Write to file

SD040 | Updated on September 16, 2026

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The “Write to file” function allows writing variables from the user code to the controller’s non-volatile memory during runtime. Recorded data can subsequently be downloaded on the computer using Cockpit. This mechanism is available in the Simulink and PLECS blocksets or in the related C/C++ routines.

Writing variables directly to the controller disk is typically useful for long-term logging, ranging from several seconds to several hours. This constitutes an attractive alternative to using Cockpit’s Rolling Plot module, notably as it operates without any dependence to the availability of the Ethernet link.

To perform the inverse operation, i.e. read pre-recorded data during execution, the “Read from file” function should be used instead. This is documented in SD039.

For long-term logging directly to the host PC’s disk rather than internal controller storage, the Python API’s Data logger feature is also available.

Principles of operation

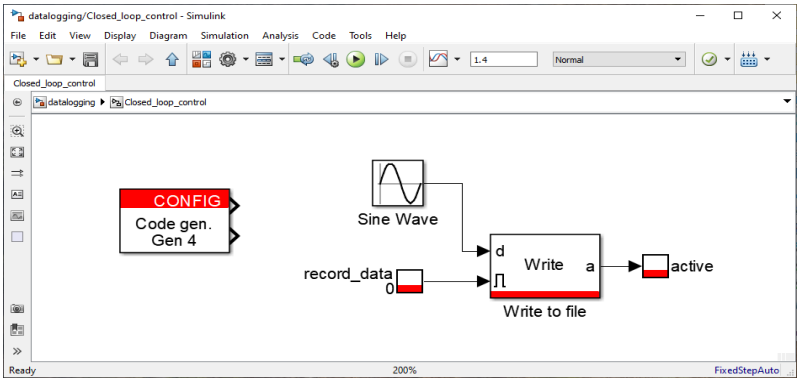
The “Write to file” function automatically writes selected data to the controller’s non-volatile memory (SSD or eMMC). When working from Simulink or PLECS, this selection is made indirectly by passing the desired data to the corresponding input **d**.

During runtime, the write process can be started by setting the **enable input** to 1. Reciprocally, it can be stopped by setting this input to 0.

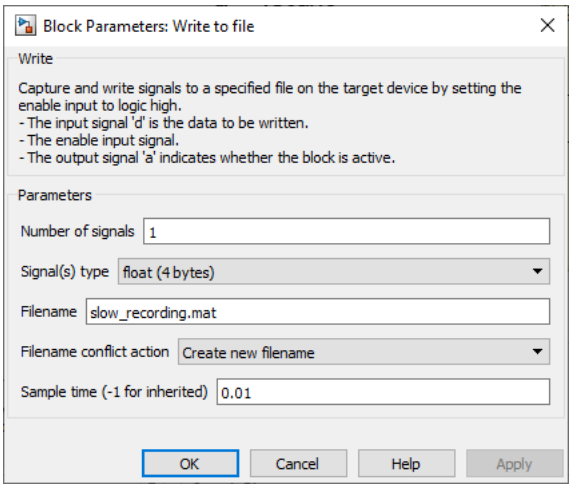
The **a** output is set to 1 when the block is active and writing data. If the enable input is set to 1, but the storage becomes full or a *bandwidth constraint* is met, the active output flag is set to 0.

Once the writing process is done, data can be retrieved from the **Target Configuration** view in Cockpit (see *File management* section).

Finally, the “Write to file” function does not write any data during offline simulation. However, the active output flag is set to 1 when the block is enabled, as if the controller was writing to its internal storage.



Sample time



The write action takes place at a configurable rate, namely:

- Data is written to disk **at the control rate**: Sample time is configured as inherited (-1).
- Data is written **at a different rate**: A specific sample time is configured.

For more details on multirate configurations, see PN145 for Simulink or PN155 for PLECS.

Hardware resources and constraints

Once enabled, the operation of the “Write to file” is continuous and unlimited in time, unless one of the following constraints is reached:

- The required data throughput exceeds the maximum achievable write bandwidth.
- The available space is exceeded.

