

EPSON

Epson Bridge Deflection Calculator Ver.1.0

User Guide

1. This evaluation board/kit or development tool is designed for use for engineering evaluation, demonstration, or development purposes only. Do not use it for other purposes. It is not intended to meet the requirements of design for finished products.
2. This evaluation board/kit or development tool is intended for use by an electronic engineer and is not a consumer product. The user should use it properly and in a safe manner. Seiko Epson does not assume any responsibility or liability of any kind of damage and/or fire caused by the use of it. The user should cease to use it when any abnormal issue occurs even during proper and safe use.
3. The part used for this evaluation board/kit or development tool may be changed without any notice.

NOTICE : PLEASE READ CAREFULLY BELOW BEFORE THE USE OF THIS DOCUMENT

The content of this document is subject to change without notice.

1. This document may not be copied, reproduced, or used for any other purposes, in whole or in part, without the consent of Seiko Epson Corporation("Epson").
2. Before purchasing or using Epson products, please contact with our sales representative for the latest information and be always sure to check the latest information published on Epson's official web sites and sources.
3. Information provided in this document such as application circuits, programs, usage, etc., are for reference purpose only. Please use the application circuits, programs, usage, etc. in the design of your equipment or systems at your own responsibility. Epson makes no guarantees against any infringements or damages to any third parties' intellectual property rights or any other rights resulting from the information. This document does not grant you any licenses, intellectual property rights or any other rights with respect to Epson products owned by Epson or any third parties.
4. Epson is committed to constantly improving quality and reliability, but semiconductor products in general are subject to malfunction and failure. In using Epson products, you shall be responsible for safe design in your products; your hardware, software and systems are designed enough to prevent any harm or damages to life, health or property even if any malfunction or failure might be caused by Epson products. In designing of your products with using Epson products, please be sure to check and comply with the latest information regarding Epson products (this document, specifications, data sheets, manuals, Epson's web site, etc.). When using the information included in the above materials such as product data, chart, technical contents, programs, algorithms and application circuit examples, you shall evaluate your products both in stand-alone basis and within your overall systems. You shall be solely responsible for deciding whether or not to adopt and use Epson products.
5. Epson has prepared this document and programs provided in this document carefully to be accurate and dependable, but Epson does not guarantee that the information and the programs are always accurate and complete. Epson assumes no responsibility for any damages which you incurred by due to misinformation in this document and the programs.
6. No dismantling, analysis, reverse engineering, modification, alteration, adaptation, reproduction, etc., of Epson products is allowed.
7. Epson products have been designed, developed and manufactured to be used in general electronic applications (office equipment, communications equipment, measuring instruments, home electronics, etc.) and applications individually listed in this document ("General Purpose"). Epson products are NOT intended for any use beyond the General Purpose that requires particular/higher quality or reliability in order to refrain from causing any malfunction or failure leading to harm to life, health or serious property damage or severe impact on society, including, but not limited to listed below. Therefore, you are advised to use Epson products only for the General Purpose. Should you desire to buy and use Epson products for the particular purpose other than the General Purpose, Epson makes no warranty and disclaims with respect to Epson products, whether express or implied, including without limitation any implied warranty of merchantability or fitness for any particular purpose.
[Particular purpose]
Space equipment (artificial satellites, rockets, etc.)
Transportation vehicles and their control equipment (automobiles, aircraft, trains, ships, etc.)
Medical equipment (other than applications individually listed in this document) / Relay equipment to be placed on sea floor
Power station control equipment / Disaster or crime prevention equipment / Traffic control equipment / Financial equipment
Other applications requiring similar levels of reliability as the above
8. Epson products listed in this document and our associated technologies shall not be used in any equipment or systems that laws and regulations in Japan or any other countries prohibit to manufacture, use or sell. Furthermore, Epson products and our associated technologies shall not be used for developing military weapons of mass destruction, military purpose use, or any other military applications. If exporting Epson products or our associated technologies, you shall comply with the Foreign Exchange and Foreign Trade Control Act in Japan, Export Administration Regulations in the U.S.A (EAR) and other export-related laws and regulations in Japan and any other countries and follow the required procedures as provided by the relevant laws and regulations.
9. Epson assumes no responsibility for any damages (whether direct or indirect) caused by or in relation with your non-compliance with the terms and conditions in this document.
10. Epson assumes no responsibility for any damages (whether direct or indirect) incurred by any third party that you assign, transfer, loan, etc., Epson products.
11. For more details or other concerns about this document, please contact our sales representative.
12. Company names and product names listed in this document are trademarks or registered trademarks of their respective companies.

