STANDARD REPORT

FILTERS
SOIL:

REQUIREMENTS SUMMARY						
FEDE ID (Legacy ID)	**RQT Version**	**Requirement Title**	**Publish Date**	**Priority Level**	**Attachment ID(s)**	**Associated Test Methods / Evaluation Methods**
RQT-120400-008420 (CX-0027)	6	CONTROLS: MAXIMUM LATENCY- USER INPUT TO VISUAL FEEDBACK	14-Jan-2016	Specification	TAR008420-3 RQT-120400-008 420/6	Design Review/1 TM-12.04-L-1553/3 TM-12.04-L-4725/1

REQUIREMENT

ID: RQT-120400-008420 **Rev:** 6 **Title:** CONTROLS: MAXIMUM LATENCY- USER INPUT TO VISUAL FEEDBACK

Legacy ID: CX-0027 **Owner:** Liao,Jamie-JLIAO (jliao) **Priority Level:** Specification

State: Released **Rqmt Published Date:** 14-Jan-2016 **Obsolete Date:** **Superseded Date:**

Interface CPSCs:
120400,120402,120403,120406,150109

Rqmt Sources(s):

Cascade To:

Cascade From:

Markets:
GLOBAL

Vehicle Types:
GLOBAL:All,,

Comments:
Test Method 12.04-L-1553 migrated from legacy DVM

Requirement Description:

RQT-120400-008420

For Fully-Integrated climate control modules:

Button or Switch Push
During normal operation of the climate control system, the time between exercising any climate control system input (button or switch) from inception of push until the customer perceived response, via the control head, shall not exceed 100ms nor be less than the minimum debounce time. The "debounce time" is 34-56ms in duration, with a minimum of 5 consecutive, evenly distributed samples, which must be identical in value to assert a new debounced state. This same criteria applies to the button or switch to be considered in a valid, non-asserted state. This requirement applies to single activations or multiple sequential activations of the switch (i.e.: the climate control system shall respond to sequential button pushes up to and including a 10Hz rate). The feedback to the customer may be issued once the button or switch has reached a valid asserted state. Once the required asserted response has been issued (update #1) the software shall determine if the switch meets the criteria for a held switch and respond accordingly.

Button or Switch Hold
During normal operation of the climate control system, any button or switch which has been asserted but has not achieved a valid non-asserted state is considered to be "held". A switch which is held remains in a functionally held state until the above non-asserted criteria are met. Display updates, and corresponding actions, shall occur at the following rates according to the required update response:
Normal update rate: 750ms after the initial push for update #2, and each 400ms thereafter for updates 3 and beyond.

For climate features exercised/displayed on a remote display:
Soft Button Push
During normal operation of a climate control feature on a remote display, the time between exercising any climate control system input (button) from inception of push until the user-perceived update of the feature on the remote display shall not exceed 165ms.

Button or Switch Hold
Requirements are as described for a fully-integrated climate control module above.

For All Climate Control HMI:
Rotating Knobs
The climate control HMI module shall be capable of reading and processing a knob rotated at the rates and accuracy indicated in the following chart:

Case	Lower Angular Rotation Rate	Upper Angular Rotation rate	Minimum Required Accuracy*
1.a.	0?/second	(270? +10?)/second	100%
1.b.	(270? +10?)/second	(540? +10?)/second	75%
1.c.	(540? +10?)/second	(810? +10?)/second	50%
1.d.	(810? +10?)/second	(1080? +10?)/second	25%
1.e.	(1080? +10?)/second	-	The module may be incapable of reading beyond the rotational speed specified.

* "Minimum Required Accuracy" is expressed as a ratio of the displayed accumulated rotational count to the actual rotation angle x 100%. Note that all numbers are 100% or less indicating that the displayed angular rotation result may not be greater than the requested angular rotation.

Under no circumstances shall the display be updated in a direction contrary to the user requested input. An example of violating this condition is the user spinning the temperature knob in the "cool" direction with the result being an increase in the display temperature.

Display updates shall be made at a rate of no less than every 60msec, regardless if an integrated or remote display is employed in the design.