Storage constraint

The available storage space can be seen from the **Target Configuration** view in Cockpit (see *File management* section).

For example, processing 24 signals using a `float` data type (4 bytes) at 10kHz represents a continuous write bandwidth of 960kB/s. At this rate, the storage capacity of a Gen. 3 device will be reached in roughly 2 hours. On the other hand, the same 24 signals logged at 1kHz would take roughly 20 hours to fill the entire memory.

Bandwidth constraint

The total required bandwidth is a function of the number of instances, the signal count, the data type size, and the execution frequency. This must be lower than the controller’s maximum achievable bandwidth. As the bandwidth is shared among other system resources (e.g., CAN, UDP), using them simultaneously may limit the achievable throughput.

$$\text{Bandwidth} = \text{Signals} \times \text{Size of Data Type (Bytes)} \times \text{Sample Rate (Hz)}$$

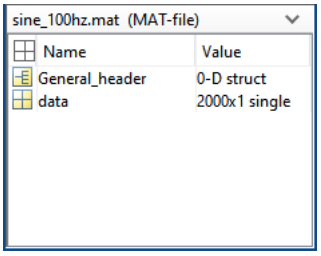
Consider, for example, two concurrent “Write to file” instances, each configured with 3 signals, a `float` data type (4 bytes), and a sample rate of 100 kHz. If both instances write data at the exact same time, each requires 1.2MB/s, resulting in a combined demand of **2.4 MB/s**. This cumulative demand exceeds the maximum allowable bandwidth for Gen. 3 devices, resulting in an immediate halt of the write procedure.

The table below summarizes the storage resources available on each imperix controller:

Param.	B-Box 4	B-Box 3	B-Box micro	B-Board 3
Memory type	SSD	eMMC	eMMC	eMMC
Capacity[1]	500 GB	8 GB	8 GB	8 GB
Max. achievable bandwidth	20 MB/s	1 MB/s	1 MB/s	1 MB/s

File format

The “Write to file” block generates a column-oriented MAT-file in which each signal is assigned its own dedicated column. The **Number of signals** specifies the number of columns, and the **Signal(s) type** defines the data type in which the logged signals are saved.



As shown in the figure above, the generated MAT-file includes a header (called General_header) containing key metadata:

- Date (UTC)
- Time resolution (sampling period)
- Firmware version

For example, the logged data can be plotted using the following MATLAB script:

Code snippet — Plotting the written MAT-file

```
% Set the filename
fileName = 'sine_100hz.mat';

% Load data
sine_100hz = load(fileName);

% Compute the time resolutions (delta t)
delta_t = sine_100hz.General_header.Time_resolution;

% Set the number of samples
nb_samples = length(sine_100hz.data);

% Create a time vector using its time steps
t = (0 : nb_samples - 1) * delta_t;

% Plot data
figure;
stairs(t, sine_100hz.data);

% Labels and styling
xlabel('Time [s]');
ylabel('Raw data value');
grid on;Code language: Matlab (matlab)
```

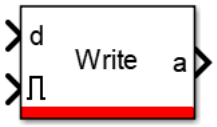
Parameters

- **Number of signals**: sets the total number of signals to be recorded in the MAT-file.
- **Signal(s) type**: selects the data type of the signals to be recorded in the MAT-file (*float/single*, *int32*, *uint32* and *double*).
- **Filename**: sets the desired MAT-file filename.
- **Filename conflict action**: specifies how to resolve filename conflicts.
  - **Create new filename**: produces an incrementally numbered file (e.g., my_file_1.mat, my_file_2.mat).
  - **Overwrite existing file**: overwrites the previous data (**only on Gen. 4 devices**).
- **Sample time**: sets the execution sample time of the block, which can be configured to establish a specific decimation rate for the block’s execution.

