

Memorandum

U.S. Department of Transportation Volpe National Transportation Systems Center

 Subject: Validation of General Electric Aviation DAPS2015
 Digital Recording and 1/3 Octave Analysis System for Use in Support of Aircraft Noise Certification Efforts in Compliance with 14 CFR Part 36; Letter Report: V324-FA5JBQ-LR4 Rev. 1

Date: 310CT2017

Reply to Attn. of: V324

From: Dave Read, IT Specialist, Acoustics, Volpe Center, Environmental Measurement and Modeling Division

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To: Rebecca Cointin; FAA AEE-100

NOTE: This is a revision of Letter Report V324-FA5JBQ-LR4. The purpose of the revision is to correctly identify the system designation for which the validation applies. The applicant originally identified the materials provided in support of this validation as pertaining to the "DAPS4" system, but has since revised their documentation to reflect the correct designation: "DAPS2015". A new Validation Checklist has been attached, and references to the system have been revised. Additionally, references to the documentation provided by the applicant have been updated where changed. No other changes have been made.

In support of the Federal Aviation Administration's Office of Environment and Energy, the Volpe Center Environmental Measurement and Modeling Division (Volpe) has completed validation of the digital recording and 1/3 octave band analysis components of General Electric Aviation's (GE) DAPS2015 instrumentation system (DAPS2015).

Based on review and evaluation of a technical report provided by GE, <u>T.M. 2015-013R1 –</u> <u>Certification Test Report for the GE Aviation Digital Acoustic Processing System 2015</u> <u>Architecture</u>, and on discussions with the applicant, Volpe has determined that the DAPS2015 system meets all applicable requirements - pertaining to the measurement and analysis of static engine noise testing - of 14 CFR Part 36 (Amdt. 31), and is suitable for use in support of aircraft noise certification. Volpe has also determined that GE have developed appropriate setup and operation protocols, as detailed in their document, <u>TM2017-27 – "GE Digital Acoustic</u> *Processing System (D.A.P.S.) Operator User Manual.* The attached Volpe Checklist documents the testing that has been performed, as well as the validated instrument configuration(s) and key performance characteristics of the DAPS2015 System.

Note that DAPS2015 is a custom hybrid of hardware and software, with the 1/3 octave band analysis portions implemented entirely in a CAD development environment. An earlier version of the DAPS was evaluated by Volpe and Approved by FAA in 2003-2004, but no formal Volpe Letter Report was generated.

As noted at the beginning of this report, a validation was performed and documented in Letter Report V324-FA5JBQ-LR4 of what was originally identified as the "DAPS4" system. This revised version supersedes and replaces that report.

If you have any comments or questions, please do not hesitate to contact me.

Attachment

cc: M. Marsan; FAA, AEE-100
S. Liu; FAA, AEE-100
B. Conze; FAA, ANM-112
C. Cutler; Volpe, V324
C. Lee, V324
C. Roof; Volpe, V322
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Aircraft Noise Certification Audio Recording / Analysis System Validation Report Checklist

Recording/Analysis System ID: GE A	viation DAPS2015			
STATUS NOTES:	COMPLETED			
Date Initiated: 22FEB2016				
Date Updated: 310CT2017				
Date Completed: 31OCT2017 (prev. 06MAR2017 for DAPS4)				
NOTE: Revised from "DAPS4" to "DAPS2015" OCT2017				
Volpe Point-of-contact:	Basis for Validation:			
Dave Read, V324	TM2015-013R1 – Certification Test Report for the GE Aviation Digital Acoustic Processing System 2015 Architecture (DAPS2015) and TM2017-27 – GE Digital Acoustic Processing System (D.A.P.S.) Operator User Manual			
Point-of-contact:				
Senior Engineer Acoustic & Installation	Aerodynamics			
Address: General Electric Aviation	Telephone: (nnn) nnn-nnnn ext nnnn			
1 Neumann Way / MD:G137 Cincinnati, OH 45215, USA	Email: egbert.geertsema@ge.com			
Instrumentation Specifics:				
Manufacturer: GE Aviation Model Designation: DAPS2015 Firmware Version: n/a Version ID: DAPS2015				