Knob Rotation Overtravel
The required debounce times shall be doubled for MAX A/C and MAX Defrost overtravel selections. The applied debounce time for these features shall be as follows:
The debounce time is 90 +/- 11ms in duration, with a minimum of 10 consecutive, evenly distributed samples, which must be identical in value to assert a new debounced state. This same criteria applies to the button or switch to be considered in a valid, non-asserted state. This requirement applies to single activations or multiple sequential activations of the switch (i.e.: the climate control system shall respond to sequential button pushes up to and including a 10Hz rate). The feedback to the customer may be issued once the button or switch has reached a valid asserted state. Once the required asserted response has been issued (update #1) the software shall determine if the switch meets the criteria for a held switch and respond accordingly.

Record results from test procedures as identified in DVM-0011-51.

*** Climate Electrical SME contact: ESCHAEF2 ***

AND/OR Grouping:

Requirement - Verification Links:

ID: Design Review **Rev:** 1 **Title:** DESIGN REVIEW

Acceptance Criteria: Per component functional specification.

Data Needed: Complete Design Review Evaluation Form (See DVM-0011-51, Detail ID #s 213024 & 213025) and store it in relevant program repository (e.g. eFDVS). The form should at minimum specify the design review purpose, method, and results of the review.|

Interface CPSCs:
120400,120402,120403,120406,150109

Recommended Milestone: FDJ

Ride Along (Yes = Requesting data from another persons test): N

Sample Size: 6

Verification Usage: DV

Requirement - Verification Links:

ID: TM-12.04-L-1553 **Rev:** 3 **Title:** MAXIMUM LATENCY: USER INPUT TO VISUAL CONTROL FEEDBACK

Acceptance Criteria: Per component functional specification.

Data Needed: Per component functional specification.

Interface CPSCs:
120400,120402,120403,120406,150109

Recommended Milestone: FDJ

Ride Along (Yes = Requesting data from another persons test): N

Sample Size: 6

Verification Usage: DV

Requirement - Verification Links:

ID: TM-12.04-L-4725 **Rev:** 1 **Title:** Climate Rotatory Controls Rotation Count Accuracy

Acceptance Criteria:

Data Needed: Test results as indentified in the test procedure.

Interface CPSCs:
120400,120402,120403,120406,150109

Recommended Milestone: FDJ

Ride Along (Yes = Requesting data from another persons test): N

Sample Size: 1

Verification Usage: DV

Attachment

Dataset Name: TAR008420-3 **Dataset Description:** TAR008420-3 **Dataset Attachment File Name:** CX-0027-3.doc

Dataset Name: RQT-120400-008420/6 **Dataset Description:** **Dataset Attachment File Name:** RQT-120400-008420-6.doc

Unit of Measure:millisec
Metric:Control action
Design Min Value:
Design Max Value:100 ms
Design Nom Value:
Life Min Value:
Life Max Value:100 ms
Life Nom Value:

Markets	GLOBAL;
Vehicle Types	GLOBAL:All

VERIFICATION TYPE

ID: Design Review	**Rev:** 1	**Title:** DESIGN REVIEW

Owner:

Verification Method State: Released

Test Types:

Test Site:

Prototype Type: Other

Owning CPSC:

Location Facility:

Legacy DVM:

Design Review

Name and Model Year of Affected Vehicle Program:		**Program Team Contact** *(Name, CDS ID, and Phone Number)*	

Description of vehicle/system/sub-system/etc. tested *(include prototype level, plate #, ID #, or similar descriptor)*	

Requirement(s) for which evaluation was performed *(provide requirement ID numbers)*	

Evaluation Purpose *(Click in Check box)*		**Method Type** *(Click in Check box)*	
☐	**Function** – evaluate whether the part delivers all of its intended functions	☐	Supplier or Engineering Technical Design Review
☐	**Manufacturing/Assembly** – evaluate whether the part can be made and installed	☐	Safety CAE Analysis Review
☐	**Service** – evaluate whether the part can be serviced	☐	Vehicle (hoist) Design Review (complete vehicle)
☐	**Robustness** – evaluate quality disciplines to determine noise factor tolerance	☐	Prototype Build Review (during the build process)
☐	**Clearance** – evaluate package and clearances to surrounding environment	☐	Fresh Eyes (Campaign Prevention) Review
		☐	Expert Evaluation ☐ Management ☐ SME ☐ Customer
		☐	Design Rule Checklist approved by Functional Chief

Evaluation Participants

Name and Position	Signature
Name: ***Title:***	
Name: ***Title:***	
Name: ***Title:***	
Name: ***Title:***	
Name: ***Title:***	

