 1.3 vehicles use Outside_Air_Temp_Stat_UB, and CGEA 1.3LC (Low Content) vehicles do not.

1.5.3.1.3 DTC-REQ-302434/A-DTC C55782, C55781

If vehicle equipped with HVAC integrated into FCIM thus OAT_Source_Cfg = 1 (FCIM):

DTC	Description
C55782*	Invalid Data Received from FCIM Control Module – Alive / Sequence Counter Incorrect / Not Updated
C55781	Invalid Data Received from FCIM Control Module – Invalid Serial Data Received
C55700	Invalid Data Received from FCIM Control Module

*C57782 applies only when the missed signal has an associated _UB signal. Currently, CGEA 1.3 vehicles use Outside_Air_Temp_Stat_UB, and CGEA 1.3LC (Low Content) vehicles do not.

1.5.3.2 DCR-REQ-302279/A-Supported Configuration DIDs

DID DExx

Size (bits)	State: Description	"0"	"1"	Default	Comments/ Information
1	Outside Air Temp	Disabled	Enabled	Disabled	When Enabled, the HUD displays OAT
1	OAT Source	HVAC	FCIM	FCIM	0 if vehicle has a stand-alone HVAC unit 1 if vehicle has an integrated HVAC in the FCIM
Note: Byte and bit location to be identified in Part II Specification for this HUD					

1.6 Reference Specification

IPC Outside Air Temp Function - CGEA1.3_v4.0
IS-0001 WARNINGS/INDICATORS/DISPLAYS PROVEOUT
IS-0046 INSTRUMENTATION MATERIAL RESISTANCE TO CLEANING
IS-0052 OPERATING VOLTAGES - FUNCTIONAL/PERFORMANCE
IS-0069 FUNCTIONAL IMPORTANCE CLASS
IS-0324 WINDSHIELD & OTHER REFLECTIONS
IS-0327 WARNING INDICATOR EVALUATION
IS-0329 FLICKERING OF LAMPS
IS-0379 NORTH AMERICAN WARNINGS AND INDICATORS STRATEGY

IL-0017 TELLTALE AND INTERIOR ILLUMINATION COLOR
IL-0021 CRAFTSMANSHIP - DISPLAYS
IL-0023 CLARITY/LEGIBILITY/READABILITY
IL-0025 INTERIOR ILLUMINATION INTENSITY
IL -0027 VISUAL CONTRAST
IL -0043 OPERATIONAL ENVIRONMENT FUNCTIONALITY
IL -0045 COLOR
IL -0047 TELLTALE; INDICATOR AND DISPLAY LIGHT INTENSITY
IL -0048 ILLUMINATION ACCEPTABILITY

03-0661 PLACEMENT: CONTROL AND DISPLAY LOCATIONS
03-0662 PLACEMENT: LOGICAL GROUPING FUNCTION AND USAGE
03-0664 PLACEMENT: DOWN VISION TO COMPONENTS WITH HIGH VISUAL DEMAND
03-0665 PLACEMENT: EXPECTED LOCATIONS OF CONTROLS AND DISPLAYS VDS
03-0670 INTERIOR VISIBILITY
03-0671 INTERIOR VISIBILITY: REFLECTIONS FROM COMPONENTS & SURFACES

03-0672 INTERIOR VISIBILITY: REFLECTIONS IN DISPLAYS
03-0673 INTERIOR VISIBILITY: VISUAL OBSCURATIONS
03-0674 INTERIOR VISIBILITY: ILLUMINATION CONTROLS / DISPLAYS
03-0675 INTERIOR VISIBILITY: VEILING GLARE
03-0677 INTERIOR VISIBILITY: SUNLIGHT WASHOUT
03-0681 IDENTIFICATION: CHARACTER AND SYMBOL SIZE
03-0682 IDENTIFICATION: LEGIBILITY
03-0685 IDENTIFICATION: SYMBOLS, ABBREV FOR CONTROL
03-0721 LOGIC OF OPERATION: OPERATIONAL STEREOTYPES
03-0722 LOGIC OF OPERATION: INTERPRETATION
03-0723 LOGIC OF OPERATION: USE OF SYSTEMS WITH VISUAL DISPLAYS