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Other: Validation performed on system originally identified as "DAPS4". Only System designation has changed.					
Configuration being validated:					
Number of simultaneous channels: 16 (config a) / 64 (config b) Bandwidth (per channel), Hz (range of nominal center frequencies): a: 3.15Hz – 80kHz / b: 0.8Hz – 20kHz Sample Rate (per channel), Hz: a: 262,144Hz / b: 65,536Hz Bit-depth (per channel): 16-bit sigma-delta Spectrum output interval, ms: n/a (long linear averages) Filter octave frequency ratio: I Base 2 Base 10 Time-averaging mode: I Linear Exponential Averaging time-period, seconds: n/a Filter design type: 6-pole Chebychev I Media type: Hard disk, removable hard disk, linear tape drive Data format: proprietary binary Power source: AC (uninterruptable power supply)					
Overall Analyzer IEC61260-1 conformance: \Box class 2 \boxtimes class 1 \Box class 0 (previous standard)					
Analyzer conformance specifics:	Pass	Fail			
☑ Relative attenuation (filter response shape) [see TM2015-031R1 Section 5.1.1]					
☑ Filter Integrated Response ("bandwidth error") [see TM2015-031R1 Section 5.1.2]					
☑ Real-time operation [see TM2015-031R1 Section 5.1.4]					
☑ Summation of output signals [see TM2015-031R1 Section 5.1.6]					
☐ Output resolution equal to or better than 0.1 dB [see TM2015-031R1 Section 5.5]					
□ Linear time integration within ±5ms of 500ms	🗆 n/a				
\Box Slow exponential time interval within ±5ms of 500ms	□ n/a				

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□ Data loss < 5ms per 500 ms sample	□ n/a	
☑ Response @ center frequencies , 50 Hz – 10 kHz within ±1.5 dB [see TM2015-031R1 Section 4]		
System conformance specifics:		
☑ Amplitude linearity [see TM2015-031R1 Section 4.1]		
☑ Anti-aliasing [see TM2015-031R1 Section 3]		
☑ Analog anti-aliasing filter prior to digitization [see TM2015-031R1 Section 3]		
☑ Frequency response [see TM2015-031R1 Appendix G]		
Quantify level range steps	□ n/a	
Maximum input signal / Overload characteristics [see TM2015-031R1 Section 4.4]		
☑ Full-scale identification [see TM2015-031R1 Section 4.4]		
□ Noise floor not tested		
Inter-channel crosstalk not tested		
Environmental sensitivity	□ n/a	
Power supply check see note on power-outage		
☑ Data validation [see TM2015-031R1 Section 7]		
□ Other (specify):		

Performance summary:

Approximate usable dynamic range, dB: 89 as tested by GE Approximate usable frequency bandwidth, Hz: config a: 3.15Hz – 80kHz / config b: 0.8Hz – 20kHz

Limitations, unique capabilities, etc. :

Validated for use in static engine noise testing in support of certification efforts only. Not evaluated for aircraft flyby testing. (No testing of time-averaging, slow timestamps, background noise, etc.)

Power-outage note: System is operated indoors only, using AC via UPS. In case of power failure, procedure is to discard data from any measurement being performed during outage and re-do.

Comments:

DAPS2015 is the latest iteration of an applicant-developed hybrid hardware/software-based audio recording and analysis system, using state-of-practice components and methods, for use in static engine testing in support of aircraft noise certification efforts. Previous versions of DAPS were evaluated, but no formal validation letter report was generated by Volpe.

Note that this validation was performed for a system originally identified as "DAPS4". This checklist and the associated Letter Report have been revised to properly identify the system as "DAPS2015". Applicant's documentation was updated to TM2015-031R1 for Technical Performance and TM2017-27 for Setup and Operation protocols.

Note that special considerations for acoustic calibration scheduling were developed and evaluated during an earlier Volpe review of the system. (See Volpe Letter Report: DTS-34-FA553-LR1 – Recommended Calibration Requirements for General Electric Aircraft Engines Static-Testing Procedures.)

Validation Activity History:

Date	Initiator		Action
	Applicant	Volpe	
06MAR2017		\boxtimes	Original Volpe Letter Report validating GE DAPS4 system
AUG2017		\boxtimes	Volpe and Conze discuss – wrong designation used by applicant and
Thru		\boxtimes	identified in validation materials associated with Volpe Letter Report
OCT2017		\boxtimes	V324-FA5JBQ-LR4, 06MAR2017
31AUG2017	\boxtimes		New DAPS2015 performance testing report TM2015-013R1
110CT2017			Applicant requests Volpe evaluation of TM2015-013R1 for validation of DAPS2015 system
110CT2017		\boxtimes	Informed applicant that TM2015-013R1 under review, requested confirmation that DAPS User Manual applies to DAPS2015 system
170CT2017		\boxtimes	Have reviewed technical report. Still need confirmation that Operators Manual applies to DAPS2015
180CT2017	\boxtimes		Geertsema on leave – Updating Operators Manual to apply to
			DAPS2015 system – should be available in a few days
270CT2017	\boxtimes		New DAPS Operator User Manual TM2017-27
310CT2017		\boxtimes	Validation complete