Assessment

Applicable requirements have been successfully met.	☐ **YES****	☐ **NO**

Approved By:

Name and Position	*Signature*
Name:	

** Rationale for disagreement must be described in the **Comments** area.*
*** Requires unanimous agreement of all participants*

Design Review

Comments (*attach additional pages as necessary*)

VERIFICATION TYPE

ID: TM-12.04-L-1553 **Rev:** 3 **Title:** MAXIMUM LATENCY: USER INPUT TO VISUAL CONTROL FEEDBACK

Owner: Liao,Jamie-JLIAO (jliao)

Verification Method State: Released

Test Types: 4-Performance

Test Site: Lab

Prototype Type: Component Assembly

Owning CPSC: 120400

Location Facility: NON-FORD: Non-Ford Test Facility

Legacy DVM: DVM-0007-CX

TEST METHOD

1.0 PURPOSE / GOAL OF TEST

1.1 Verify latency from Climate Control Module button push to visual feedback on display

2.0 INSTRUMENTATION

2.1 All test measurement equipment must be calibrated and maintained per FAP03-015, Control, Calibration, and Maintenance of Measurement and Test Equipment.

2.2 All applicable safety guidelines and procedures must be followed.

3.0 EQUIPMENT AND FACILITIES

3.1 See Procedure Steps

4.0 SAMPLE PREPARATION

4.1 See Procedure Steps

5.0 PROCEDURE STEPS

5.1 The supplier shall demonstrate conformance to this requirement by presenting an engineering analysis documenting minimum, maximum and nominal switch latency times in bar diagram form at a minimum. The diagram shall include time required and descriptions for the following:

5.1.1 Mechanical activation time

5.1.2 Switch/button debounce time

5.1.3 Round robin (software polling) / interrupt acknowledge time

5.1.4 Button processing time

5.1.5 Loading / information transmission time, including, but not limited to:

5.1.5.1 Buffer fill (if applicable)

5.1.5.2 Buffer dump (if applicable)

5.1.5.3 Transmission to external device (cluster, bus-enabled device, etc, if applicable)

5.1.6 Display update time.

5.2 Alternatively, a test shall be instrumented such that the operator may measure the time between a button/switch activation and a corresponding update of the display. The measurement shall be accurate to within + 5ms. The measurement shall begin once the switch has been fully depressed and shall be stopped once the display has reached 90% of its full luminous intensity.

5.3 Recommendation for Test Instrumentation:

A field expedient test may be instrumented using a stop-frame capable video camera. The video camera shall be mounted or held in such a way as to allow capture of both the subject button being pushed and the target display. With the camera in "record" mode the button/switch shall be activated. After the response to the button activation has occurred the camera shall be

stopped and the button/switch activation & response sequence shall be replayed in stop frame mode. The user shall count the number of frames between full button depression and corresponding display update. With the time between each frame known the response time of the button push to display update may be calculated to within +2 frame times. A high speed capture video camera is recommended for this purpose. Current technology prescribes video capture rates of 30 frames per second (33.3ms/frame) rendering consumer level equipment inadequate for this test method.

5.4 Output Buffering/Bus Transmission=FNOSout time: Defined in the "FNOSLatency_Diagram.xls ". This time cannot be controlled by neither transmitting nor receiving module.

5.5 Input Buffering/Bus Transmission=FNOSin time: Defined in the "FNOSLatency_Diagram.xls". This time cannot be controlled by neither the climate control module nor the module displaying the climate information.

6.0 GENERAL INSTRUCTION/SUPPLEMENTAL INFORMATION

Definitions:

6.1 Fully-Integrated Climate Control Module: A climate control module which directly reads the switches, buttons and potentiometers subject to this requirement and contains the hardware, and software algorithms, for processing the switch contacts/voltage levels, and debounce and assertion timing. Furthermore, this climate control module may physically contain an integrated display.

6.2 Remote-Display Climate Control Module: A climate control module which physically contains a switch/button matrix, or individual integrated switches and buttons, but displays the climate control information on a physically separated display module. Furthermore, this climate control module directly reads the switches, buttons and potentiometers subject to this requirement and contains the hardware, and software algorithms, for processing the switch contacts/voltage levels, and debounce and assertion timing.

6.3 Remote Climate Control Module: A Climate control module which neither reads switch/button activations directly nor has a physically attached display.