2022.08

©Seiko Epson Corporation 2023, All rights reserved.

Table of Contents

Revision History	4
1. Introduction	5
1.1. Overview.....	5
1.2. Functions	5
1.3. System Requirements.....	5
1.4. Software Installation	5
1.5. Uninstalling the Software	5
2. Operation Procedure	6
2.1. Starting and Exiting	6
2.2. Operation Flow	6
2.3. How to read the screen	7
3. CSV file format specificationsion Port.....	8
3.1. Input CSV file.	8
3.2. Output CSV file.....	8
4. Recommended installation and measurement conditions for the acceleration sensor	9
4.1. Acceleration sensor installation conditions.....	9
4.2. Acceleration sensor setting conditions	9
4.3. Measurement conditions.....	9
5. Contact.....	10

Revision History

Rev. No.	Date	Page	Description
20250325	22025/03/25	ALL	New release

1. Introduction

1.1. Overview

"Epson Bridge Deflection Calculator" is software that calculates the displacement due to the response acceleration integral when a vehicle passes over a bridge. This software is provided free of charge to customers who are evaluating the acceleration sensor M-A352/552.

1.2. Functions

This software can do the following.

- Load acceleration data (CSV files)
- Load displacement reference data (CSV files)
- Display acceleration time series graphs
- Calculate and display displacement by integrating acceleration, and display graphs of displacement reference data
 - Note) It is recommended to compare with displacement reference data measured simultaneously with the acceleration sensor.
 - Note) Customers need to prepare both acceleration sensor data and displacement reference data.
- Calculate and display vehicle entry and exit times
- Export CSV files of the calculated displacement by integrating acceleration
- Output graph images

The acceleration integral displacement calculation with Bridge Deflection Calculator makes it easy to calculate the match with the reference displacement data from the measurement data and the vehicle entry/exit time, which is useful for measuring displacement due to deflection when a vehicle passes over a bridge.

1.3. System Requirements

This software requires the following operating environment.

Operating System	Windows11, Windows10 (64-bit) ^{*1}
Memory (recommended)	4 GB or higher
Storage Space	500 MB free storage space before installation

Note) Operating systems other than Windows11 and Windows10 (64-bit) have not been tested.

Note) If you are using a computer with low specifications and experience operational issues such as delayed plot updates, please use a computer with high specifications.

1.4. Software Installation

- 1) Please extract and decompress the compressed file "EpsonBridgeDeflectionCalculator_Ver.1.0.zip" to any location.
- 2) The following folders and files will be created inside the folder "EpsonBridgeDeflectionCalculator_Ver.1.0":
 - ① The "_internal" folder containing libraries used by this software
 - ② The software executable file "EpsonBridgeDeflectionCalculator_Ver.1.0.exe"
 - ③ The sample acceleration and displacement data file "sample.csv"
 - ④ The End User License Agreement file "EULA.txt"

1.5. Uninstalling the Software

To uninstall this software, please delete the "EpsonBridgeDeflectionCalculator_Ver.1.0" folder.

