



# Data Export and Import in TAM System Explorer

## Application Note

Version	Date	Editor	Comment
001	2014-06-06	chm	Initial edit
002	2017-06-16	chm	Add reference to Matlab script
003	2018-09-14	chm	Cope with Enums
004	2019-01-14	chm	Introduce CSV auto-save

Document AN132\_TamSystemExplorerDataExchange\_EP  
Version 005  
Source Q:\doc\ApplicationNotes\  
Destination T:\doc\Org\Templates  
Owner chm

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## 1 Overview

The TAM System Explorer application ([1], [2]) is the primary service tool for setting up Triamec Motion drives. One primary component is the scope. Acquired data can be persisted by printing or saving an image of the scope to disc. This document focuses on yet two other possibilities: exporting data as comma-separated values to a text file (CSV), streaming, and importing all that data again.

Section 2 deals with the CSV export and import, while section 3 cares about streaming. The data formats are defined separately in section 4.

## 2 Working With Comma Separated Values

Sections 2.1 and 2.2 help in persistency and restoration of acquired data. For an informal specification of the text data format, see section 4.2.

### 2.1 Save Data

Using the menu **Scope | Save Plot Data...**, export all data to CSV.

A scope configuration companion file is always saved beneath the actual data file. The same name is given, with the extension changed to `.auto.TAMSCO`. This companion file isn't necessary for long term storage. However, it supports a round-trip experience when loading the data back into the scope afterwards. Naturally, renaming and re-basing of the data file requires synchronization with the companion file.

#### Auto-Save

When repeat is enabled, you may opt-in to automatically save a CSV file each time the scope concludes a measurement. Figure 1 shows how to enable the feature.

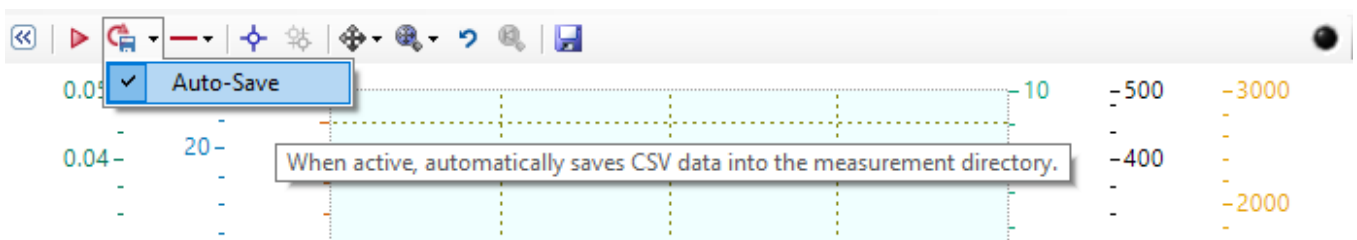


Figure 1: Auto-save is configured via the repeat button in the tool-strip. While enabled, the repeat button receives a disc floppy overlay.

Data is saved in sub-folders of the measurement directory of the current workspace. The sub-folders are named according to the time when the acquisition started, while the individual CSV files get a name according to the start time of the samples they hold.

This directory is most easily located using menu **File | Open Workspace Folder**, and navigating down the `Measurement` directory.

**Note** With a larger acquisition duration, the scope doesn't roll to the side as usual when auto-save is enabled.

Auto-save is reset when the application closes.

**Caution** The application does not detect the case where disk goes out of space.

Only one scope configuration companion file is saved for one directory.

## 2.2 Load Data

The menu **Scope | Load Plot Data...** opens the dialog shown in figure 2. Offline data is always shown in a separate window, the *Data Viewer*. This way, several Data Viewer windows might be opened. However, when invoking the menu from the Data Viewer, you have the choice to *append* new data to existing data, or *replace* data.

Several *data sets* can be imported at once or by appending the files incrementally. The *Alignment* option defines how data sets will be associated in the time axis. Choose *Align Left* when you have triggered data where the first sample of each data set shall have the same time. Choose *Align Absolute* in order to strictly adhere to the date as specified in the file.