6.4 Hard buttons: Physical buttons which feature tactile feedback.

6.5 Soft buttons: Virtual buttons which are realized via a touch screen, or similar device, with little to no tactile feedback.

6.6 Hard Indicators: Physical devices which illuminate when current flows through them.

6.7 Soft Indicators: A virtual indicator, such as may be found on a touch screen, which do not illuminate directly but indicate state change via a color illumination intensity change.

7.0 DATA GENERATED & FORMATTING OF PRESENTATION

7.1 See Procedure Steps

8.0 REFERENCES

8.1 FAP03-179, Developing Corporate Engineering Test Procedures.

9.0 APPENDIX/ATTACHMENT

9.1 None

Support Documents Details

Dataset Name: CETP-Legacy-Data-TM-12.04-L-1553/3 **Dataset Description:** **Dataset Attachment File Name:** CETP-Legacy-Data-TM-12.04-L-1553-3.doc

Cross References	
Design Specific Information	
DVM Comments	
Keywords(LegacyData)	
Operating Conditions	
Sample Preparation	

VERIFICATION TYPE

ID: TM-12.04-L-4725	**Rev:** 1	**Title:** Climate Rotatory Controls Rotation Count Accuracy

Owner: Liao,Jamie-JLIAO (jliao)

Verification Method State: Released

Test Types: 4-Performance

Test Site: Lab

Prototype Type: Component Assembly

Owning CPSC: 120400

Location Facility: NON-FORD: Non-Ford Test Facility

Legacy DVM: DVM-1521-51

TEST METHOD

1.0 PURPOSE / GOAL OF TEST

1.1 This test will verify that the module requesting updates to the climate control temperature, blower, etc…, via rotary knobs, will capture and reflect the required updates when rotating the knobs at the prescribed angular rotation rates.

2.0 INSTRUMENTATION

2.1 All test measurement equipment must be calibrated and maintained per FAP03-015, Control, Calibration, and Maintenance of Measurement and Test Equipment.

2.2 All applicable safety guidelines and procedures must be followed.

2.3 The following test instrumentation is required:

High-speed multi-channel digital storage oscilloscope. There must be enough channels available to monitor all knobs being tested in addition the ARM (defined below) rotational position feedback signal.

3.0 EQUIPMENT AND FACILITIES

The following test equipment is required. Verbiage in italics font are not requirements but provide supplemental information:

3.1 A power supply to power up the DUT. The power supply shall be regulated and able to supply no less than 5A at 13.5V +/- 0.1V

3.2 A computer running a network-simulator.

3.2.1 The simulator must provide all of the periodic messages which the unit would receive under normal operation.

3.2.2 The simulator shall also transmit the messages required to make the DUT operate in the Normal_Run vehicle state (Key-On, Engine Running).

3.3 In the event that direct readout of the final knob rotation results cannot be directly seen a computer, and interfacing equipment, may be needed to read out the results of the knob rotation. Diagnostics software may also be required to read control memory.

3.3.1 *Set temp and blower changes may be seen directly on the control display however the number of detents accumulated on the manual knob position may not be readily read.*

3.4 Any interface device needed between the computer and DUT to run the simulation.

3.5 A harness which supports the electrical connections to apply power and the multiplexed messages to DUT.

3.6 A means to securely mount the DUT, to prevent it from moving or rotating, during the test.

3.7 A means to rotate all the DUT knobs simultaneously through a minimum of 360° travel. This is termed an “Active Rotating Mechanism” or ARM, for the purposes of this test procedure.

3.7.1 The ARM may be a device such as a stepper motor, or any other mechanism which meets these requirements.

3.7.2 The angular rotation rate provided by the ARM must be linear with respect to time and repeatable.

3.7.3 The ARM shall provide at least twice the torque required to rotate the knobs through all detents.

3.8 A device must be affixed to the ARM to provide feedback as to the ARM's angular movement. A pulse shall be generated by the ARM FD at each knob detent which would generate an increment/decrement in the value being measured. In the event that a generalized test fixture is to be used, without being constructed to support a per-detent pulse, the resolution of the ARM feedback device (ARM FD) shall be no less than 3° +/- 0.5°.

3.8.1 Alternative Method: In the cases where pulses may be obtained directly by measuring the DUT knob-rotation, circuit(s), these circuits may serve as the ARM FD(s).