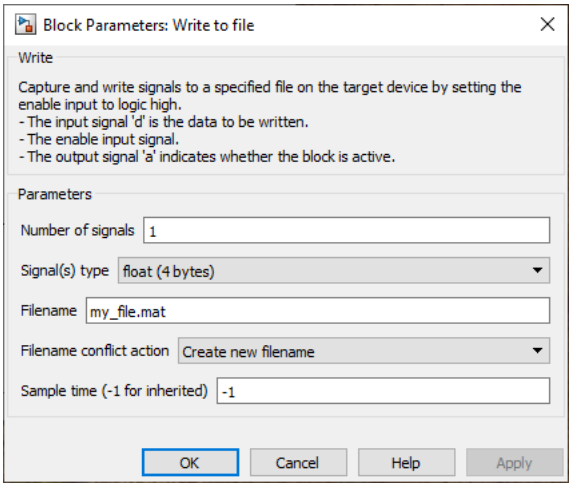
Simulink block

Signal specification

- The data input signal d receives a vector containing the data to be written into MAT-file. The expected vector length can be configured with the **Number of signals** parameter, and its data type using the **Signal type** parameter.
- The enable input signal initiates the MAT-file writing procedure. Setting this input to **0** resets the block to its initial conditions.
- The activate output flag a is set to **1** when writing to a file. If the output is **0** while the block is enabled, either the storage is full or a bandwidth constraint was met.



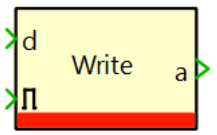
Mask



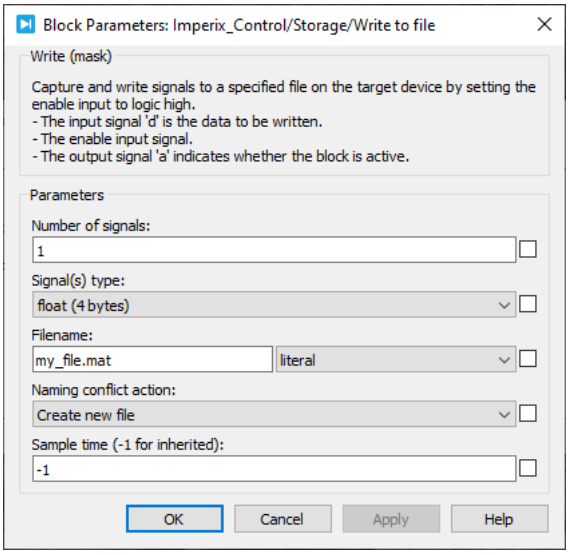
PLECS block

Signal specification

- The data input signal d receives a vector containing the data to be written into MAT-file. The expected vector length can be configured with the **Number of signals** parameter, and its data type using the **Signal type** parameter.
- The enable input signal initiates the MAT-file writing procedure. Setting this input to **0** resets the block to its initial conditions.
- The activate output flag a is set to **1** when writing to a file. If the output is **0** while the block is enabled, either the storage is full or a bandwidth constraint was met.



Mask



C++ functions

`Wr_Configure` — Configure the Write to file instance

```
void Wr_Configure(unsigned int id, const char *filename, unsigned int number_of_sig, unsigned int data_type, void
```

Configures the “Write to file” instance.

Can only be called in `UserInit()`.

Parameters

- `id`: the unique identifier of the “Write to file” instance. The valid range is **0 to 7** (inclusive)
- `filename`: the desired filename (must have the .mat extension)
- `number_of_sig`: the number of signals to be written into the MAT-file
- `data_type`: the data type of the data to be written in to the MAT-file
- `data`: a pointer to the memory location where the data to be written into the MAT-file is stored. The source buffer must be pre-allocated, and its size must be exactly equal to `number_of_sig * sizeof(dataType)` (e.g., 3 * sizeof(double))
- `overwrite`: flag indicating whether the MAT-file should be overwritten in case of a filename conflict