The second option is typically used when combining measurement data taken from different systems simultaneously, where the time bar consists of Tria-Link timestamps. Refer to section 2.3 in the [Twincat Library: Diagnostics Application Note](#) [3].

When a companion scope configuration exists, as described in the above section, the configuration is loaded after importing the first data set. In contrast to the primary scope in the TAM System Explorer, existing plots are not replaced with those defined in the configuration. Instead, those plots matching the configuration are just reconfigured. Companion scope configurations of other data sets beyond the first imported one are ignored.

When importing more than one data set, a *template plot* is chosen from existing plots for each of the imported data columns. The template plot needs to have the same name as the imported data column. If none of the existing plots share the same name, an arbitrary existing plot is chosen instead. The new plot is then aligned to the template plot with respect to the alignment option, and assigned the same value axis as the template plot.

You can delete plots which aren't of current interest to you. However, you cannot restore plots without reloading the file.

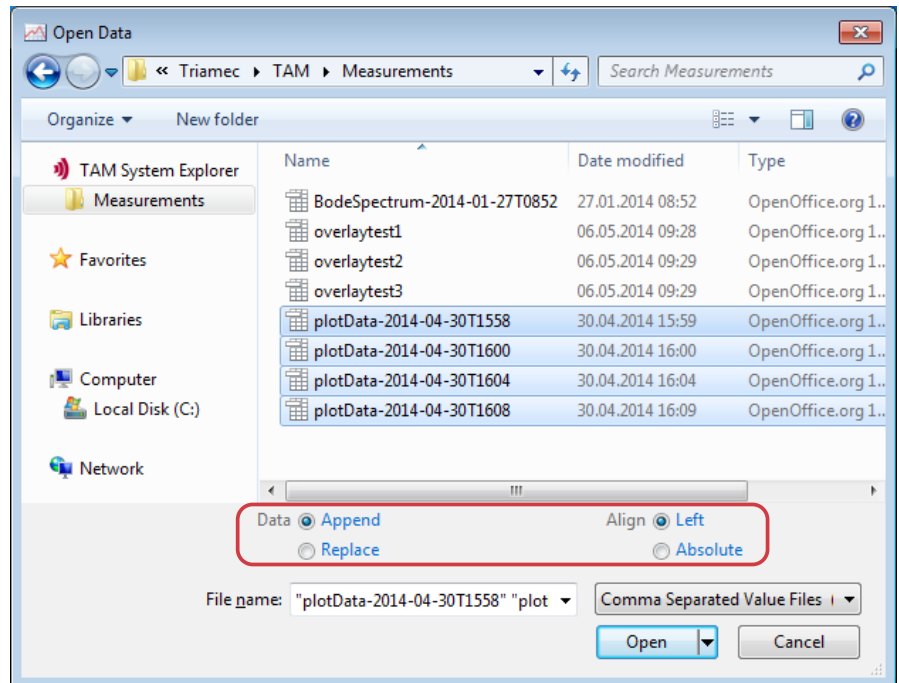


Figure 2: Open Data File Dialog: Select one or several files to import. Note the two radio button pairs adding to the standard elements.

## Loading Auto-Save Data

It can make sense to overlay data from several files produced with Auto-Save activated. This works best when the data was acquired using a trigger.

Loading continuous data is not currently supported, though, and won't look correct, even when choosing absolute alignment.

## 3 Working With Streaming Data

Streaming is the tool for saving data from a long test run for later off-line analysis. While the scope can be used to see data spanning maximally 10-20 seconds, streaming duration is only limited by disk space.

Sections 3.1 describes how to stream to disk while plotting. Section 3.2 explains how to read from the persisted stream. For the specification of the streaming format, see section 4.3.

### 3.1 Streaming to Disk

Establish streaming by going to the Scope | General tab, and there to the category Sophisticated Behavior. Expand the Streaming property as shown in figure 3. Set the Enabled property to True. A default destination will be filled in above. Alternatively, you can specify whatever destination you like.

Now, each time the scope is starting, the data stream will be written to the specified location. The stream is taken before triggering, that is, a continuous data stream is produced independently from the data actually shown in the scope. You can safely set any trigger condition without losing valuable data.