2. Operation Procedure

2.1. Starting and Exiting

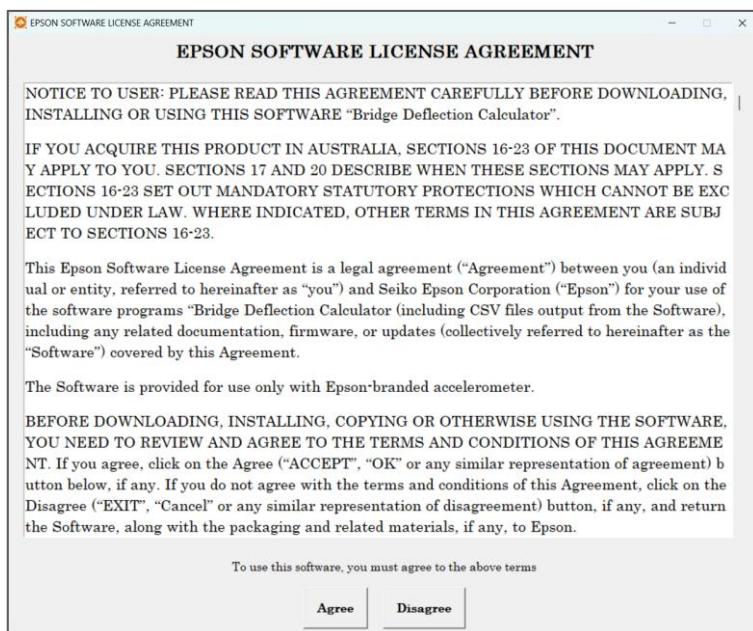
Double-click "EpsonBridgeDeflectionCalculator_Ver.1.0.exe" to start this software. To exit the software, click the "x" button at the top right of the screen. While the software is running, a Windows command prompt window will be displayed, but it will also close when the software is exited.

Software Icon:



2.2. Operation Flow

When you start this software, the software license agreement will be displayed. Please review the content of the agreement and click the "Agree" button to use the software. After you agree to the software license agreement, it will not be displayed again.

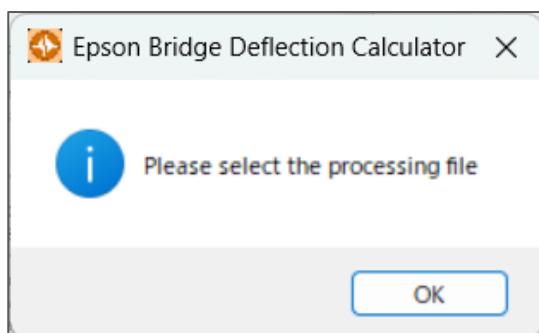


After agreeing to the software license agreement, 1) a dialog box will be displayed. Please click the "OK" button. 2) A file selection dialog will appear. Please select the CSV file to be used for the calculation of displacement by integrating acceleration.

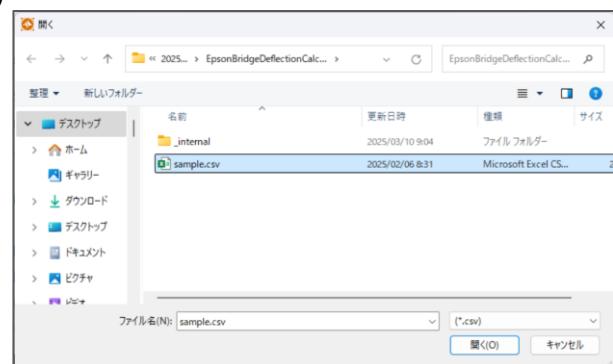
Note) If you click the cancel button in the file selection dialog, the software will exit.

Note) If you start the software again, 1) will be displayed.

1)