`Wr_Configure` — Configure the Write to file instance

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void Wr_Configure(unsigned int id, const char *filename, unsigned int number_of_sig, unsigned int data_type, void
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- `filename`: the desired filename (must have the .mat extension)
- `number_of_sig`: the number of signals to be written into the MAT-file
- `data_type`: the data type of the data to be written in to the MAT-file
- `data`: a pointer to the memory location where the data to be written into the MAT-file is stored. The source buffer must be pre-allocated, and its size must be exactly equal to `number_of_sig * sizeof(dataType)` (e.g., 3 * sizeof(double))
- `overwrite`: flag indicating whether the MAT-file should be overwritten in case of a filename conflict

`Wr_ConfigureMetadata` — Configure the Write to file metadata

```
struct {
    float sample_time;
} tWrMetadata;

void Wr_ConfigureMetadata(unsigned int id, tWrMetadata metadata);Code language: C++ (cpp)
```

Configures the metadata structure written in the MAT-file. This structure can be used to save the time resolution (decimation rate) of the recorded signals.

Can only be called in `UserInit()`.

Parameters

- `id`: the unique identifier of the “Write to file” instance. The valid range is **0 to 7** (inclusive)
- `metadata`: the metadata structure containing the sample time

`Wr_Write` — Write to file

```
int Wr_Write(unsigned int id, int enable);Code language: C++ (cpp)
```

Writes the data stored into the data pointer configured in `Wr_Configure()` into the MAT-file.

Can only be called in the interrupt routine.

Parameters

- `id`: the unique identifier of the “Write to file” instance. The valid range is **0 to 7** (inclusive)
- `enable`: control flag where **1** (logic high) starts execution and **0** (logic low) resets the instance to its initial conditions

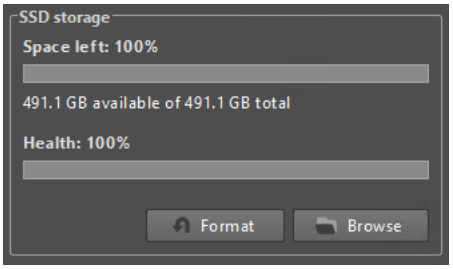
Return value

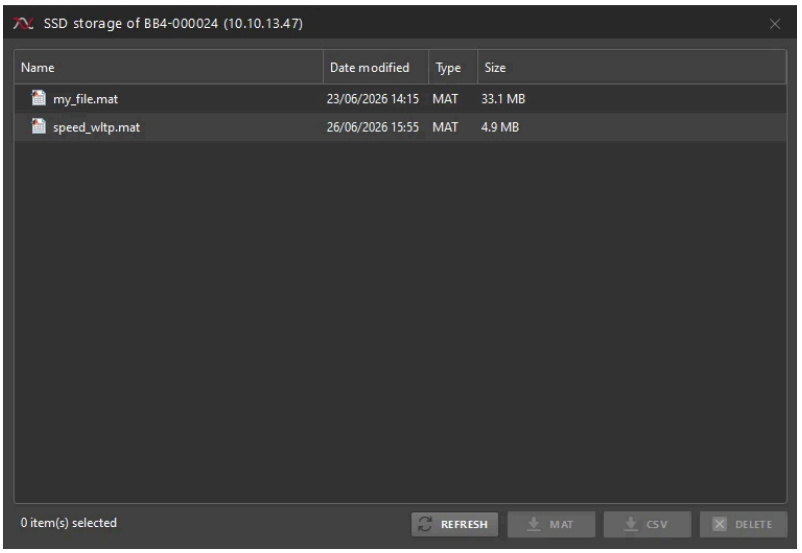
- Returns **1** once the non-volatile memory is full, **0** otherwise.

File management

The target’s internal storage unit is accessible via the **Target Configuration** view in Cockpit, providing the following file management capabilities:

- **File Listing:** View all files currently stored on the target.
- **Exporting:** Download and convert target files into CSV or MAT-file formats.
- **Deletion:** Permanently remove files from the target’s storage.





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1. Gen. 4 reserves 10 GB and Gen. 3 reserves 0.8 GB for internal system use (e.g., filesystem). ↩