Typically, you will have to enable repeat mode to enable continuous streaming.

If the scope shows more than 1.2 seconds of data, streaming will be more efficient if you lower the Refresh frequency (visible above the Streaming properties in figure 3).

**Warning** The destination file is overwritten each time you start the scope.

**Caution** The application does not detect the case where disk goes out of space.

Similar to saving CSV files, a companion scope configuration is saved, as described in section 2.1 above.

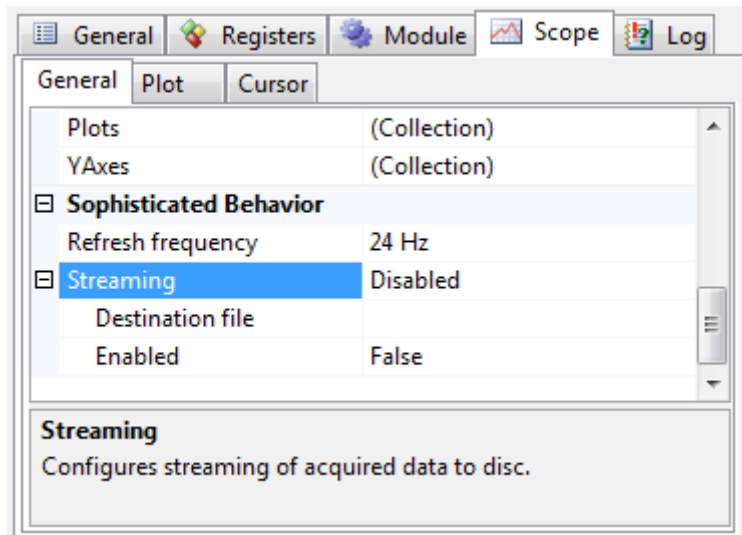


Figure 3: Configuring the scope to stream data to disk

## 3.2 Load Streaming Data

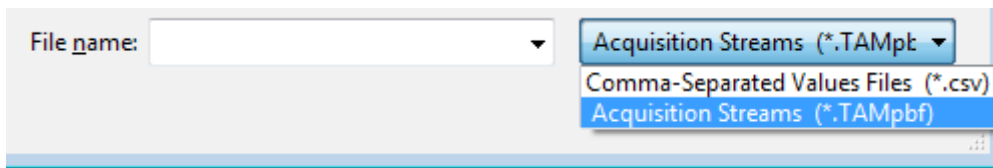


Figure 4: Opening streaming data from disk

A stream can be loaded for off-line analysis of measurement data just the same way as when opening CSV data (see section 2.2). As shown in figure 4, you need to change the filter criterion in the open file dialog box. The *Data* and *Align* settings are ignored when loading streaming data.

As opposed to loading CSV data, no data is initially plotted. Instead, you need to configure and start the scope yourself. Typically, repeat mode will be off, since the data is streamed much faster than real-time. Be aware that you cannot rewind until the end of the stream is reached or you load the same file again.

See also section 2.2 regarding the companion scope configuration and deleting plots.

The function `PlotScopeStream.m` from the Matlab developer sample demonstrates how to consume streaming data in MATLAB, using a .NET library from the TAM SDK.