1.6.1 (MS-CAN)_Climate_Control_Data….(HS-CAN)_BodyInformation_1

Message: (MS-CAN)_Climate_Control_Data….(HS-CAN)_BodyInformation_1

Signal: Outside_Air_Temp_Stat

Data Range and °F conversion for display

Outside Temperature			Outside Temperature			Outside Temperature		
°C	Signal State	°F	°C	Signal State	°F	°C	Signal State	°F
-40.0	0x00	-40	-18.5	0x2B	-1	3.0	0x56	37
-39.5	0x01	-39	-18.0	0x2C	0	3.5	0x57	38
-39.0	0x02	-38	-17.5	0x2D	1	4.0	0x58	39
-38.5	0x03	-37	-17.0	0x2E	1	4.5	0x59	40
-38.0	0x04	-36	-16.5	0x2F	2	5.0	0x5A	41
-37.5	0x05	-35	-16.0	0x30	3	5.5	0x5B	42
-37.0	0x06	-35	-15.5	0x31	4	6.0	0x5C	43
-36.5	0x07	-34	-15.0	0x32	5	6.5	0x5D	44
-36.0	0x08	-33	-14.5	0x33	6	7.0	0x5E	45
-35.5	0x09	-32	-14.0	0x34	7	7.5	0x5F	46
-35.0	0x0A	-31	-13.5	0x35	8	8.0	0x60	46
-34.5	0x0B	-30	-13.0	0x36	9	8.5	0x61	47
-34.0	0x0C	-29	-12.5	0x37	10	9.0	0x62	48
-33.5	0x0D	-28	-12.0	0x38	10	9.5	0x63	49
-33.0	0x0E	-27	-11.5	0x39	11	10.0	0x64	50
-32.5	0x0F	-26	-11.0	0x3A	12	10.5	0x65	51
-32.0	0x10	-26	-10.5	0x3B	13	11.0	0x66	52
-31.5	0x11	-25	-10.0	0x3C	14	11.5	0x67	53
-31.0	0x12	-24	-9.5	0x3D	15	12.0	0x68	54
-30.5	0x13	-23	-9.0	0x3E	16	12.5	0x69	55
-30.0	0x14	-22	-8.5	0x3F	17	13.0	0x6A	55
-29.5	0x15	-21	-8.0	0x40	18	13.5	0x6B	56
-29.0	0x16	-20	-7.5	0x41	19	14.0	0x6C	57
-28.5	0x17	-19	-7.0	0x42	19	14.5	0x6D	58
-28.0	0x18	-18	-6.5	0x43	20	15.0	0x6E	59
-27.5	0x19	-17	-6.0	0x44	21	15.5	0x6F	60
-27.0	0x1A	-17	-5.5	0x45	22	16.0	0x70	61
-26.5	0x1B	-16	-5.0	0x46	23	16.5	0x71	62
-26.0	0x1C	-15	-4.5	0x47	24	17.0	0x72	63
-25.5	0x1D	-14	-4.0	0x48	25	17.5	0x73	64
-25.0	0x1E	-13	-3.5	0x49	26	18.0	0x74	64
-24.5	0x1F	-12	-3.0	0x4A	27	18.5	0x75	65
-24.0	0x20	-11	-2.5	0x4B	28	19.0	0x76	66
-23.5	0x21	-10	-2.0	0x4C	28	19.5	0x77	67
-23.0	0x22	-9	-1.5	0x4D	29	20.0	0x78	68
-22.5	0x23	-8	-1.0	0x4E	30	20.5	0x79	69
-22.0	0x24	-8	-0.5	0x4F	31	21.0	0x7A	70
-21.5	0x25	-7	0.0	0x50	32	21.5	0x7B	71
-21.0	0x26	-6	0.5	0x51	33	22.0	0x7C	72
-20.5	0x27	-5	1.0	0x52	34	22.5	0x7D	73
-20.0	0x28	-4	1.5	0x53	35	23.0	0x7E	73
-19.5	0x29	-3	2.0	0x54	36	23.5	0x7F	74
-19.0	0x2A	-2	2.5	0x55	37	24.0	0x80	75