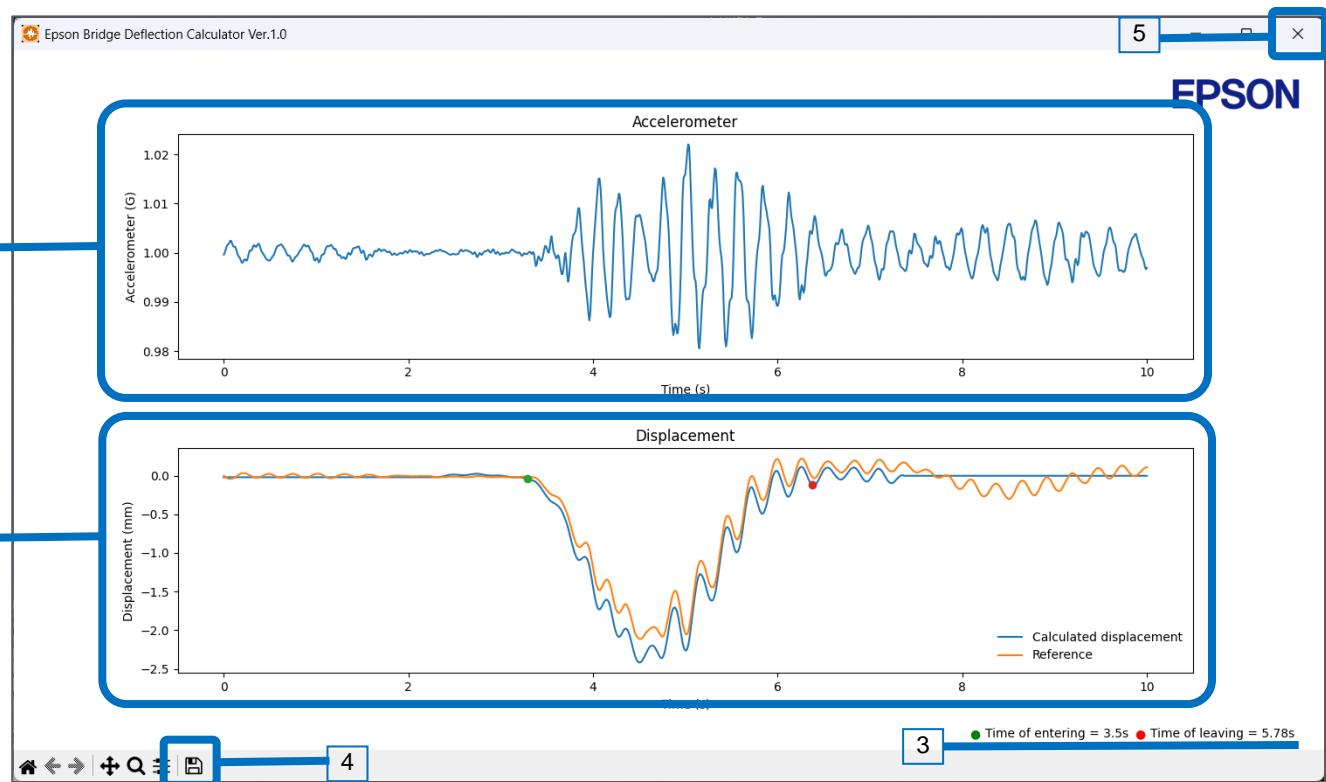


2)



2.3. How to read the screen

When you select the CSV file to input to the acceleration integral displacement calculation, the following screen will be displayed.



1	Accelerometer	Displays the acceleration time series waveform of the loaded CSV file.
2	Displacement	Displays the displacement waveform calculated from the acceleration data of the loaded CSV file. (Blue) Displays the displacement data of the loaded CSV file. (Orange)
3	Entry/Exit time	Displays the calculated displacement waveform or the entry/exit time calculated from the displacement data.
4	Graph image save	Saves the acceleration time series waveform graph and displacement waveform graph as png image files. Specify a folder and file name of your choice to save.
5	Software exit	Click the x button in the upper right corner of the screen to exit the software. A CSV file with displacement calculations from the acceleration data will be automatically created in the "EpsonBridgeDeflectionCalculator_Ver.1.0" folder.

3. CSV file format specifications on Port

3.1. Input CSV file.

The input CSV file specifications used by Bridge Deflection Calculator are as follows.

- Comma-separated csv format file
- Time unit: s, Acceleration input unit: G, Displacement unit: mm
- The header is a specified string as follows:

Column A (time): Time_(s)

Column B (Acceleration data): Accel_(G)

Column C (Displacement reference data): Ref_(mm)

Note) This software will operate even if there is no displacement reference data

- The minimum data size is 331 rows
- The sampling rate should be 100sps.

	A	B	C	D
1	Time (s)	Accel (G)	Ref (mm)	
2	0.01	1.000246286	-0.003874	
3	0.02	1.000271678	-0.003874	
4	0.03	1.000193894	-0.003874	
5	0.04	0.999994636	-0.000577	
6	0.05	0.999886811	0.00014	
7	0.06	1.000002444	0.00014	
8	0.07	1.000140846	0.00014	
9	0.08	1.000030637	0.00014	
10	0.09	0.999756575	0.00014	
11	0.1	0.999650478	0.003439	
...

3.2. Output CSV file

The output CSV file specifications used by Bridge Deflection Calculator are as follows.

- Comma-separated CSV format file
- The header is a specified string as follows:

Column A (time): Time(s)

Column B (displacement after acceleration integration): Displ. (mm)

- The file name will be "input file name" + Displ.