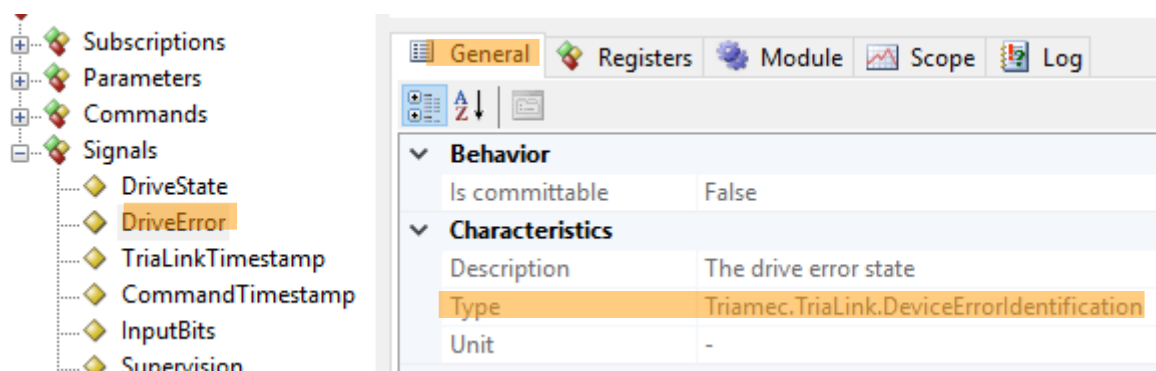
## 4 Data Formats

Section 4.1 explains how to interpret data from registers of an enumeration type. The remaining content is solely targeted to developers.

### 4.1 Enumerations

Enumeration values are saved in a numerical format. The name-value mapping can be retrieved with the following exemplary procedure:

1. In the TAM System Explorer, select the source register, and bring up the *General* tab.
2. Copy the value of the type, in this case, `Triamec.TriaLink.DeviceErrorIdentification`.



3. Via menu **Help | Documentation**, browse to the *Software* documentation, and there, open the `SWNET_TamApiReference-<version>_EP001.chm` document.
4. Bring up the *Index* tab, paste the type name there and press Enter. You can now see the docu-



mentation of the enumeration, including the values for each member.

## 4.2 CSV Data Format

The format used is comma-separated values. Every column contains the data of one signal. The first column is typically the time vector in the unit of seconds. Since the sampling time may be different from signal to signal, undefined samples are just left out.

### Informal Definition

A typical data file, when imported into a spreadsheet, will look like this:

<i>System:</i>	Log-Version	0.1	Lib-Version	4.4
<i>PC:</i>	Host-Name	W7-DESKTOP-1	Time	2014-05-06T 12:53:47.4188998Z
<i>SignalName:</i> time	ActualCurrentQ	ControlOutputVoltageQ	PositionError	
<i>Uri:</i>	tam://localhost/A/L/S/D/ Register/Axes[0]/Signals/ CurrentController/Actual- CurrentQ	tam://localhost/A/L/S/D/ Register/Axes[0]/Signals/ CurrentController/Con- trolOutputVoltageQ	tam://localhost/A/L/ S/D/Register/Axes[0]/ Signals/PositionCon- troller/PositionError	
<i>Unit:</i> s	A	V	m or rad	
<i>Sampling [s]:</i> 2E-05	2.00E-005	2.00E-005	2.00E-005	
3166.08977	-0.1171922684	-2.593126297	0	
3166.08979	-0.1197965443	-2.6025352478	-0.0032158147	
3166.08981	-0.1197965443	-2.6452968121	-0.0039303675	
3166.08983	-0.1210986823	-2.6758315563	-0.0046451855	
3166.08985	-0.1237029508	-2.6938037872	-0.0053602685	
3166.08987	-0.1289114952	-2.6660251617	0	

There is a total number of 10 header rows, followed by an arbitrary number of data rows. Each header row starts with a cell which is either empty or has a title text ending with a colon character. The title text defines the content of the cells in that header row.

The semantics of the headers is as follows:

#### **PC**

Contains the host name of the measurement system and the time related to the first data row.

#### **SignalName**

Contains the name of each signal.




In order for the first column to be recognized as the time bar, it needs to be named *time*. Otherwise, 1ms is assumed as sampling time.

### **Axis**

Contains the index or name of the axis of the signal. This string will be prepended to the signal name.

### **Uri**

Contains the source address of the signal. If the source exists, the synchronize button  above the plot legend will focus the source register.

### **Unit**

Contains the unit of the signal. A small “u” may denote “m or rad”.

### **Sampling [s]**

This row can be present in order to explicitly specify the sampling time of each signal. If not present, this information is computed from the time bar.

Note that the data is expected to be exactly equidistant. However, the time bar is allowed to specify non-equidistant durations between adjacent samples. The plots will correctly use that information in an x-y manner.