Outside Temperature		
°C	Signal State	°F
24.5	0x81	76
25.0	0x82	77
25.5	0x83	78
26.0	0x84	79
26.5	0x85	80
27.0	0x86	81
27.5	0x87	82
28.0	0x88	82
28.5	0x89	83
29.0	0x8A	84
29.5	0x8B	85
30.0	0x8C	86
30.5	0x8D	87
31.0	0x8E	88
31.5	0x8F	89
32.0	0x90	90
32.5	0x91	91
33.0	0x92	91
33.5	0x93	92
34.0	0x94	93
34.5	0x95	94
35.0	0x96	95
35.5	0x97	96
36.0	0x98	97
36.5	0x99	98
37.0	0x9A	99
37.5	0x9B	100
38.0	0x9C	100
38.5	0x9D	101
39.0	0x9E	102
39.5	0x9F	103
40.0	0xA0	104
40.5	0xA1	105
41.0	0xA2	106
41.5	0xA3	107
42.0	0xA4	108
42.5	0xA5	109
43.0	0xA6	109
43.5	0xA7	110
44.0	0xA8	111
44.5	0xA9	112
45.0	0xAA	113

Outside Temperature		
°C	Signal State	°F
45.5	0xAB	114
46.0	0xAC	115
46.5	0xAD	116
47.0	0xAE	117
47.5	0xAF	118
48.0	0xB0	118
48.5	0xB1	119
49.0	0xB2	120
49.5	0xB3	121
50.0	0xB4	122
50.5	0xB5	123
51.0	0xB6	124
51.5	0xB7	125
52.0	0xB8	126
52.5	0xB9	127
53.0	0xBA	127
53.5	0xBB	128
54.0	0xBC	129
54.5	0xBD	130
55.0	0xBE	131
55.5	0xBF	132
56.0	0xC0	133
56.5	0xC1	134
57.0	0xC2	135
57.5	0xC3	136
58.0	0xC4	136
58.5	0xC5	137
59.0	0xC6	138
59.5	0xC7	139
60.0	0xC8	140
60.5	0xC9	141
61.0	0xCA	142
61.5	0xCB	143
62.0	0xCC	144
62.5	0xCD	145
63.0	0xCE	145
63.5	0xCF	146
64.0	0xD0	147
64.5	0xD1	148
65.0	0xD2	149
65.5	0xD3	150
66.0	0xD4	151

Outside Temperature		
°C	Signal State	°F
66.5	0xD5	152
67.0	0xD6	153
67.5	0xD7	154
68.0	0xD8	154
68.5	0xD9	155
69.0	0xDA	156
69.5	0xDB	157
70.0	0xDC	158
70.5	0xDD	159
71.0	0xDE	160
71.5	0xDF	161
72.0	0xE0	162
72.5	0xE1	163
73.0	0xE2	163
73.5	0xE3	164
74.0	0xE4	165
74.5	0xE5	166
75.0	0xE6	167
75.5	0xE7	168
76.0	0xE8	169
76.5	0xE9	170
77.0	0xEA	171
77.5	0xEB	172
78.0	0xEC	172
78.5	0xED	173
79.0	0xEE	174
79.5	0xEF	175
80.0	0xF0	176
80.5	0xF1	177
81.0	0xF2	178
81.5	0xF3	179
82.0	0xF4	180
82.5	0xF5	181
83.0	0xF6	181
83.5	0xF7	182
84.0	0xF8	183
84.5	0xF9	184
85.0	0xFA	185
85.5	0xFB	186
86.0	0xFC	187
86.5	0xFD	188

1.7 Revision History

SPSS Module Revision History

Revision Level	Name	Change Description	Date
1.0	M. Ye	Initial release	4/24/2014
1.1	A. Salameh	Initial VSEM RM Release	3/21/2018