3.9 A multichannel digital-capture oscilloscope. In the event that the alternative method is to be used. featuring ≥ 10Mohm input impedance for each channel.

3.9.1 One channel per knob being tested will be required to perform the test.

4.0 SAMPLE PREPARATION

The sample, or Device Under Test (DUT) shall be prepared as follows:

4.1 A fully functional DUT must be utilized which has production-level hardware and software.

4.2 The DUT shall be placed in the fixture which contains the ARM and the ARM devices shall be attached to the rotary knobs to be tested.

4.3 The power supply shall be adjusted 13.5V +/- 0.1V, with the current limited to no less than 5A.

4.4 The network-simulator shall be started and the interface device (as needed) shall be attached between the computer and the harness.

4.5 The DUT shall be powered up via the power supply and the network simulation device shall place the unit in the Normal_Run vehicle state (Key-On, Engine Running).

4.6 The oscilloscope shall be attached to each ARM FD per knob being tested.

5.0 PROCEDURE STEPS

The following procedure shall be used in conducting this test:

5.1 Each knob being tested shall be set to the furthest Counter-Clockwise (CCW) setting to provide maximum possible traverse of the knob travel.

5.1.1 This would typically equate to LO/60° setpoint on ATC's, Min temp on manual controls and blower speed of 1.

5.1.2 Knob overtravels, if possible, shall not be included in the testing. Overtravels would include MAX AC and MAX Defrost.

5.2 Starting at the lowest range of rotation(1a) the knobs shall be simultaneously rotated Clockwise (CW) to the positions equal to the maximum valid value for the given knob, but not beyond the maximum value. The knobs shall be rotated at the stated "Upper Angular Rotation rate".

5.2.1 This would typically equate to HI/90° setpoint on ATC's, Max temp on manual controls and blower speed of 7.

5.3 Upon completion of the rotation the following shall occur:

5.3.1 The current setpoint on the control for blower and temperature shall be recorded.

5.3.2 The actual angular rotation angle shall be verified by counting the pulses shown on the monitoring oscilloscope.

5.3.3 The current setpoint for each knob shall be compared against the actual angular rotation. Compliance to the requirement shall be verified by comparing the ratio of the control count versus the actual rotation count to the "Minimum Required Accuracy".

5.4 The knobs shall be rotated CCW at same rate and as the CW direction to verify compliance to the requirement for both directions of rotation.

5.5 Each range of rotation shall be tested until the highest rotational rate has tested at which point the test is concluded.

5.6 The test results shall be recorded and the test shall be classified as passed or failed based on the results obtained.

6.0 GENERAL INSTRUCTION/SUPPLEMENTAL INFORMATION

6.1 Not applicable

7.0 DATA GENERATED & FORMATTING OF PRESENTATION

The following data shall be recorded. Example data is shown in italics.

7.1 The test results shall be recorded in tabular form with the following information included for

7.1.1 CW rotation

7.1.2 CCW rotation

7.1.3 Each knob tested

7.1.4 Each rotational rate range tested

7.2 The case being tested *(i.e.:1b)*

7.3 The actual angular rate tested. *(i.e.: 540°/sec)*

7.4 The direction of angular rotation *(i.e.: CW)*

7.5 The change in reading of the value after the knob has been rotated *(i.e.: 28degree setpoint change).*

7.6 The actual change in reading the knob would have reported at 100% accuracy after the knob has been rotated *(i.e.: 30degree setpoint change).*

7.7 The accuracy of the knob rotation expressed as a percentage *(i.e.: (28degrees/30degrees) x 100% = 93.3%)*

7.8 The minimum required accuracy for the test case *(i.e.: 75%)*

7.9 "Pass" or "Fail" for each test case *(i.e.: "Pass" for this example)*

7.10 The oscilloscope recordings shall be included for each test.

8.0 REFERENCES

8.1 FAP03-179, Developing Corporate Engineering Test Procedures.

8.2

9.0 APPENDIX/ATTACHMENT

9.1

Support Documents Details

Dataset Name: CETP-Legacy-Data-TM-12.04-L-4725/1 **Dataset Description:** **Dataset Attachment File Name:** CETP-Legacy-Data-TM-12.04-L-4725-1.doc

Cross References	
Design Specific Information	
DVM Comments	
Keywords(LegacyData)	
Operating Conditions	
Sample Preparation	