### **Factor**

Specifies a scaling divisor to apply to each sampling point in order to get the actual value as declared by the unit. The plots will show the actual values after that computation. This column helps to save performance in real-time diagnostic tools.

## **Formal Definition**

This section is to be done in general, but already contains some notes refining the informal definition given in the section above.

- The *list separator* is the comma, as defined by the invariant culture of the .NET framework.
- The title text of each header must end with the sequence of a colon and a space. The space needs to be there even if at end of line or before the list separator.
- The PC header needs to be structured exactly as shown in the above table.
- The number of header rows is not specified. However, some simple straight tools might assume a total of ten. Since the format is text, a manual modification towards the required number of rows is easily done.
- An empty header row consists either of an empty line, or an arbitrary number of list separators.

## **Compatibility**

The format doesn't adhere to RFC 4180 [4] in that it typically contains several header lines before actual data lines start.

Importing data into Microsoft Excel isn't straightforward in German speaking countries. [This](#) article [5] provides information for different versions of Microsoft Excel.



Empty values in the data translate to empty cells in spreadsheets, or NaN in MATLAB, respectively.

## 4.3 Streaming Data Format

The format is *protobuf* Error: Reference source not found compressed with *gzip* [7]. The following `.proto` file describes the message format.

```
package Triamec.Acquisitions.Serialization;
import "bcl.proto"; // schema for protobuf-net's handling of core .NET types
message Info {
  optional string Address = 1;
  optional string Name = 2;
  optional string Unit = 3;
}
message Segment {
  // The number of 100-nanosecond intervals that have elapsed since
  // 12:00:00 midnight, January 1, 0001.
  required int64 StartTime = 1 [default = 0];
  // The number of 100-nanosecond intervals that make up the sampling time
  required int64 SamplingTime = 2 [default = 0];
  repeated double Data = 3;
  optional Variable Variable = 4;
}
message Variable {
  optional Info Info = 1;
  optional bool IsRegular = 2 [default = false];
  repeated bcl.NetObjectProxy Segments = 3; // reference-tracked Segment
}
message VariableCollection {
  repeated Segment items = 1; // always Variable
}
```

The imported `bcl.proto` looks like this:

```
package bcl;
message NetObjectProxy {
  // for a tracked object, the key of the first time this object was seen
  optional int32 existingObjectKey = 1;
  // for a tracked object, a new key, the first time this object is seen
  optional int32 newObjectKey = 2;
  // for dynamic typing, the key of the first time this type was seen
  optional int32 existingTypeKey = 3;
  // for dynamic typing, a new key, the first time this type is seen
  optional int32 newTypeKey = 4;
  // for dynamic typing, the name of the type (only present along with newTypeKey)
  optional string typeName = 8;
  // the new string/value (only present along with newObjectKey)
  optional bytes payload = 10;
}
```

Multiple messages are collated with 32-bit little-endian length prefixes.

Before implementing an application using the above information, consider using the `Triamec.Acquisitions.Protobuf` class.



## Glossary

**CSV** Refers to the Comma-separated values file format.

## References

- [1] TAM System Explorer software web-page, 2019  
<https://www.triamec.com/de/tam-system-explorer.html>
- [2] "Drive Setup Guide", SW\_TSD-TSP360-TSP710-Setup-Guide\_EP001.pdf, Triamec Motion AG, 2019
- [3] "Twincat Library: Diagnostics Application Note", AN100\_TwinCAT-Diagnostics\_EP003.pdf, Triamec Motion AG, 2019
- [4] "RFC 4180", Internet Engineering Task Force, 2005  
<http://tools.ietf.org/html/rfc4180>
- [5] "Excel: CSV-Datei importieren", PCTipp, 2017  
<https://www.pctipp.ch/tipps-tricks/kummerkasten/office/artikel/excel-csv-datei-oeffnen-bzw-importieren-27911/>
- [6] protobuf – Protocol Buffers – Google's data interchange format, 2014  
<https://github.com/protocolbuffers/protobuf>
- [7] GNU Gzip, 2019, <http://www.gnu.org/software/gzip/>