	A	B	C
1	Time(s)	Displ.(mm)	
2	0.01	-0.06705	
3	0.02	-0.06705	
4	0.03	-0.06705	
5	0.04	-0.06705	
6	0.05	-0.06705	
7	0.06	-0.06705	
8	0.07	-0.06705	
9	0.08	-0.06705	
10	0.09	-0.06705	
11	0.1	-0.06705	

4. Recommended installation and measurement conditions for the acceleration sensor

When using this software, the important points are the installation conditions and the setting requirements for the acceleration sensor in acceleration measurement. This page shows the measurement know-how required when measuring bridges using our quartz acceleration sensor M-A352/552.

4.1. Acceleration sensor installation conditions

No.	Acceleration sensor installation conditions	reason
1	Install monitoring points on the primary structure of the bridge	For steel bridges, it is recommended to mount them on the bridge girder.
2	Place monitoring points near the center of the span or between supports	The displacement response to vehicle loading is greatest and S/N is optimal
3	Install monitoring points away from bridge structures such as streetlights	Areas that are less affected by the inherent vibrations of streetlights and other structures, as well as wind-induced deflections provide a better S/N in the measurement area.
4	Install monitoring points away from bridge structures such as guardrails	Areas that are less influenced by the inherent vibrations of guardrails and other structures, as well as wind-induced deflections offer a better S/N in the measurement area.
5	Do not install monitoring points on structures associated with the vehicular-lane such as sidewalks	These structures may be structurally isolated from the main part of the bridge that supports vehicle loads, leading to inaccurate vehicle load measurement

4.2. Acceleration sensor setting conditions

No.	Acceleration sensor setting conditions	reason
1	At the monitoring points, apply vibration isolation to prevent unwanted vibrations from affecting the accelerometers, thereby isolating them from external vibration noise	—
2	Use the input data with a sampling rate of 100spS	—
3	It is desirable that the input data consist of acceleration measurements(A-352) with a bandwidth below 20Hz	—

4.3. Measurement conditions

No.	Measurement conditions	reason
1	This program has been validated using heavy vehicles of 5t or more	Lower vehicle loads may not produce a sufficient S/N in the response data
2	This program has been verified with measurement data from both steel and concrete bridges	This may not function correctly for all types of bridge structures.
3	The acceleration data should include periods without vehicles on the monitored bridge girder at both the start and end of the data set	A single vehicle crossing or A pair of vehicles is preferred
4	The acceleration data must include measurements in a direction that is nearly normal(perpendicular) to the bridge deck's travel plane.	—

5. Contact

AMERICA

EPSON AMERICA, INC.

Headquarter:
3131 Katelyn Ave.
Los Alamitos, CA 90720, USA
Phone: +1-800-463-7766

San Jose Office:
2860 Zanker Road, Suite 204,
San Jose, CA 95134, U.S.A
Phone: +1-800-463-7766

EUROPE

EPSON EUROPE ELECTRONICS GmbH

Riesstrasse 15, 80992 Munich,
GERMANY
Phone: +49-89-14005-0 FAX: +49-89-14005-110

ASIA

EPSON (CHINA) CO., LTD.

4F, Tower 1 of China Central Place, 81 Jianguo Street, Chaoyang District,
Beijing 100025 CHINA
Phone: +86-400-810-9972 X ext.2
Mail EPSON_MSM@ecc.epson.com.cm

EPSON SINGAPORE PTE. LTD.

438B Alexandra Road, Block B Alexandra TechnoPark, #04-01/04, Singapore
119968
Phone: +65-6586-5500

EPSON TAIWAN TECHNOLOGY & TRADING LTD.

15F, No.100, Song Ren Road, Taipei 110, TAIWAN
Phone: +886-2-8786-6688 Fax: +886-2-8786-6660

EPSON KOREA Co., Ltd.

10F Posco Tower Yeoksam, Teheranro 134 Gangnam-gu,
Seoul, 06235 KOREA
Phone: +82-2-558-4270 Fax: +82-2-3420-6699

JAPAN

SEIKO EPSON CORPORATION.

MD SALES & MARKETING DEPT.

<https://www.epsondevice.com/sensing/en/contact/>

Product Information on www server

<https://www.epsondevice.com/sensing/en/>